AAOS

Eleventh Edition

Emergency

Care and Transportation of the Sick and Injured

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Emergency

Care and Transportation of the Sick and Injured

AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

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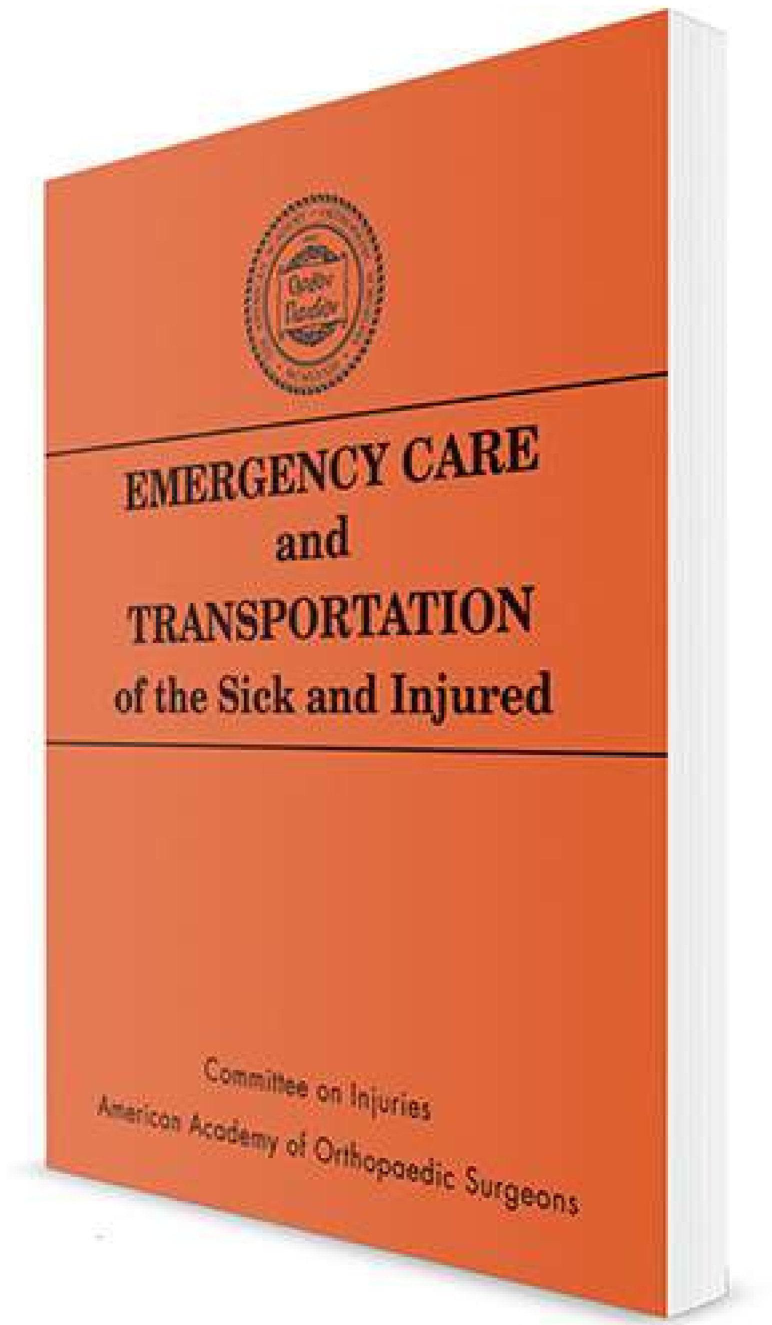

In 1971, the American Academy of Orthopaedic Surgeons (AAOS) published the first edition of ***Emergency Care and Transportation of the Sick and Injured*** with its now-familiar orange cover and laid the foundation of EMS training. Today, the AAOS's commitment and dedication to excellence has transformed how EMS education is delivered throughout the world and helped develop and train countless world-class EMS providers.

In 1997, the AAOS partnered with Jones & Bartlett Publishers (JB Learning) to release ***Emergency Care and Transportation of the Sick and Injured, Revised Sixth Edition***. Since the publication of that edition, the AAOS and JB Learning have worked together to transform all levels of EMS training, from emergency medical responder to paramedic. Our partnership has resulted in market-leading resources that go beyond initial training into assessment, continuing education, and professional resources to support EMS providers through every step of their education and career.

Today, the AAOS suite of EMS educational resources, from first aid and CPR to critical care transport, are the gold standard in training programs with exceptional content and instructional resources that meet the diverse needs of today's educators and students.

JB Learning is proud and honored to congratulate our esteemed partner, the American Academy of Orthopaedic Surgeons, on the 45th anniversary of their first publication of the Orange Book.

To explore other AAOS publications, programs, and products on orthopaedic trauma and other practice areas, please visit

www.aaos.org/Education.

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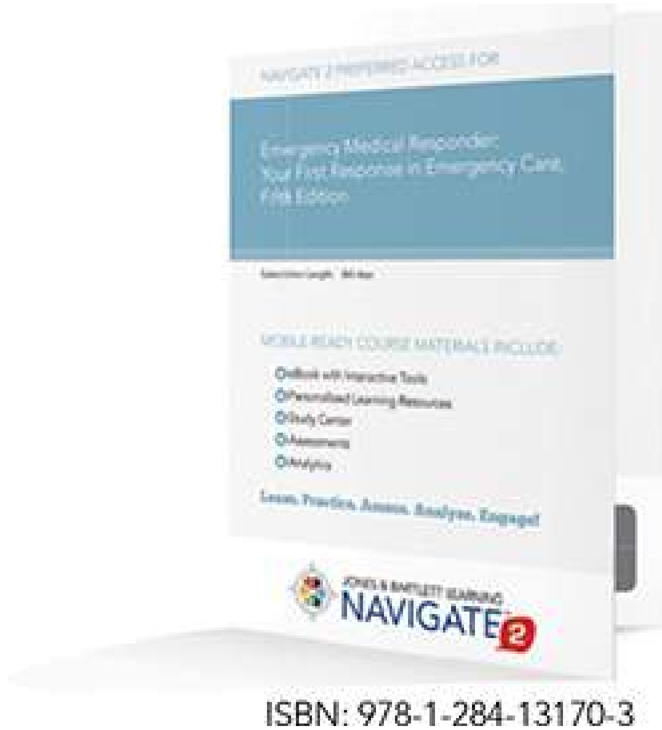

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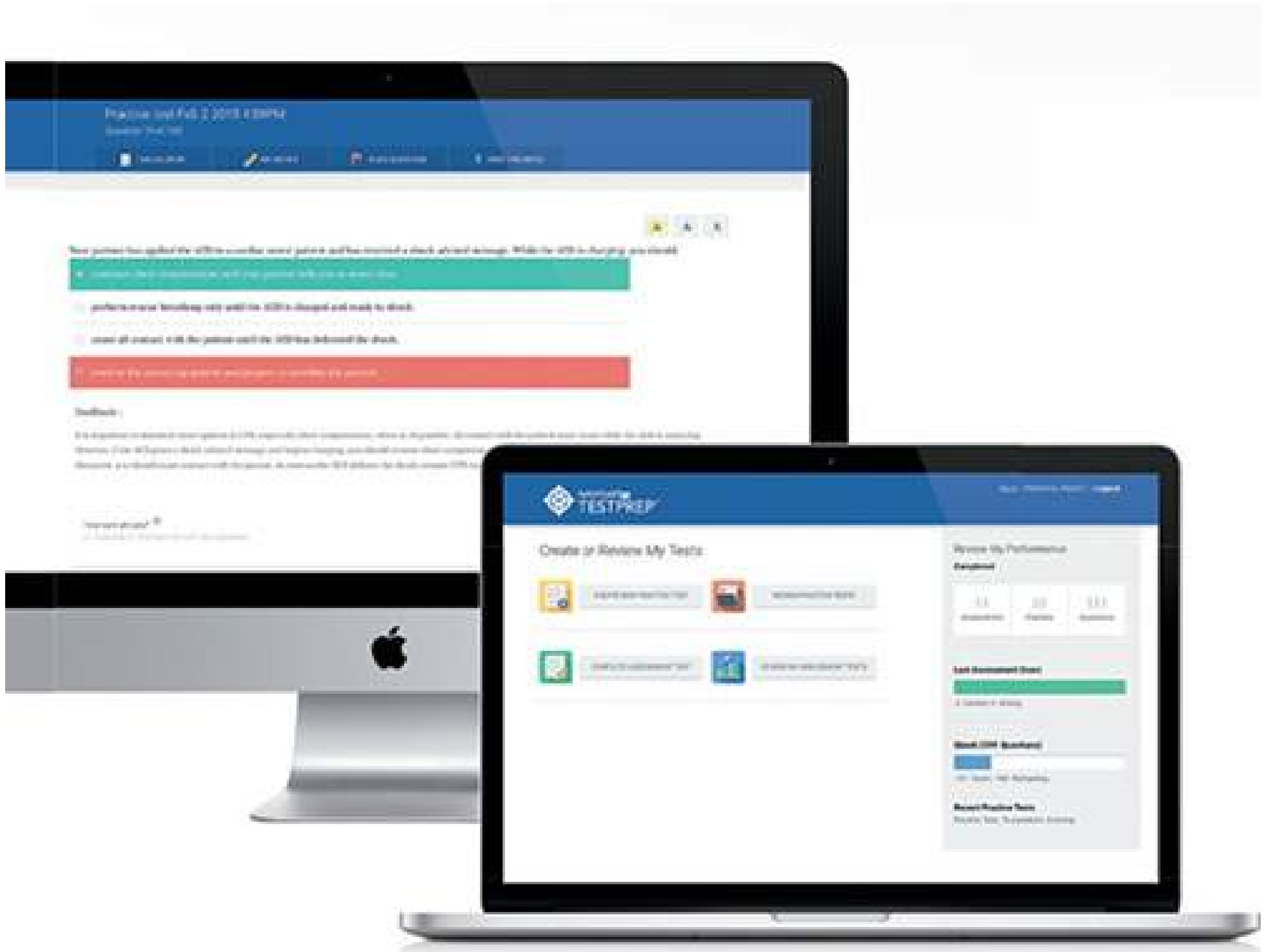
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EMS

SECTION

1

Preparatory

CHAPTER 1

EMS Systems

National EMS Education Standard Competencies

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal, and ethical issues to the provision of emergency care.

Emergency Medical Services (EMS) Systems

› EMS systems (pp 15–26)
› History of EMS (pp 9–10)
› Roles/responsibilities/professionalism of EMS personnel (pp 26–27)
› Quality improvement (pp 20–21)
› Patient safety (pp 7, 26)

Research

› Impact of research on emergency medical responder (EMR) care (pp 24–26)
› Data collection (p 25)
› Evidence-based decision making (pp 25–26)

Public Health

Uses simple knowledge of the principles of illness and injury prevention in emergency care.

Knowledge Objectives

1. Define emergency medical services (EMS) systems. (p 5)
2. Name the four levels of EMT training and licensure. (pp 6–8)
3. Describe EMT licensure criteria; include how the Americans with Disabilities Act (ADA) applies to employment as an EMT. (p 8)
4. Discuss the historical background of the development of the EMS system. (pp 9–10)
5. Describe the levels of EMT training in terms of skill sets needed for each of the following: EMR, EMT, AEMT, and paramedic. (pp 10–14)

6. Recognize the possible presence of other first responders at a scene with EMR training, some knowledge of first aid, or merely good intentions, and their need for direction. (pp 13–14)
7. Name the 14 components of the EMS system. (pp 15–26)
8. Describe how medical direction in an EMS system works, and the EMT's role in the process. (p 18)
9. Define mobile integrated healthcare and community paramedicine. (p 19)
10. Discuss the purpose of the EMS continuous quality improvement (CQI) process. (pp 20–21)
11. Characterize the EMS system's role in disease and injury prevention and public education in the community. (pp 23–24)
12. Describe the roles and responsibilities of the EMT. (p 26)
13. Describe the attributes an EMT is expected to possess. (p 27)
14. Explain the impact of the Health Insurance Portability and Accountability Act (HIPAA) on patient privacy. (p 27)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

This textbook serves as the primary resource for the emergency medical technician (EMT) course. It discusses what will be expected of you during the course and what requirements you must meet to be licensed or certified as an EMT in most states. You will learn about the differences between first aid training, a Department of Transportation (DOT) emergency medical responder (EMR) training course, and the training courses for an EMT, advanced emergency medical technician (AEMT), and paramedic.

Emergency medical services (EMS) is a *system*. This system's key components and how they influence and affect the EMT and his or her delivery of emergency care are carefully discussed in this chapter. The administration, medical direction, quality control, and regulation of EMS are also presented. The chapter concludes with a detailed discussion of the roles and responsibilities of the EMT as a health care professional.

Course Description

You are about to enter an exciting field. The **emergency medical services (EMS)** system consists of a team of health care professionals who, in each area or jurisdiction, are responsible for and provide emergency care and transportation to the sick and injured **Figure 1-1**. Each emergency medical service is part of a local or regional EMS system that provides the many prehospital and hospital components required for the delivery of proper emergency medical care. The standards for prehospital emergency care and the people who provide it are governed by the laws of each state they serve and are typically regulated by a state office of EMS.

Figure 1-1 As an EMT, you are part of a larger team that responds to a variety of calls and provides a wide range of prehospital emergency care.

After you successfully complete this course, you should be eligible to take either the National Registry of EMTs exam or your state's certification exam. A **certification** exam is used to ensure all health care providers have at least the same basic level of knowledge and skill. After you pass this exam, you will be eligible to apply for state licensure. **Licensure** is the process by which states ensure applicant competency in an examination setting. This allows states to manage who can function as a health care provider. It is the same principle as taking a driving test to obtain a driver's license to certify you know how to operate a motor vehicle. Different states will refer to the authority granted to you to function as an EMT as licensure, certification, or credentialing. For the purposes of this textbook, the term *licensure* will be used.

YOU are the Provider — PART 1

You are working your first shift as an EMT. You are on duty with an experienced EMT and her paramedic partner. The crew is familiarizing you with the ambulance when the tone alert sounds, "EMS 4, respond to 325 Blossom Avenue for a woman with back pain." You and your crew proceed to the scene, which is located 4 miles from your station.

1. Do your roles and responsibilities as an EMT differ from those of a paramedic? If so, how?
2. What is the difference between what you learned in your EMT class and the care you provide in the field?

In most states, people who work on an ambulance are categorized into four training and licensure levels: **emergency medical responder (EMR)**, **emergency medical technician (EMT)**, **advanced EMT (AEMT)**, and **paramedic**. An EMR has very basic training and provides care before the ambulance arrives. EMRs may also perform in an assistant role within the ambulance. An EMT has training in basic life support (BLS), including automated external defibrillation, use of airway adjuncts, and assisting patients with certain medications. An AEMT has training in specific aspects of **advanced life support (ALS)**, such as **intravenous (IV) therapy** and the administration of certain emergency medications. A paramedic has extensive training in ALS, including endotracheal intubation, emergency pharmacology, cardiac monitoring, and other advanced assessment and treatment skills.

Although the specific training and licensure requirements vary from state to state, almost every state's requirements follow or exceed the guidelines recommended in the current National Highway Traffic Safety Administration (NHTSA) EMS Education Standards.

This textbook covers the practice and skills identified in the 2009 *National EMS Education Standards*. It also covers the information needed for EMTs to perform the skills outlined in the 2005 National EMS Scope of Practice Model. In the United States, NHTSA is the federal administrative source for education standards and related documents.

Like any introductory course, the EMT course covers a great deal of information and introduces many skills **Figure 1-2**. EMT courses include didactic instruction (knowledge), psychomotor instruction (skills laboratories), and clinical behavior/judgment (professionalism). Everything you learn in the course will be important to your ability to provide high-quality emergency care once you are licensed and ready to practice. In addition, the knowledge, understanding, and skills that you acquire in the EMT course will serve as a foundation for the additional knowledge and training you will receive in future years.

In addition to the required core content, this text includes additional information to help you understand and apply the knowledge and skills included in the EMT course. Your instructor will furnish you with reading assignments. It is essential that you complete the assigned reading before each class. Each class builds upon the previous; ensuring you complete the readings and assignments will help you understand subsequent lessons. This approach is pivotal to your success in this course.

Figure 1-2 In the classroom, you will learn both didactic and practical skills to prepare you for various types of calls.

In class, your instructor will review the key parts of the reading assignment and clarify and expand on them. He or she will answer any questions you have and clarify any points you or others find confusing. Unless you carefully read the assignment and made notes before coming to class, you will not fully understand or benefit from the classroom presentations and discussions. Creating your own tools such as flashcards, study questions, and outlines will help you retain important information. It will also help you take better notes during class **Table 1-1**.

The EMT course includes four types of learning activities:

1. Reading assignments from the textbook, lecture presentations, and classroom discussions provide you with the necessary knowledge base.
2. Step-by-step demonstrations teach you the hands-on skills you then need to practice repeatedly in supervised small group workshops.
3. Summary skills sheets help you memorize the sequence of steps in complex skills that contain a large number of steps or variations so you can perform the skill with no errors or omissions.
4. Case presentations and scenarios used in class help you learn how to apply the knowledge and skills acquired to situations you will find in the field.

Table 1-1 Study Tips for Using This Textbook

- Complete each assignment diligently and carefully.
- Reading a textbook is different from reading a newspaper, website, blog, or novel. Make sure you understand what you have read, and study difficult concepts.
- Read each chapter several times and underline key points. Take notes!
- Note the chapter's objectives so you can measure your knowledge effectively.
- Ask your instructor to clarify any questions you note in your reading or in class.
- Take additional notes when the assigned material is expanded upon in class.

Use supporting materials suggested by your instructor, such as digital assessments, animations, videos, and student workbooks.

- Remember: The only absurd question is the one that you fail to ask.

EMT Training: Focus and Requirements

What is an EMT? EMTs are the backbone of the EMS system in the United States. You provide emergency care to the sick and injured. Some of the patients you will treat are in life-threatening situations, whereas others require only supportive care.

The skills you need to safely deliver this care are found within this textbook. Some of the subjects discussed include:

- **Scene size-up:** Scene size-up involves both awareness of scene safety *and* a big-picture awareness of the overall situation at hand. EMS operates in a wide variety of environments that can create situations where EMS personnel can be injured—outside on a highway, inside a cluttered house, or anywhere in between. Your primary job is to ensure it is as safe as possible. During scene size-up you must gain a big-picture perspective of the call, determine whether it is safe to proceed, determine whether additional resources are needed, and identify the initial approach to mitigate the emergency.
- **Patient assessment:** Patient assessment is the foundation of any EMS call. You must determine what is wrong with the patient. Patients can have many complaints and you will learn to determine which complaints are life threatening.

Words of Wisdom

The Star of Life

The National Highway Transportation Safety Administration (NHTSA) recognized the need for a symbol that would represent EMS as a critical public service and created the *Star of Life*. NHTSA holds priority rights to the use of this registered certification mark.

Adapted from the personal Medical Identification Symbol of the American Medical Association, each bar on the Star of Life represents an EMS function. The functions include:

1. Detection
2. Reporting
3. Response
4. On-scene care
5. Care in transit
6. Transfer to definitive care

The serpent and staff in the symbol portray the staff of Asclepius, an ancient Greek physician deified as the god of medicine. Overall, the staff represents medicine and healing, with the skin-shedding serpent being indicative of renewal.

The Star of Life has become synonymous with emergency medical care around the globe. This symbol can be seen as a means of identification on ambulances, emergency medical equipment, patches or apparel worn by EMS providers, and materials such as books, pamphlets, manuals, reports, and publications that either have a direct application to EMS or were generated by an EMS organization. It also appears on road maps and highway signs indicating the location of or access to qualified emergency medical care.

Source: Adapted from US National Highway Traffic Safety Administration. www.ems.gov.

- **Treatment:** As an EMT, you will provide oxygenation and medication therapies. You will control bleeding and assist patients during childbirth. In addition to hands-on skills, you will learn how to manage patients who are in emotional crisis, and to calm patients and to relieve some of their anxiety.
- **Packaging:** Most patients need to be transported to a facility. This could mean a hospital, clinic, or other medical care facility. You will learn how to transport patients with a wide variety of illnesses and injuries.
- **EMS as a career:** Many of you are taking this course because you want to help people. To ensure all EMS providers have a long, healthy career, it is important for you to learn how to take care of yourself. We will discuss job stressors and successful ways to cope with them.

Licensure Requirements

To be recognized and function as an EMT, you must meet certain requirements. The specific requirements differ from state to state. Ask your instructor, learning institute, or your state EMS official about the requirements in your state. Generally, the criteria to be licensed and employed as an EMT will include the following:

- High school diploma or equivalent
- Proof of immunization against certain communicable diseases
- Successful completion of a background check and drug screening
- Valid driver's license
- Successful completion of a recognized health care provider basic life support (BLS)/ cardiopulmonary resuscitation (CPR) course
- Successful completion of a state-approved EMT course
- Successful completion of a state-recognized written certification examination
- Successful completion of a state-recognized practical certification examination
- Demonstrate the mental and physical ability necessary to safely and properly perform all the tasks and functions described in the defined role of an EMT
- Compliance with other state, local, and employer provisions

The **Americans With Disabilities Act (ADA)** of 1990 protects people who have a disability from being denied access to programs and services that are provided by state or local governments and prohibits employers from failing to provide full and equal employment to the disabled. In addition, Title I of the ADA protects EMTs with disabilities seeking gainful employment under many circumstances. Employers with a certain number of employees are required to adjust processes so that a candidate with a disability can be considered for the position, and when possible, modify the work environment or how the job is normally performed. This allows EMTs who can perform the functional job skills the opportunity to pursue a career in EMS.

YOU are the Provider — PART 2

You arrive at the scene, ensure it is safe to enter, and make contact with the patient, a 59-year-old woman. She is sitting on her couch, is in obvious pain, and states it has been ongoing for the past month. You assess the patient as your partner prepares to take her vital signs.

Recording Time: 0 Minutes	
Appearance	Grimacing; obvious pain
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions or foreign bodies
Breathing	Adequate rate and depth
Circulation	Radial pulse, normal rate and rhythm; skin is pink, warm, and dry

3. How do you know if this patient is experiencing a "true emergency?"

One of the primary responsibilities of each state is to ensure the safety of its residents. As such, states have requirements prohibiting people with certain legal infractions from becoming EMS providers. The specific legal exclusions, either misdemeanors and/or felonies, are created on a state-by-state basis. Contact your state EMS office for more information.

Special Populations

EMS systems must be capable of handling many different situations, including obstetric, pediatric, and geriatric emergencies. Proper procedures, drug dosages, and even assessment techniques are often different in children, adults, and older people.

Overview of the EMS System

History of EMS

As an EMT, you will join a long tradition of people who provide emergency medical care to their fellow human beings. With the early use of motor vehicles in warfare, volunteer ambulances were organized and personnel went overseas to provide care for the wounded in World War I. During World War II, the military trained special corpsmen to provide care in the field and bring the casualties to aid stations staffed by nurses and physicians. In the Korean conflict, this evolved into the field medic and rapid helicopter evacuation to nearby Mobile Army Surgical Hospital units, where immediate surgical interventions could be performed. Many advances in the immediate care of trauma patients resulted from the casualty experiences in the Korean and Vietnam conflicts.

Unfortunately, emergency care of the injured and ill at home had not progressed to a similar level. As recently as the 1960s and early 1970s, emergency ambulance service and care varied widely across the United States. In some places, it was provided by well-trained advanced first aid personnel who had well-equipped, modern ambulances. In a few urban areas, it was provided by hospital-based ambulance services that were staffed with interns and early forms of prehospital care providers. In many areas, the only emergency care and ambulance service was provided by the local funeral home using a hearse that could be converted to carry a cot and serve as an ambulance. In other places, the police or fire department used a station wagon that carried a cot and a first aid kit. In most cases, these vehicles were staffed with a driver and an attendant who had some basic first aid training. In the few areas where a commercial ambulance was available to transport the ill, it was usually similarly staffed and served primarily as a means to transport the patient to the hospital.

Many communities did not have formal provisions for prehospital emergency care or transportation. Injured people were given basic first aid by police or fire personnel at the scene and were transported to the hospital in a police or fire officer's car. Customarily, patients with an acute illness were transported to the hospital by a relative or neighbor and were met by their family physician or an on-call hospital physician, who assessed them and then summoned any specialists and operating room staff that were needed. Except in large urban centers, most hospitals did not have the emergency department (ED) staff available today.

EMS as we know it today had its origins in 1966 with the publication of *Accidental Death and Disability: The Neglected Disease of Modern Society*, known more commonly as The White Paper. This report, prepared jointly by the Committees on Trauma and Shock of the National Academy of Sciences/National Research Council, revealed to the public and Congress the serious inadequacy of prehospital emergency care and transportation in many areas. As a result, Congress mandated that two federal agencies address these issues. The NHTSA of the DOT, through the Highway Safety Act of 1966, and the Department of Health, Education, and Welfare (now known as the Department of Health and Human Services), through the Emergency Medical Services Development Act of 1973, created funding sources and programs to develop improved systems of prehospital emergency care. This explains why EMS is administrated at the federal level through the DOT and not the Department of Health.

In the early 1970s, the DOT developed and published the first curriculum to serve as the guideline for EMT training. To support the EMT course, the American Academy of Orthopaedic Surgeons prepared and published the first EMT textbook—*Emergency Care and Transportation of the Sick and Injured*—in 1971, often called the Orange Book for its original trademark orange cover. Through the 1970s, following the recommended guidelines, each state developed the necessary legislation, and the EMS system expanded throughout the United States. During the same period, emergency medicine became a recognized medical specialty, and the fully staffed EDs that we know today became the accepted standard of care.

In the late 1970s, the DOT developed a recommended National Standard Curriculum for the training of paramedics and identified a part of the course to serve as training for EMTs.

During the 1980s, many areas enhanced the EMT National Standard Curriculum by adding EMTs with advanced levels of training who could provide key components of ALS care and advanced lifesaving procedures. The availability of paramedics and ALS-level care on calls that require or benefit from advanced care has grown steadily in recent years. In addition, with the evolution in training and technology, the EMT and AEMT can now perform a number of important advanced skills in the field that were formerly reserved for only the paramedic.

This growth and sophistication of the EMS system did not come without its drawbacks. As each state sought to create a system that would meet the needs of its citizens, the definitions of EMS providers began to vary from state to state. For example, in some states EMTs were allowed to administer medications, while in other states they were not.

In the 1990s NHTSA began an examination of EMS from a national perspective. With the counsel of EMS providers, physicians, fire chiefs, nurses, state administrators, educators, and other interested professionals, NHTSA created the *EMS Agenda for the Future*. This important document created a plan to standardize the levels of EMS education and EMS providers in an effort to ensure a more seamless delivery of EMS care across the country.

The skills you learn and the scope of practice EMTs now enjoy are part of this national movement toward an EMS system that meets the needs of an ever-changing health care industry and meets those needs through a safe and efficient method.

Levels of Training

As discussed earlier, licensure of EMTs is a state function subject to the laws and regulations of the state in which the EMT practices. Each state is granted the ability to control the functions of its licensed providers. For this reason there remains some variation from state to state on the scope of EMT practice, as well as training and recertification requirements. Here is how the system is supposed to work from the federal level down to the local level.

At the federal level, NHTSA brings in experts from around the country to create the **National EMS Scope of Practice Model**. This document provides overarching guidelines for the minimum skills each level of EMS provider should be able to accomplish. **Table 1-2** shows the guidelines from that model. Some items in the table are flagged and corresponding notes are provided to show areas where current practice has evolved. For example, certain skills listed in the table are no longer practiced or have been aligned with a different skill level. Because licensure is a state function, at the state level laws are enacted to regulate how EMS providers will operate and are then executed by the state level EMS administrative offices that control licensure. Finally, the local medical director provides daily oversight and support to EMS personnel **Figure 1-3**. For example, the medications that will be carried on an ambulance or where patients are transported are the day-to-day operational concerns on which the medical director will have direct input.

The national guidelines are intended to ensure consistent delivery of EMS across the country. The only way a medical director can allow an EMT to perform a skill is if the state has already approved that skill. The medical director can limit scope of practice but cannot expand it beyond state law. Expanding the scope of practice requires state approval.

You can download the EMR, EMT, AEMT, and paramedic education standards and instructional guidelines at www.ems.gov. In addition, the National Registry of Emergency Medical Technicians (NREMT) is a nongovernmental agency that provides national standardized EMS testing and certification in much of the United States. Many states use the National Registry standards to certify their EMTs and grant licensing reciprocity to NREMT-certified EMTs. It is important to remember EMS is regulated entirely by the state in which you are licensed.

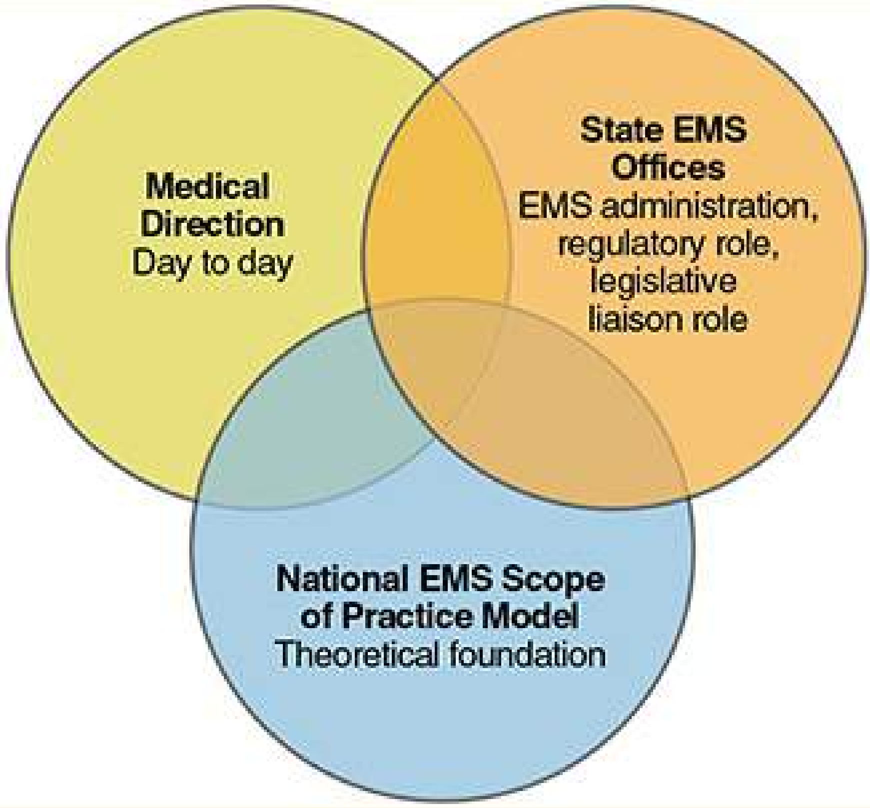

Figure 1-3 Hierarchies of the National EMS Scope of Practice Model.

Table 1-2 The Interpretive Guidelines: National EMS Scope of Practice Model

Note:
An EMT also provides the skills listed in the EMR level.
An AEMT also provides the skills listed in the EMR and EMT levels.
A paramedic also provides the skills listed in the EMR, EMT, and AEMT levels.

Airway and Breathing Minimum Psychomotor Skill Set			
EMR	**EMT**	**AEMT**	**Paramedic**
Oral airway	Humidifiers	Supraglottic airway	BiPAP/CPAP
Bag mask device	Partial rebreathing mask		Needle chest decompression
Sellick maneuver[a]	Venturi mask		Chest tube monitoring
Head tilt–chin lift	Manually triggered ventilators		Percutaneous cricothyrotomy
Jaw-thrust	Automatic transport ventilators		$ETCO_2$/capnography
Modified chin lift	Oral and nasal airways		NG/OG tube
Obstruction, manual			Nasal and oral endotracheal intubation
Oxygen therapy			Airway obstruction removal by direct laryngoscopy
Nasal cannula			Positive end-expiratory pressure
Nonrebreathing mask			
Upper airway suctioning			
Assessment Minimum Psychomotor Skill Set			
Manual BP	Pulse oximetry	Blood glucose monitoring[b]	ECG interpretation
	Manual and auto BP		Interpretive 12-lead
			Blood chemistry analysis
Pharmacologic Intervention Minimum Psychomotor Skill Set			
Medication Administration Routes ▪ Unit dose auto-injector for self or peer care (MARK 1)[c]	*Assisted Medications* ▪ Assisting a patient in administering his/her own prescribed medications, including auto-injector	▪ Peripheral IV insertion ▪ IV fluid infusion ▪ Pediatric IO insertion	▪ Central line monitoring ▪ IO insertion ▪ Venous blood sampling

Pharmacologic Intervention Minimum Psychomotor Skill Set

	Medication Administration Routes ▪ Buccal ▪ Oral	*Medication Administration Routes* ▪ Aerosolized ▪ SC ▪ IM ▪ Nebulized ▪ SL ▪ Intranasal (IN) ▪ IV push for D_{50} and narcotic antagonist only	*Medication Administration Routes* ▪ Endotracheal ▪ IV (push and infusion) ▪ Nasogastric (NG) ▪ Rectal ▪ IO ▪ Topical ▪ Accessing implanted central IV port
	Medications To Be Administered ▪ Physician-approved over-the-counter medications (oral glucose, aspirin for chest pain or suspected ischemic origin)	*Medications To Be Administered* ▪ SL nitroglycerin for chest pain of suspected ischemic origin ▪ SC[d] and IM epinephrine for anaphylaxis	*Medications To Be Administered* ▪ Physician-approved medications ▪ Maintenance of blood administration

Pharmacologic Intervention Minimum Psychomotor Skill Set

EMR	EMT	AEMT	Paramedic
		▪ Glucagon and IV D_{50} for hypoglycemia ▪ Inhaled beta-agonist for dyspnea and wheezing ▪ Narcotic antagonist ▪ Nitrous oxide for pain relief	▪ Initiation of thrombolytics

Emergency Trauma Care Minimum Psychomotor Skill Set

Manual cervical stabilization	Spinal immobilization		Morgan lens
Manual extremity stabilization	Seated spinal immobilization		
Eye irrigation	Long board		
Direct pressure	Extremity splinting		
Hemorrhage control	Traction splinting		
Emergency moves for endangered patients	Mechanical patient restraint		
	Tourniquet[e]		

Emergency Trauma Care Minimum Psychomotor Skill Set		
	MAST/PASG*	
	Cervical collar	
	Rapid extrication	
Medical/Cardiac Care Minimum Psychomotor Skill Set		
CPR	Mechanical CPR	Cardioversion
AED	Assisted complicated delivery of an infant	Carotid massage
Assisted normal delivery of an infant		Manual defibrillation
		TC pacing

Abbreviations: AED, automated external defibrillator; BiPAP/CPAP, bilevel positive airway pressure/continuous positive airway pressure; BP, blood pressure; CPR, cardiopulmonary resuscitation; D_{50}, 50% dextrose in water; ECG, electrocardiogram; IM, intramuscular; IO, intraosseous; IV, intravenous; MAST/PASG, military antishock trousers/pneumatic antishock garments; NG, nasogastric; OG, orogastric; SL, sublingual; SC, subcutaneous; TC, transcutaneous.

Note: The 2005 National EMS Scope of Practice Model serves as a foundation for states to build their own model. It is intended to illustrate the operation of each level of EMS provider and the progression from one level to another. It is not inclusive of every skill a state may allow.

[a] The Sellick maneuver is no longer routinely recommended.
[b] Blood glucose monitoring is now considered an EMT-level skill.
[c] Mark I has been replaced by the DuoDote and the Antidote Treatment Nerve Agent Auto-Injector (ATNAA).
[d] Subcutaneous epinephrine administration is typically considered a paramedic-level skill now.
[e] Tourniquet use has evolved to be practiced by all providers including the EMR level.

Public Basic Life Support and Immediate Aid

With the development of EMS and increased awareness of the need for immediate emergency care, millions of laypeople have been trained in BLS/CPR. In addition to CPR, many people take first aid courses that include bleeding control and other simple skills that may be required to provide immediate essential care. These courses are designed to train people so those in the workplace—teachers, coaches, child care providers, and others—can provide the necessary critical care in the minutes before EMTs or other responders arrive at the scene.

In addition, many people, such as those who regularly accompany groups on camping trips or are in other situations where the arrival of EMS may be delayed because of remote location, are trained in advanced first aid. This course includes BLS and the essential additional care and packaging that may be necessary until the help of rescuers and EMTs can be obtained at a remote location.

One of the most dramatic recent developments in prehospital emergency care is the use of an **automated external defibrillator (AED)**. These remarkable devices, some no larger than a cell phone, detect treatable life-threatening cardiac dysrhythmias (ventricular fibrillation and ventricular tachycardia) and deliver the appropriate electrical shock to the patient. Designed to be used by the untrained layperson, these devices are now included at every level of prehospital emergency training.

Emergency Medical Responders

Because the presence of a person who is trained to initiate BLS and other urgent care cannot be ensured, the EMS system includes immediate care by EMRs, such as law enforcement officers, firefighters, park rangers, ski patrollers, or other organized rescuers who often arrive at the scene before the ambulance and EMTs **Figure 1-4**. EMR training provides these people with the skills necessary to initiate immediate care and assist the EMTs on their arrival. The course focuses on providing immediate BLS and urgent care with limited equipment. It also familiarizes students with the additional procedures, equipment, and packaging techniques that EMTs may use and the EMR may be called on to assist.

In addition to professional EMRs, EMTs often encounter a variety of people on the scene eager to help. You will encounter Good Samaritans trained in first aid and CPR, physicians and nurses, and other well-meaning people with or without prior training and experience. Identified and used properly, these people can provide valuable assistance when you are shorthanded. At other times, they can interfere with operations and even create problems or danger for themselves or others. It will be your task in your initial scene size-up to identify the various people on the scene and orchestrate well-meaning attempts to assist.

Emergency Medical Technician

The EMT course requires approximately 150 hours (more in some states) and provides the essential knowledge and skills required to provide basic emergency care in the field. The course serves as the foundation on which additional knowledge and skills are built in AEMT training. On arrival at the scene, you and any other EMTs who have responded should assume responsibility for the assessment and care of the patient and follow the proper packaging and transport of the patient to the ED if appropriate.

Figure 1-4 Emergency medical responders, such as law enforcement officers, are trained to provide immediate basic life support until EMTs arrive on the scene.

Advanced Emergency Medical Technician

The AEMT course and training are designed to add knowledge and skills in specific aspects of ALS to providers who have been trained and have experience in providing emergency care as EMTs. These additional skills include IV therapy, use of advanced airway adjuncts, and the knowledge and skills necessary to administer a limited number of medications. The AEMT course ranges between 200 and 400 hours. The purpose of this level of EMS provider is to deliver an expanded range of skills beyond the EMT. In some parts of the United States, the availability of paramedics is limited. AEMTs help to fill the gap by providing limited ALS care to regions where paramedics are not available.

Paramedic

The paramedic completes an extensive course of training that significantly increases knowledge and mastery of basic skills and covers a wide range of ALS skills **Figure 1-5**. This course ranges from 1,000 to more than 1,300 hours, divided between classroom and internship training. Increasingly, this training is offered within the context of an associate's degree or bachelor's degree college program.

Figure 1-5 Paramedic training covers a wide range of ALS skills.

Words of Wisdom

There are many directions you can take your EMS career. Specialty certifications include technical rescue, tactical EMS, critical care transport, disaster management, and much more. Other career paths include serving as an instructor or administrator. Advancement into positions such as EMS directors, administrators, and educators frequently requires formal education or degrees related to EMS.

Components of the EMS System

The *EMS Agenda for the Future* is a multidisciplinary, national review of all aspects of EMS delivery. The goal is to develop a more cohesive and consistent system across the country. In the document, there are 14 components of an EMS system as outlined in **Table 1-3**. NHTSA has taken these components and organized them in such a way to understand some of the interrelationships between the components.

Figure 1-6 demonstrates how the components interact. The tabs on the right side show the primary 9-1-1 components of EMS. Someone recognizes an emergency, 9-1-1 is activated, an ambulance is dispatched, and emergency care and transportation are administered. In the center are the essential aspects needed to allow the primary 9-1-1 components to function—finances, radios, computers, and people. The left side demonstrates the continuum of care from the prehospital environment to the ED and beyond. Finally, as patients leave the health care system, there are strategies of prevention and education to help ensure people live long and healthy lives. Understanding the 14 components will help you better understand how the EMS system works.

Table 1-3 ***EMS Agenda for the Future Components of an EMS System***

EMS System	
1. Public Access	8. Communication Systems
2. Clinical Care	9. Human Resources
3. Medical Direction	10. Legislation and Regulation
4. Integration of Health Services	11. Evaluation
5. Information Systems	12. System Finance
6. Prevention	13. Public Education
7. EMS Research	14. Education Systems

YOU are the Provider — PART 3

Your partner records the patient's vital signs on the patient care report as you ask the patient additional questions regarding her back pain. She tells you her lower back began hurting about a month ago; however, she has never been evaluated by a physician. She denies injuring her back. She further denies any other symptoms or past medical history.

Recording Time: 4 Minutes	
Respirations	16 breaths/min; regular and unlabored
Pulse	88 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	126/66 mm Hg
Oxygen saturation (Spo_2)	99% (on room air)

Your assessment of the patient's back does not reveal any obvious deformities, swelling, or bruising, and her vital signs are stable. The patient requests you take her to the hospital.

4. The patient has requested you transport her to the hospital, but does not appear to be experiencing any life-threatening conditions. Should you transport her to the hospital?

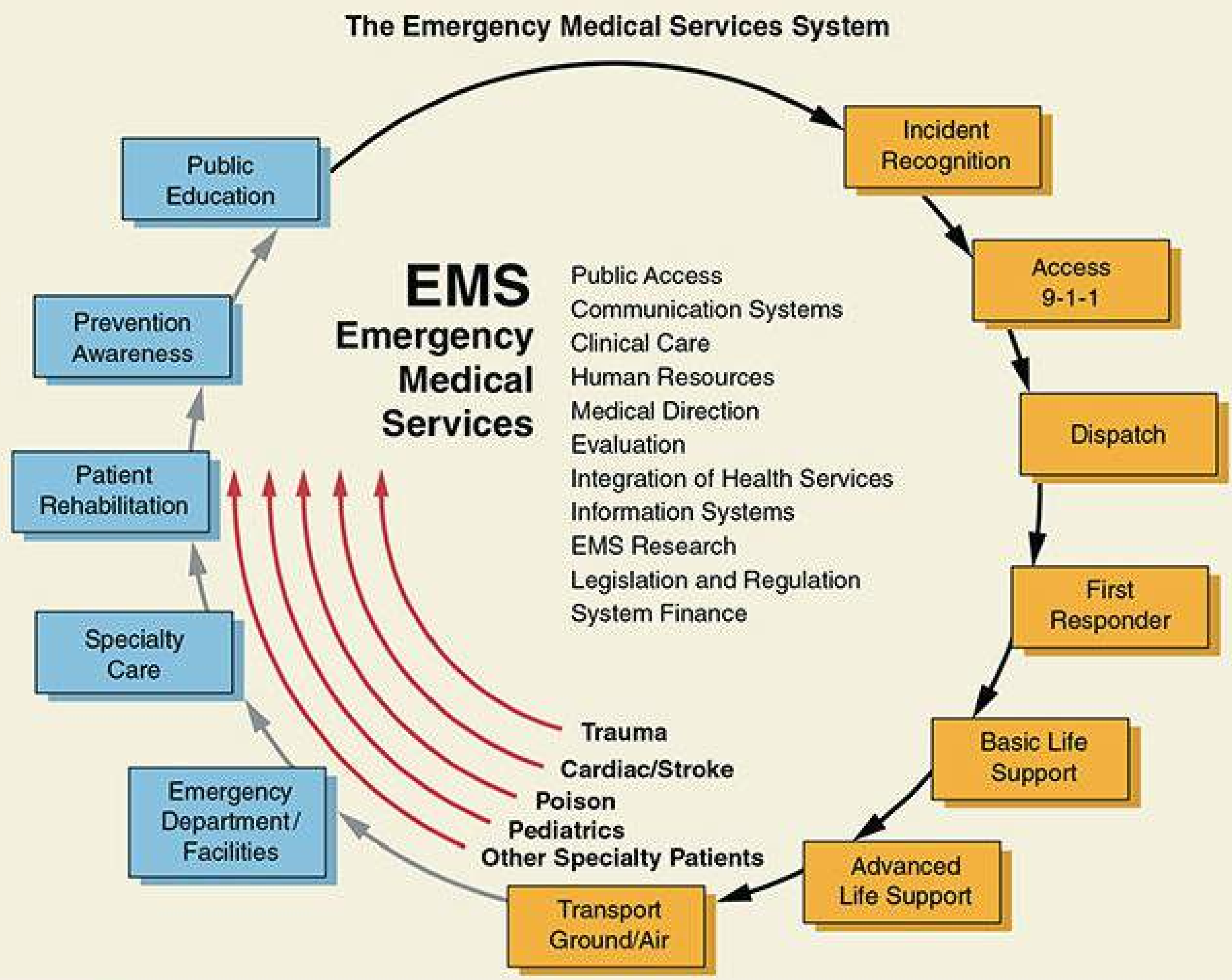

Figure 1-6 Interaction of the components of the National Highway Traffic Safety Administration's emergency medical services system.

Source: www.ems.gov.

Public Access

Easy access to help in an emergency is essential. In most of the country, an emergency communication center that dispatches fire, police, rescue, and EMS units can be reached by dialing 9-1-1. At the communication center, trained dispatchers obtain the necessary information from the caller and, following dispatch protocols, dispatch the ambulance crew and other equipment and responders that may be needed **Figure 1-7**. This communication center is called a **public safety access point**.

In an enhanced 9-1-1 system, the address of the caller is displayed on a screen. The address remains on the screen until the dispatcher removes it. Therefore, if the caller is unable to speak or hangs up, the location remains displayed. However, not all cell phones have this capability. Most emergency communication centers are equipped with special equipment allowing people with speech or hearing disabilities to communicate with the dispatcher via a keyboard and printed messages. In some areas, rather than 9-1-1, a different special published emergency number may be used to call for EMS. Social media may play an evolving role in allowing lay people trained in CPR to be alerted of a cardiac arrest in their area. Training the public how to summon an EMS unit is an important part of the public education responsibility of each EMS service. Enhanced 9-1-1 systems are now available that can identify not only the cell phone number from which an emergency call is being placed, but also the exact geographic coordinates of the cell phone at the time the call is made. Such systems use global positioning system (GPS) technology. Because cell phones capable of transmitting a GPS signal and a system capable of receiving that signal are both required, the technology requires additional time and resources to implement.

Figure 1-7 Trained dispatchers obtain information about the call and then send responders to the scene as needed.

A system called **emergency medical dispatch (EMD)** was developed to assist dispatchers in providing callers with vital instructions to help them deal with a medical emergency until EMS crews arrive. Dispatchers are trained and provided scripts to help them relay relevant instructions to the callers. The system helps dispatchers select appropriately resourced units to respond to a request for assistance. It is the dispatcher's duty to relay all relevant and available information to the responding crews in a timely manner. Keep in mind current technology does not allow the dispatcher to "see" what is actually going on at the scene; however, it is not uncommon for you to find the reality of the call quite different from the dispatch information.

Communication Systems

Using the information provided by the caller, the dispatcher will select the appropriate parts of the emergency system that need to be activated. Over half of EMS support is provided by a governmental entity such as a fire agency (about 45%) or other non-fire governmental agency (20%). Private services deliver about one-fourth of EMS support. Other models seen less frequently include hospital-based programs and Native American tribal services.

New technologies are constantly being developed to assist responders in locating their patients. As previously described, cell phones can be linked to GPS units to display their location. Responding units can transmit their position to a dispatcher who can transmit the location of a call to a moving digital map in the unit, complete with turn-by-turn directions. Medical databases can be queried and patient information can be directly downloaded to the EMT's computer or uploaded from the EMT's laptop to the database. Familiarize yourself with mobile phone dispatch systems in your jurisdiction so you are aware of who will potentially be on-scene when you arrive to a cardiac arrest. Constant training and education are required to keep the EMT's knowledge of technological developments up-to date.

Safety Tips

As an EMT, you are responsible for checking the ambulance and making sure equipment is completely functional. If equipment is not functioning properly, you should notify a supervisor immediately and either take the ambulance out of service or replace the nonfunctioning piece of equipment. Remember, safety first.

Clinical Care

Clinical care describes the various pieces of equipment and scope of practice for using that equipment. As an EMT, you will use a wide range of different emergency equipment. During the EMT course, you will be introduced to, and learn how to use, a variety of appliances and devices that you may need on a call. You will learn when the use of each is indicated and when it is of no benefit or may cause harm. Although the use of different models and brands of a given device will follow the same basic principles and methods, some variation and peculiarities may exist from one model to another. When you join a service, check each key piece of equipment before going on duty to ensure that it is in its assigned place, that it is working properly, and that you are familiar with the specific model carried on your ambulance.

Each EMT may be called on to drive the ambulance. Therefore, you must familiarize yourself with the roads in your **primary service area (PSA)** or sector. The PSA is the main area in which an EMS agency operates. Before going on duty, check all the equipment and supplies and communication equipment that the ambulance carries. It is your responsibility to ensure the ambulance is fully fueled, has sufficient oil and other key fluids, and that the tires are in good condition and properly inflated **Figure 1-8**. You should also test each of the driver's controls and each built-in unit and control in the patient compartment. If you have not driven the specific ambulance before, it is a good idea to take it out and become familiar with it before you respond to a call. Maintenance and safe driving of the ambulance are discussed in detail in Chapter 37, *Transport Operations*.

Figure 1-8 Making sure the ambulance is fueled is part of an EMT's responsibility.

Human Resources

The human resources component deals with people. Who delivers the care? How are these people compensated for their time and energy? How do other members of the medical community interact and participate within the EMS world? These are some of the questions discussed within the component of human resources.

EMS in this component is examined as a profession. The overarching concept is to encourage the creation of EMS systems that provide an environment where talented people want to work and can turn their passion into a rewarding career.

Several objectives need to be accomplished to help make a career in EMS a lasting one. Efforts are being made to ensure that EMS providers can move from one state to another more seamlessly. From a global point of view, one of the core functions of a state is to provide and protect its citizens. This obligation has led to the creation of EMS levels that are unique to a particular state. Though effective for any one state, these idiosyncratic EMS levels make movement from one state to another complicated. One of the functions of the National Scope of Practice Model is to create stable foundations on which each level of EMS provider is grounded. The net effect is to encourage a more consistent definition of "what is an EMT" so providers can move more freely about the country.

The *EMS Agenda for the Future* encourages the creation of systems that help to protect the well-being of EMS providers. It also encourages systems to develop career ladders, allowing talented EMS providers ways to use their talent for many years.

Medical Direction

Each EMS system has a physician **medical director** who authorizes the EMTs in the service to provide medical care in the field. The appropriate care for each injury, condition, or illness that you will encounter in the field is determined by the medical director and is described in a set of written standing orders and protocols. Protocols are described in a comprehensive guide delineating the EMT's scope of practice. Standing orders are part of protocols and designate what the EMT is required to do for a specific complaint or condition. Providers are not required to consult medical direction before implementing standing orders.

The medical director is the ongoing working liaison between the medical community, hospitals, and the EMTs in the service. If treatment problems arise or different procedures should be considered, they are referred to the medical director for his or her decision and action. To ensure the proper training standards are met, the medical director determines and approves the continuing education and training that are required of each EMT in the service.

Medical control is provided either off-line (indirect) or online (direct), as authorized by the medical director. Online medical control consists of direction given over the phone or radio directly from the medical director or designated physician. The medical direction can be transferred by the physician's designee; it does not have to be transferred by the physician himself or herself. Off-line medical control consists of standing orders, training, and supervision authorized by the medical director. Each EMT must know and follow the protocols developed by his or her medical director.

The service's protocols will identify an EMS physician, usually at a local hospital, who can be reached by radio or telephone for medical control during a call. This is a type of direct online medical control. On some calls, once the ambulance crew has initiated any immediate urgent care and gives their radio report, the online medical control physician may either confirm or modify the proposed treatment plan or may prescribe any additional special orders that the EMTs are to follow for that patient. The point at which the EMTs should give their radio report or obtain online medical direction will vary.

Legislation and Regulation

Although each EMS system, medical director, and training program has latitude, their training, protocols, and practices must conform to the EMS legislation, rules, regulations, and guidelines adopted by each state. The state EMS office is responsible for authorizing, auditing, and regulating all emergency medical services, training institutions, courses, instructors, and providers within the state. In most states, the state EMS office obtains input from an advisory committee made up of representatives of the services, service medical directors, medical associations, hospitals, training programs, instructors' associations, EMT associations, and the public in that state.

At the local level, each EMS system operates in a designated PSA in which it is responsible for the provision of prehospital emergency care and the transportation of the sick and injured to the hospital.

EMS is usually administered by a senior EMS official. Daily operations and overall direction of the service are provided by an appointed chief executive officer and several other officers who serve under him or her. When EMS is a part of a fire or police department, the department chief will usually delegate the responsibility for directing EMS to an assistant chief or other officer whose sole responsibility is to manage the EMS activities of the department. To provide clear guidelines, most services have written operating procedures and policies. When you join a service, you are expected to learn and follow them.

The chief executive of the service is in charge of both the necessary administrative tasks (eg, scheduling, personnel, budgets, purchasing, vehicle maintenance) and the daily operations of the ambulances and crews. Except for medical matters, he or she operates as the chief (similar to a fire chief or police chief) of EMS for the service and the PSA that it covers.

Integration of Health Services

EMS does not work in a vacuum. EMS personnel travel to people's homes and to vehicle crashes. Once on scene, they deliver care and transport the patient to a care facility. Integration of health services means that the prehospital care you administer is coordinated with the care administered at the hospital. When you deliver a patient to the ED you are simply transferring that patient to another care provider. The excellent care that you began should be continued in the ED. This component helps to decrease errors, to increase efficiencies, and, most of all, to ensure the patient receives comprehensive continuity of care.

Words of Wisdom

A patient may experience only once what you may experience hundreds of times. Understand and be empathetic to the patient's anxiety.

Although it may not appear like an emergency to you, it is considered an emergency by your patient and his or her family members. Treat them with respect. Your patients and their family members will always remember how you acted when you were with them.

Some EMS systems have collaborated with local hospitals to improve patient outcomes associated with time sensitive treatment like heart attacks, trauma, and stroke. This is accomplished through special training in the EMS system and certain hospital departments. For example, when paramedics determine a patient is having a heart attack, they alert the ED. In turn, the personnel in the ED notify the cardiac catheterization team, or you may be directed to transport the patient to a cardiac specialty center. As a result, the key personnel are ready to begin critical treatments as soon as the patient arrives at the hospital. Similar activities take place for stroke and trauma patients.

Mobile Integrated Healthcare

Mobile integrated healthcare (MIH) is a new method of delivering health care that utilizes the prehospital spectrum. It has evolved as a result of the Patient Protection and Affordable Care Act, with the goal to facilitate improved access to health care at an affordable price. In the MIH model, health care is provided within the community, rather than at a physician's office or hospital. An integrated team of health care professionals, including EMS providers, delivers health care services in the community, and connects patients with other valuable resources such as social services. An advantage of this model is that it offers access for care to patients within communities with limited medical resources, and leads to better service for those who are home-bound or disabled.

This new branch of health care is causing the evolution of additional training levels for EMS providers. One new aspect is **community paramedicine**, in which experienced paramedics receive advanced training to equip them to provide services within a community. In addition to the patient care services a paramedic would typically provide, services provided by community paramedics may include performing health evaluations, monitoring chronic illnesses or conditions, obtaining laboratory samples, administering immunizations, and serving as a patient advocate.

Evaluation

The medical director is responsible for maintaining **quality control**, ensuring that all staff members who are involved in caring for patients meet appropriate medical care standards on each call. To provide the necessary quality control, the medical director and other involved staff review patient care reports (PCR), audit administrative records, and survey patients.

Continuous quality improvement (CQI) is a circular system of continuous internal and external reviews and audits of all aspects of an EMS system. To provide CQI, periodic run review meetings are held with those involved in patient care to review the run reports and then discuss any areas of care that appear to need change or improvement. Positive feedback is also discussed. If a problem appears to be repeated by a single EMT or crew, the medical director will discuss the details with those involved. The CQI process is designed to identify areas of improvement and, if necessary, assign remedial training or develop some other educational activity. The medical director is also responsible for ensuring that appropriate continuing education and training are available.

Information and skills in emergency medical care change constantly. You need refresher training or continuing education as new modalities of care, equipment, and understanding of critical illnesses and trauma develop. Equally, when you have not used a particular procedure for some time, skill decay may occur. Therefore, your medical director may establish a training program to correct the deficit. For example, an ED physician noted that despite their assessments, many EMTs were missing a high number of closed long bone fractures, resulting in poor prehospital care. A subsequent audit of calls led to a review and retraining session for assessment and care of fractures. This same process can apply to CPR or any other type of skill you do not use often. Ensuring your skills and knowledge are current is one of the ongoing commitments of being an EMT.

YOU are the Provider — PART 4

The patient is placed onto the stretcher, placed in a position of comfort, and loaded into the ambulance. You and the paramedic are in the back with the patient as your EMT partner drives to the hospital. En route, the paramedic starts an intravenous (IV) line and administers pain medication to the patient. Shortly after the medication has been administered, you reassess the patient.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert
Respirations	16 breaths/min; regular and unlabored
Pulse	90 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	120/62 mm Hg
Spo_2	97% (on room air)

Within a few minutes, the patient tells you her back pain has subsided. She asks you if you think her back pain could be a sign of a serious problem.

5. Is the paramedic required to contact medical control prior to administering any medications?
6. How should you answer the patient's question regarding her concern that she may have a serious condition?

Another function of the evaluation process is to determine ways to limit or eliminate human error. During the delivery of EMS, as with any occupation, there are times when errors can happen. Driving to the scene can be hazardous. As you are lifting and moving a patient, the patient can be dropped. Communicating with other EMTs or transferring the patient to the ED presents circumstances where errors can happen. Remember, errors can occur at any point during the call that can result in harm to the patient, public, and you.

Errors are not inevitable, though. If the circumstances of the errors are understood, it may be possible to eliminate or at least minimize them. There are many ways to examine medical errors. This textbook focuses on errors from three possible sources. They can occur as a result of a rules-based failure, a knowledge-based failure, or a skills-based failure (or any combination of these). For example, does the EMT have the legal right to administer the particular medication the patient needs? Has the medical director given permission to administer the drug? If not, a rules-based failure has occurred if the EMT assists with the administration. Does the EMT know all of the pertinent information about the medication being delivered? If not, a breakdown at this point, such as the administration of the wrong medication, would be referred to as a knowledge-based failure. Finally, is the equipment operating and being used properly? If not, a skills-based error has occurred. Any error can come from multiple sources.

Limiting errors requires the efforts of both the EMS agency and EMS personnel. Agencies need to have clear protocols, which are detailed plans that describe how certain patient issues, such as chest pain or shortness of breath, are to be managed. These protocols need to be understood by all EMTs within the service.

The environment can also contribute to errors. Are there ways to limit distractions? How do we improve lighting so EMTs can see well? How organized is the equipment? Can the EMT find what he or she needs in a timely manner? Environmental considerations can be managed using many approaches. Sometimes the solution is as easy as ensuring flashlights are available on all ambulances. Consider having police assistance on certain types of EMS calls or getting the assistance of an EMS supervisor. Perhaps a new type of equipment bag will provide better organization. Typically, when trying to reduce environmental factors regarding errors, this means having the right people with the right equipment in place.

EMTs can also help to reduce errors. Your job is to protect the patient from harm and to deliver high-quality medical care. This is one of your most important responsibilities. You are a patient care advocate—you speak for patients on their behalf. Keeping this responsibility in mind will help you to limit errors.

There are other ways errors can be reduced. When you are about to perform a skill, ask yourself, "Why am I doing this?" Knowing the reason for your actions gives you time to reflect and make a more informed decision. Even within EMS, rarely do you have to act so quickly that you do not have a moment to consider what it is you are doing and why. If you have considered what to do and cannot come up with a solution, ask for help. Talk with your partner, contact medical control, or call your EMS supervisor.

Another way to help limit medical errors is to use “cheat sheets.” Keep a copy of your protocol book with you. Emergency physicians have many reference materials available to them. Physicians recognize they cannot memorize everything, so referencing a book or an Internet resource helps ensure the accuracy of their memory.

Finally, after a troublesome call, sit down and talk. Talk with your partner and/or your supervisor. Discussing the events that just happened provides an excellent avenue for learning. Your discussions can help lead to changes in protocol, how equipment is stocked, or even the purchase of new equipment.

Information Systems

EMS is not unlike any other profession in today’s world. Without computers, the job would be much more difficult. An information system allows EMS providers to efficiently document the care that has been delivered. Once that information is stored electronically, it can be used to improve care. For example, how many times has a department seen patients with chest pain? What is the average on-scene time for major trauma patients? How many AED runs has the department had? These questions and many more can be answered using the information gathered from computerized medical records.

This information is used for a variety of purposes. It is used to construct educational sessions for the department. Data from ambulance activity logs is used to justify hiring more personnel. Examining the types of patients and their frequency can provide the foundation for the purchase of new equipment and guide continuing education sessions. This information can also be combined with other database resources, such as from a hospital, to determine patient outcome. Departments from around the country are sending information to Washington, DC, so a national snapshot of EMS activities can be obtained. Information gathered by the National EMS Information System (NEMSIS) can be found at http://www.nemsis.org. This information will be used to better plan for the needs of EMS systems today and in the future.

System Finance

All EMS departments need a funding system that allows them to continue to provide care; however, the type of system needed depends on many variables. There are several types of EMS departments around the country. The *Journal of Emergency Medical Services* annually reports on how EMS is delivered in the 200 largest cities within the United States. See **Table 1-4** for the breakdown of types of EMS services within the United States for the year 2012.

These departments may have paid or volunteer personnel, or a mix of both. Financial resources are available for EMS departments through taxation, fee for service, paid subscription, donations, federal/ state/local grants, fund-raisers, or combinations of same. Which financial system is used depends on the needs and makeup of each EMS department.

How are EMTs involved with the financial side of EMS? You may think the financial activities belong to those who work in the office. However, you may be asked to gather insurance information from patients, secure signatures on certain documents such as HIPAA notifications, or obtain written permission from patients to bill their health insurance company. All of these steps are important to the health care process. When you do not provide needed information, the patient may be billed, rather than the insurance company.

EMTs are also involved in helping with fund-raisers, stuffing envelopes, or just making calls to potential subscribers to the service. Regardless of what type of system you work, you will help the department secure its financial resources.

Table 1-4 Types of EMS Services that Transport Patients in the 200 Largest Cities Within the United States

Type of Organization Providing EMS Transport Services	
Private organization	39.6%
Fire department	37.4%
Third service and hospital	23.0%

Data from: Ragone, MG. JEMS Surveys 200 Most Populous Cities. February 1, 2012. Accessed 11/4/14 at http://www.jems.com/article/administration-and-leadership/jems-surveys-200-most-populous-cities.

Education Systems

Your training will be conducted by many knowledgeable EMS educators. In most states, the instructors who are responsible for coordinating and teaching the EMT course and continuing education courses are approved and licensed by the state EMS office or agency. Most EMS training programs must adhere to national standards established by the accrediting organizations CoAEMSP (Committee on Accreditation of Educational Programs for the Emergency Medical Services Professions) and CAAHEP (Commission on Accreditation of Allied Health Education Programs). To be licensed in some states, an instructor must have extensive medical and educational training and teach for a designated period while being observed and supervised by an experienced instructor. ALS-level instructors and directors must hold a four-year degree.

Generally, ALS training is provided either in a college, adult career center, or hospital setting. In most states, educational programs that provide ALS training must be approved by the state and have their own medical director. In these courses, many of the lectures and small group sessions are presented by the medical director or other physicians, nurses, and EMS instructors. In clinical sessions in which supervised practice is obtained in the ED or other in-hospital settings, students are also supervised directly by physicians and nurses.

The quality of care you provide depends on your ability and the quality of your training. Therefore, your instructor and the many others who develop and participate in your training program are key members of the emergency care team.

When you no longer have the structured learning environment that is provided in your initial training course, you must assume responsibility for directing your own study and learning. As an EMT, you are required to attend a certain number of hours of continuing education approved for EMTs each year to maintain, update, and expand your knowledge and skills. In many services, the required hours are provided by the training officer and medical director. In addition, most EMS education programs and hospitals offer a number of regular continuing education opportunities in each region. You may also attend state and national EMS conferences to help keep you current about local, state, and national issues affecting EMS. Because there are many levels of licensing, you should ensure that the continuing education you receive is approved for the EMT. Whether you take advantage of these opportunities depends on you. You may decide to remain an EMT or you may want to achieve a higher level of training and certification, but whatever you choose, the key to being a good EMT and providing high-quality care is your commitment to continual learning and increasing your knowledge and skills.

EMTs possess special knowledge and skills that are directed to the care of patients in emergency situations. The authority that is delegated to you to care for patients is a very special one. Maintaining your knowledge and skills is a substantial responsibility. Knowledge and skills that are learned in any profession weaken when they are not used on a continual basis. Consider the steps involved in CPR, for example. If you have not used these skills since your original training, it is unlikely you will perform CPR proficiently. Frequent continuing education, refresher courses, and computer-based or manikin-based self-education exercises are measures you can take to maintain your skills and knowledge.

Prevention and Public Education

The next two components of the EMS system are often closely associated with each other. Prevention and public education are aspects of EMS where the focus is on public health. **Public health** examines the health needs of entire populations with the goal of preventing health problems. Although there are many definitions possible for public health, the prevention of health problems seems to provide a good overarching framework.

Health care in the United States is currently in a state of flux. The high-tech, on-demand style of care that is prevalent has two major drawbacks. One, it is very expensive. In the United States, more than 17.9% of the gross domestic product is accounted for by health care. Two, it may not deliver a better product. The US government reports people born in the United States have an average life expectancy of 79 years. There are 35 other countries where people are living longer. If we are spending such large sums on health care, shouldn't we be living longer?

What needs to be addressed is the concept of prevention. Is it more expensive to treat a patient with a heart attack or to work with communities to help prevent the heart attack from ever happening? Or consider the scenario of an EMS provider working with a community to help get new traffic lights installed, thereby decreasing the incidence of vehicle collisions and subsequent injuries. The concept of prevention applies to both the patient and the EMS provider. Eating right, exercising, and using other stress management techniques can help prevent medical emergencies. It may seem strange, but the goal of education should be to create an environment where the need for EMS is decreased.

The focus of the public health arm of health care is prevention. Public health works to prevent illness and injury, meaning being proactive. A good example of public health at work is the common product, salt. The next time you buy salt, look at the contents. In the United States, salt is sold with the additive iodine. It was discovered years ago that a condition known as goiter (abnormally large thyroid gland) is caused by a decrease in iodine levels within people's diets. The solution was to add this important element into a commonly used food source. Today, goiters are rare within the United States. Table 1-5 demonstrates other significant accomplishments of the public health system.

EMS is able to work with public health agencies on both primary and secondary prevention strategies. **Primary prevention** focuses on strategies that will prevent the event from ever happening. Polio was a devastating disease that caused death and disability for thousands of Americans in the early 1900s. A vaccine was developed to prevent the disease. In the span of one generation, the disease was virtually eliminated. Vaccinations are a good example of primary prevention within public health.

Table 1-5 Examples of Public Health Accomplishments

Vaccination programs	Clean drinking water
Fluoridation of water supplies	Seat belt laws
Helmet laws	Tobacco use laws
Sewage systems	Restaurant inspections
Formation of the Food and Drug Administration	Prenatal screenings

In 2009, the World Health Organization declared the swine flu (H1N1) virus to be at pandemic levels, which meant that the virus had spread throughout the world. The Centers for Disease Control and Prevention estimated that between 2009 and 2010 there were approximately 60.8 million cases and 12,469 deaths in the United States. If a major outbreak were to occur in the United States, EMTs may be called on to assist in the administration of vaccinations. Other examples of primary prevention include ensuring people know the dangers of drinking and driving and the harmful effects of using tobacco and other drugs. There are several ways EMTs can contribute to primary prevention efforts. You can become involved in programs that educate the community about pool safety and car seat installation or in home safety and fall prevention programs for senior adults. Other opportunities include teaching first aid and CPR to various groups within your area. Remember, small actions can lead to big differences!

In a **secondary prevention** strategy, the event has already happened. The question is how can we decrease the effects of the event? Helmets and seat belts do not prevent the accident from happening, yet they do prevent serious injuries from occurring due to the accident. The next time you drive down a major roadway, take note of the construction of the guardrails. There have been significant changes in guardrail construction over the years as more information has become available on what happens during a vehicle collision.

As an EMT, you may also be involved in the surveillance of illnesses and injuries. The PCRs that are generated by EMS personnel can be used to determine if a serious, widespread condition exists. For example, EMS is in a perfect position to provide statistical information to the local government about collisions. Injury surveillance data can be used to determine ways to improve a dangerous intersection, to prevent accidents from ever happening, or to limit the severity of injuries to drivers.

As discussed earlier, you can help educate the public. People may not understand why an accident has happened. A parent allows her 15-month-old child to play outside with other children unsupervised. The child falls and cuts her hand. EMS arrives and the cause of the injury is obvious. You can work with the parents professionally, respectfully, and kindly to help educate them on how to prevent this injury from occurring in the future.

The public may not understand the education that EMS providers have, and what services you can provide. You can go to local schools and teach children to call 9-1-1 when there is a medical emergency. You can work with local health care institutions to inform local residents when to call for an ambulance and when other transportation methods are more appropriate. Also, efforts to use social media to alert the public of a cardiac arrest are developing. You should consider advocating for social-media-directed or mobile phone dispatch systems that encourage lay people trained in CPR to respond to episodes of cardiac arrest that occur in close proximity to them.

Teaching people how to perform CPR, how to help a choking victim, or even how to assist in the delivery of a baby are all aspects of public education. Educating the public on the benefits of compression-only CPR is another example. One of the important effects of public education is an increase in public respect for EMS. When people understand what it means to work on an ambulance and provide care to the sick and injured, they are more likely to consider EMS a vital part of the public health care system. This change in attitude can be powerful and lead to increased EMS funding and greater respect for EMS as a profession.

EMS Research

Why do EMTs perform the skills they do? How many ambulances does a city need? Should we remain on the scene and stabilize the patient or should we rapidly transport the patient? These questions and thousands more like them help determine the shape and impact of EMS on the community. The answers to these questions are derived from research. Unfortunately, many of the tools and techniques that EMS providers use are borrowed from other health care settings without any research proving their effectiveness in EMS.

In the early days of EMS, it was believed major trauma patients needed to be stabilized on the scene before they were transported. Paramedics would start IV lines and use advanced airways. There was no foundation to support this behavior; it was assumed that this care needed to be done. After compiling significant amounts of prehospital EMS research, it was determined that major trauma patients needed to be transported to an operating room more than they needed IV fluids. Now EMS providers provide rapid transport of major trauma patients to trauma centers where they can get the surgical care they need. This is the power of EMS research.

Applying evidence-based practice is becoming an integral part of functioning as an EMS provider. Patient care should be focused on procedures that have proven useful in improving patient outcomes. There is a limited amount of prehospital EMS research relative to other areas of medical research; however, as EMS research continues, evidence-based practice will have a correspondingly greater role in EMS. All aspects of the EMT role are currently being researched, not only within the academic community, but in growing numbers of the practitioner community, as every EMT has something to contribute to improving the role.

As an EMT, you will be involved in research typically through gathering data. You may be part of a study to determine how much oxygen should be given to patients with shortness of breath. You may be involved in a study to track the time it takes to get serious trauma patients to the ED. Your job is to ensure you carefully record all of the information about these patients. The information gathered is analyzed by others to answer these questions and the results are shared with the rest of the EMS community to change patient care practices. Traditional medical practice is based on such research.

Research can also be done at each EMS facility. EMS personnel can examine patient care records to determine where the department can improve. This information can be used to generate educational sessions for the EMTs or it can be used to plan public education/public prevention strategies. High-quality patient care should focus on procedures useful in improving patient outcomes through sound research.

It is important to stay current on the latest advances in health care. On a regular basis, the International Liaison Committee on Resuscitation (ILCOR), along with its member the American Heart Association, update guidelines based on current medical evidence. The ILCOR guidelines are an excellent example of evidence-based medical decision-making in progress. These changes occur because more information is known.

One word of caution: When reading new research, make sure you understand what the results mean. Research information can be powerful, but it is often powerful within a very limited setting. A manufacturer of a defibrillator boasts their new machine will terminate ventricular fibrillation on the first shock 95% of the time. On the basis of this information, you may immediately want to buy this new product. Terminating ventricular fibrillation is certainly a positive result, but does this defibrillator save more lives than other defibrillators? In this example, the manufacturer is reporting the defibrillator is able to terminate ventricular fibrillation, not that the defibrillator is able to save more lives. People who do not examine the research will often make that hasty conclusion.

YOU are the Provider **PART 5**

The patient's condition has remained stable throughout transport. She is now pain free. After reassessing her, the paramedic asks you to call in your patient report to the receiving facility. Your estimated time of arrival is 8 minutes.

Recording Time: 19 Minutes	
Level of consciousness	Conscious and alert
Respirations	14 breaths/min; regular and unlabored
Pulse	70 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	118/60 mm Hg
Spo_2	98% (on room air)

You deliver the patient to the emergency department (ED) in stable condition and give your verbal report to a staff nurse. The patient thanks you and your crew for taking such good care of her. You depart the hospital and return to service. On the way back to the station, the paramedic critiques your performance.

7. What is the purpose of an EMS call critique?

Be skeptical when reading research. Ask questions and conduct your own research. Conclusions that seem too good to be true are usually not true.

Roles and Responsibilities of the EMT

As an EMT, you will often be the first health care professional to assess and treat the patient; as such, you have certain roles and responsibilities Table 1-6 and are expected to possess certain attributes Table 1-7. The guiding principle for EMS personnel is "everything you do needs to be done with the patient in mind." What is in the best interest of the patient? This is referred to as being a patient advocate.

Often, patient outcomes are determined by the care you provide in the field and your identification of patients who need prompt transport. You are responsible for all aspects of EMS, from the preparation of the equipment to the delivery of care to providing a good example for others within the community.

Table 1-6 Roles and Responsibilities of the EMT

- Keep vehicles and equipment ready for an emergency.
- Ensure the safety of yourself, your partner, the patient, and bystanders.
- Emergency vehicle operation.
- Be an on-scene leader.
- Perform an evaluation of the scene.
- Call for additional resources as needed.
- Gain patient access.
- Perform a patient assessment.
- Give emergency medical care to the patient while awaiting the arrival of additional medical resources.
- Give emotional support to the patient, the patient's family, and other responders.
- Maintain continuity of care by working with other medical professionals.
- Resolve emergency incidents.
- Uphold medical and legal standards.
- Ensure and protect patient privacy.
- Give administrative support.
- Constantly continue your professional development.
- Cultivate and sustain community relations.
- Give back to the profession.

Table 1-7 Professional Attributes of EMTs

Attribute	Description
Integrity	Consistent actions, a firm adherence to a code of honest behavior
Empathy	Aware of and thoughtful toward the needs of others
Self-motivation	Able to discover problems and solve them without someone directing you
Appearance and hygiene	Uses persona to project a sense of trust, professionalism, knowledge, and compassion
Self-confidence	A state of being where you know what you know AND know what you not know; able to ask for help
Time management	Able to perform or delegate multiple tasks ensuring efficiency and safety
Communications	Able to understand others and have them understand you
Teamwork and diplomacy	Able to work with others; to know your place within a team; able to communicate while giving respect to the listener
Respect	Places others in high regard or importance; understands others are more important than self
Patient advocacy	Constantly keeping the needs of the patient at the center of care
Careful delivery of care	Pays attention to detail; makes sure what is being done for the patient is done as safely as possible

Professional Attributes

As an EMT, whether you are paid or a volunteer, you are a health care professional. Part of your responsibility is to make sure patient care is given a high priority without endangering your own safety or the safety of others. Another part of your responsibility to yourself, other EMTs, the patient, and other health care professionals is to maintain a professional appearance and manner at all times. Appearance, including uniforms, hair length, and tattoos, are usually regulated by the policies of your department **Figure 1-9**. Your attitude and behavior must reflect that you are knowledgeable and sincerely dedicated to serving anyone who is injured or in an acute medical emergency. A professional appearance and manner help to build confidence and ease the patient’s anxiety. You are expected to perform under pressure with composure and self-confidence. Patients and families who are under stress need to be treated with understanding, respect, and compassion.

Most patients will treat you with respect and appreciation, but some will not. Some patients are uncooperative, demanding, unpleasant, ungrateful, and verbally abusive. You must be nonjudgmental and overcome your instincts to react poorly to such behavior. Remember, when people are hurt, ill, under stress, frightened, despondent, under the influence of alcohol or drugs, or feel threatened, they will often react with inappropriate behavior, even toward those who are trying to help and care for them. Every patient, regardless of his or her attitude, is entitled to compassion, respect, and the best care that you can provide.

Figure 1-9 **A.** A professional appearance and demeanor help build confidence and ease patient anxiety. **B.** An unprofessional appearance may promote distrust and incompetence.

Words of Wisdom

Professionalism extends beyond appearance and the activities you perform on a daily basis. As a professional, you have a responsibility to your partner, colleagues, patients, and profession to maintain a current level of knowledge.

Most people in this country can obtain proper routine medical care when they are ill and are surrounded by relatives and friends who will help to take care of them. However, when you are called to a home for a medical problem that is clearly not an emergency, remember that for some patients, calling an ambulance and being transported to the ED is the only way to obtain medical care.

As a new EMT, you will be given a lot of advice and training from the more experienced EMTs with whom you serve. Some may voice a callous disregard for some types of patients. Do not be influenced by the unprofessional attitude of these providers, regardless of how experienced or skilled they appear.

As a health care professional and an extension of physician care, you are bound by patient confidentiality. You should not discuss your findings or any disclosures made by the patient with anyone but those who are treating the patient or in limited situations, as required by law, the police or other social agencies. When discussing a call with others, you should be careful to avoid revealing any information that might disclose the name or identity of patients you have treated. Be careful not to gossip about calls and patients with others, even in your own home. The protection of patient privacy has drawn national attention with the passage of the **Health Insurance Portability and Accountability Act (HIPAA)**. You should be familiar with the requirements of this legislation, especially as it applies to your particular practice.

YOU are the Provider SUMMARY

1. Do your roles and responsibilities as an EMT differ from those of a paramedic? If so, how?

The fundamental roles and responsibilities—providing *safe and effective* emergency medical care to the sick and injured, and transporting patients to an appropriate medical facility—are the same for the EMT, AEMT and paramedic provider.

The only difference between the EMT and the paramedic is the level of care that is provided to the patient. EMTs have a fundamental knowledge of emergency care and provide basic life support (BLS), such as cardiopulmonary resuscitation, bleeding control, bandaging and splinting, and basic airway management. Paramedics have a comprehensive knowledge of emergency medical care, which is built on a solid knowledge of BLS, and provide advanced life support interventions, such as advanced airway management, cardiac monitoring, and medication administration.

2. What is the difference between what you learned in your EMT class and the care you provide in the field?

Your education and training is intended to prepare you to function as an entry-level competent EMT; therefore, your education should reflect the current practice of prehospital emergency medical care. The cognitive knowledge and psychomotor skills learned in the classroom are concepts that you will apply when caring for patients in the field. With experience and contact with many patients experiencing a variety of injuries and illnesses, your ability to apply the concepts learned in the classroom will be enhanced. You will develop your own “routine” regarding your general approach to patient care; however, you must be able to alter your routine based on the situation and the needs of the patient. Experience also enhances your critical thinking abilities. Critical thinking is a complex combination of skills; it includes the following characteristics:

- **Rationality:** Relying on reason rather than emotion; requiring evidence; not ignoring evidence; following evidence where it leads; and being more concerned about finding the best explanation than about being right; analyzing apparent confusion; and asking questions
- **Self-awareness:** Weighing the influences of your motives and biases and recognizing your own assumptions, prejudices, biases, or point of view
- **Open-mindedness:** Evaluating all reasonable inferences; considering a variety of possible viewpoints or perspectives; remaining open to alternative interpretations; accepting new explanations because they explain the evidence better; accepting new priorities in response to reevaluation of the evidence; and not rejecting unpopular views as out of hand
- **Judgment:** Recognizing the relevance and/ or merit of alternative assumptions and perspectives and recognizing the extent and weight of evidence
- **Discipline:** Being precise, meticulous, comprehensive, and exhaustive; resisting manipulation and irrational appeals; and avoiding snap judgments

3. How do you know if this patient is experiencing a “true emergency?”

An emergency can be defined as any event or situation that requires immediate intervention to minimize or prevent serious injury or death. An emergency to one person may not be an emergency to another. You must recognize that people call EMS when they perceive their situation as an emergency. In the interest of the patient, you should assume an emergency exists unless a thorough and accurate assessment yields otherwise.

Your job is to take care of patients whether a “true emergency” exists or not.

4. The patient has requested you transport her to the hospital, but does not appear to be experiencing any life-threatening conditions. Should you transport her to the hospital?

Delivering excellent and compassionate care and providing transportation to a higher level of care should be the norm. The absence of any obvious life-threatening conditions does not mean this patient does not require further medical evaluation and treatment. She has been experiencing back pain for a month; this could indicate a serious underlying problem that can only be diagnosed in a hospital. You will often encounter patients who are not experiencing any life-threatening conditions but still require EMS treatment—even if it is just supportive—and transport to the hospital.

Consulting with online medical control is recommended when a patient refuses treatment or transportation and you feel these interventions are in the patient's best interest. Similarly, if you feel transportation is not necessary, consulting with online medical control can help ensure this is the correct decision. This consultation should always be documented. If you allow patients with recognized or potentially serious medical problems to refuse care or do not offer these patients transportation to obtain higher level evaluation you expose yourself to greater levels of legal liability.

5. Is the paramedic required to contact medical control prior to administering any medications?

It depends on the EMS system's protocols. Some EMS protocols require prior contact before administering certain medications; others do not. Medical control is either off-line (indirect) or online (direct), as authorized by the EMS medical director. Online medical control consists of direction given over the phone or radio directly from the medical director or designated physician. Off-line medical control consists of standing orders, interventions that do not require prior contact with medical control, as authorized by the medical director. In this case, the paramedic started an IV line and administered medication without contacting medical control first. This indicates he or she had standing orders to do so. The paramedic recognized the need for pain medication, has been appropriately educated and trained on the medication and how to administer it, and has been authorized by the medical director to administer it at his or her discretion. It is important to note that just because your EMS system has standing orders for certain interventions, you should always contact medical control if you have any questions or concerns or need advice. Be familiar with your EMS system's protocols.

6. How should you answer the patient's question regarding her concern that she may have a serious condition?

Honesty is a critical attribute of any EMS provider. Lying to a patient and providing false hope and reassurance are unethical and inhumane. In many cases, the most honest answer to a question is "I don't know." Do not speculate—based solely on your assessment—and tell her she does or does not have a serious condition; you do not have the diagnostic equipment and resources needed to come to any conclusions. If you do not know the answer to a patient's question, do not be afraid to say "I don't know." Follow this up by reassuring her you will give her the best medical care possible and that the physician at the hospital will do the same. Patients deserve to hear the truth; never tell them otherwise.

7. What is the purpose of an EMS call critique?

The purpose of an EMS call critique is to provide feedback regarding how you cared for the patient and met his or her physical and emotional needs. It should not be punitive or demeaning; it is an educational tool that will enable you to enhance your patient care skills. EMTs must be open to constructive criticism; this is how they learn and become more proficient emergency care providers. Informal, one-on-one critiques, such as what the paramedic is conducting with you after the call, are ideal learning opportunities because information about the call is still fresh in your mind. Formal critiques, such as those that are conducted as part of the EMS continuous quality improvement (CQI) process, are designed to ensure that safe and effective patient care is consistently provided by all EMS providers in the system. To provide CQI, periodic run review meetings are held with those involved in patient care to review patient care reports and discuss any areas of care that appear to need change or improvement. Positive feedback should also be provided. If a problem appears to be repeated by a single EMT or crew, the medical director will discuss the details with those involved. If deemed necessary by the medical director, he or she may assign remedial training or develop some other educational activity. Many EMS systems have a designated person, who is assigned by the medical director, to carry out these tasks.

EMS Patient Care Report (PCR)

Date: 3-23-16	**Incident No.:** 010109	**Nature of Call:** Back pain		**Location:** 325 Blossom Ave.	
Dispatched: 0720	**En Route:** 0720	**At Scene:** 0723	**Transport:** 0735	**At Hospital:** 0750	**In Service:** 0801

Patient Information

Age: 59 **Sex:** F **Weight (in kg [lb]):** 64 kg (141 lb)	**Allergies:** None **Medications:** Ibuprofen **Past Medical History:** None **Chief Complaint:** Back pain

Vital Signs

Time: 0727	**BP:** 126/66	**Pulse:** 88	**Respirations:** 16	**Spo_2:** 99%
Time: 0735	**BP:** 120/62	**Pulse:** 90	**Respirations:** 16	**Spo_2:** 97%
Time: 0742	**BP:** 118/60	**Pulse:** 70	**Respirations:** 14	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** IV line, pain medication (by paramedic)

Narrative

Dispatched for a 59-year-old woman with back pain. On arrival at the scene, found the patient sitting on the couch in her living room. She was conscious and alert; her airway was patent; and her breathing was adequate. Patient reports lower back pain, which has been present for the past month. She denied injuring her back; she further denied any other symptoms or past medical history. Medications include ibuprofen for pain. Assessment of patient's back revealed no gross evidence of deformity, swelling, or bruising. Pulse, sensory, and motor functions were grossly intact in all extremities. The patient stated she has not been evaluated by a physician for her back pain; however, because it has progressively worsened, she called 9-1-1. Obtained vital signs, placed patient onto stretcher and placed her in position of comfort, loaded her into the ambulance, and began transport to the hospital. En route, paramedic started IV line and administered analgesia. Shortly after analgesia was administered, patient expressed relief of her pain. Reassessment revealed that she remained conscious and alert with stable vital signs. Provided reassurance and reassessment throughout remainder of transport. Delivered patient to emergency department without incident and gave verbal report to staff nurse.**End of report**

Prep Kit

Ready for Review

- The standards for prehospital emergency care and the providers who deliver it are governed by the laws in each state and are typically regulated by a state office of EMS.

- The EMS ambulance is staffed by EMTs who have been trained to the emergency medical technician, advanced EMT (AEMT), or paramedic level according to recommended national standards and have been licensed by the state they serve.
- An EMT has training in basic emergency care skills, including automated external defibrillation, use of airway adjuncts, and assisting patients with certain medications.
- An AEMT has training in specific aspects of advanced life support (ALS), such as intravenous therapy and the administration of certain emergency medications.
- A paramedic has extensive training in ALS, including endotracheal intubation, emergency pharmacology, cardiac monitoring, and other advanced assessment and treatment skills.
- Emergency medical responders, such as law enforcement officers, firefighters, park rangers, ski patrollers, or other organized rescuers often arrive at the scene before the ambulance and EMTs.
- After the EMTs size up the scene and assess the patient, they provide the emergency care and transport that is indicated based on their findings and ordered by their medical director in the service's standing orders and protocols or by the physician who is providing online medical direction.
- The National EMS Scope of Practice Model, developed by NHTSA, provides overarching guidelines as to what skills each level of EMS provider should be able to accomplish.
- The *EMS Agenda for the Future* is a multidisciplinary, national review of all aspects of EMS delivery that encourages the creation of systems that help to protect the well-being of EMS providers. It includes 14 components that make up an EMS system.
- You will often be the first health care professional to assess and treat the patient; as such, you have certain roles and are expected to possess certain attributes.
- EMT attributes include compassion and motivation to reduce suffering, pain, and mortality in those who are injured or acutely ill; a desire to provide each patient with the best possible care; commitment to obtain the knowledge and skills that this position requires; and the drive to continually increase your knowledge, skills, and ability.
- The EMT course that you are now taking will present the information and skills that you will need to pass the required certification examination needed to become a licensed EMT.
- Once you have completed the course, you must assume responsibility for directing your own study through continuing education provided by your service's training officer and medical director or through other opportunities available to you. Your commitment to continued learning is the key to being a good EMT.
- Throughout your career, seek new certifications and roles that will broaden your abilities and experience. Mobile integrated healthcare, including the role of community paramedic, is an example of how EMS roles are evolving.
- As a health care professional and an extension of physician care, you are bound by patient confidentiality.

Vital Vocabulary

advanced EMT (AEMT) An individual who has training in specific aspects of advanced life support, such as intravenous therapy, and the administration of certain emergency medications.

advanced life support (ALS) Advanced lifesaving procedures, some of which are now being provided by the EMT.

Americans With Disabilities Act (ADA) Comprehensive legislation that is designed to protect people with disabilities against discrimination.

automated external defibrillator (AED) A device that detects treatable life-threatening cardiac dysrhythmias (ventricular fibrillation and ventricular tachycardia) and delivers the appropriate electrical shock to the patient.

certification A process in which a person, an institution, or a program is evaluated and recognized as meeting certain predetermined standards to provide safe and ethical care.

community paramedicine A health care model in which experienced paramedics receive advanced training to equip them to provide additional services in the prehospital environment, such as health evaluations, monitoring of chronic illnesses or conditions, and patient advocacy.

continuous quality improvement (CQI) A system of internal and external reviews and audits of all aspects of an EMS system.

emergency medical dispatch (EMD) A system that assists dispatchers in selecting appropriate units to respond to a particular call for assistance and provides callers with vital instructions until the arrival of EMS crews.

emergency medical responder (EMR) The first trained professional, such as a police officer, firefighters, lifeguard, or other rescuer, to arrive at the scene of an emergency to provide initial medical assistance.

emergency medical services (EMS) A multidisciplinary system that represents the combined efforts of several professionals and agencies to provide prehospital emergency care to the sick and injured.

emergency medical technician (EMT) An individual who has training in basic life support, including automated external defibrillation, use of a definitive airway adjunct, and assisting patients with certain medications.

Health Insurance Portability and Accountability Act (HIPAA) Federal legislation passed in 1996. Its main effect in EMS is in limiting availability of patients' health care information and penalizing violations of patient privacy.

intravenous (IV) therapy The delivery of medication directly into a vein.

licensure The process whereby a competent authority, usually the state, allows people to perform a regulated act.

medical control Physician instructions given directly by radio or cell phone (online/direct) or indirectly by protocol/guidelines (off-line/indirect), as authorized by the medical director of the service program.

medical director The physician who authorizes or delegates to the EMT the authority to provide medical care in the field.

mobile integrated healthcare (MIH) A method of delivering health care which involves providing health care within the community rather than at a physician's office or hospital.

National EMS Scope of Practice Model A document created by the National Highway Traffic Safety Administration (NHTSA) that outlines the skills performed by various EMS providers.

paramedic An individual who has extensive training in advanced life support, including endotracheal intubation, emergency pharmacology, cardiac monitoring, and other advanced assessment and treatment skills.

primary prevention Efforts to prevent an injury or illness from ever occurring.

primary service area (PSA) The designated area in which the EMS agency is responsible for the provision of prehospital emergency care and transportation to the hospital.

public health Focused on examining the health needs of entire populations with the goal of preventing health problems.

public safety access point A call center, staffed by trained personnel who are responsible for managing requests for police, fire, and ambulance services.

quality control The responsibility of the medical director to ensure the appropriate medical care standards are met by EMTs on each call.

secondary prevention Efforts to limit the effects of an injury or illness that you cannot completely prevent.

Assessment *in Action*

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You are tasked with teaching a review course for the National Registry written exam. Several students are worried about passing the cardiology and trauma sections. You reassure them that while these are very important topics, the fundamentals form the building blocks for our profession and should not be forgotten. After sharing those words of wisdom, you begin class.

1. Which of the following agencies is the federal source for the EMT education standards?

   A. Department of Health and Human Services
   B. National Highway Traffic Safety Administration
   C. Federal Emergency Management Agency
   D. Department of Transportation

2. What is the primary job of the EMT?

   A. Provide appropriate medical care
   B. Diagnose the patient’s condition
   C. Ensure personal safety
   D. Provide transport to the closest hospital

3. This act of legislation protects people with disabilities from being denied access to programs and services that are provided by state or local governments.

   A. Ryan White Act
   B. Marchman Act
   C. Equal Rights Amendment
   D. Americans with Disabilities Act

4. Which of the following is NOT a component of an EMS system under the EMS Agenda for the Future?

   A. Medical direction
   B. Certification reciprocity

C. Public education
D. EMS research

5. Which of the following is an example of secondary prevention?

A. Providing cervical spine immobilization
B. Administering vaccines
C. Conducting injury surveillance
D. Teaching safety in schools

6. The roles and responsibilities of an EMT include all of the following EXCEPT:

A. performing a patient assessment.
B. upholding medical and legal standards.
C. providing legal advice to patients.
D. ensuring and protecting patient privacy.

7. An example of teamwork and diplomacy is:

A. using your persona to project a sense of trust.
B. being able to communicate while giving respect to the listener.
C. placing others in high regard or importance.
D. delegating multiple tasks ensuring efficiency and safety.

8. The Health Insurance Portability and Accountability Act (HIPAA):

A. enables patients to travel without losing health insurance.
B. requires insurance companies to justify denying health care.
C. prevents an emergency department from refusing to care for a critically ill patient.
D. limits the availability of a patient’s health care information.

9. What is continuous quality improvement (CQI) and how is it used to help ensure the safety of patients?

10. Why is EMS research a vital part in the evolution of patient management?

CHAPTER

2

Workforce Safety and Wellness

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care transportation based on assessment findings for an acutely ill patient.

Infectious Diseases

Awareness of

› How to decontaminate equipment after treating a patient (pp 48–50)

Assessment and management of

› How to decontaminate the ambulance and equipment after treating a patient (pp 48–50)

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal, and ethical issues to the provision of emergency care.

Workforce Safety and Wellness

› Standard safety precautions (pp 42–47)
› Personal protective equipment (pp 43–47)
› Stress management (pp 35–36, 67–70)
  • Dealing with death and dying (pp 65–67)
› Prevention of response-related injuries (pp 38, 52–58)
› Prevention of work-related injuries (pp 38, 52–58)
› Lifting and moving patients (p 38)
› Disease transmission (pp 40–42)
› Wellness principles (pp 35–40)

Knowledge Objectives

1. State the steps that contribute to wellness and their importance in managing stress. (pp 35–40)
2. Define infectious disease and communicable disease. (p 40)
3. Describe the routes of disease transmission. (pp 41–42)
4. Describe the routes of transmission and the steps to prevent and/ or deal with an exposure to hepatitis, tuberculosis, and HIV/AIDS. (pp 41–48)
5. Know the standard precautions used in treating patients to prevent infection. (pp 42–47)
6. Describe the steps to take for personal protection from airborne and bloodborne pathogens. (pp 42–47)
7. Explain proper handwashing techniques. (pp 43–44)
8. List the ways immunity to infectious diseases is acquired. (pp 50–51)
9. Explain postexposure management of exposure to patient blood or body fluids, including completing a postexposure report. (p 52)
10. Describe the steps necessary to determine scene safety and to prevent work-related injuries at the scene. (pp 52–58)
11. Describe the different types of protective clothing worn to prevent injury. (pp 58–61)
12. Explain the care of critically ill and injured patients. (pp 61–64)
13. Describe issues concerning care of the dying patient, death, and the grieving process of family members. (pp 65–67)
14. Know the physiologic, physical, and psychological responses to stress. (pp 67–69)
15. Describe posttraumatic stress disorder (PTSD) and steps that can be taken, including critical incident stress management, to decrease the likelihood that PTSD will develop. (pp 69–70)
16. Identify the emotional aspects of emergency care. (pp 69–70)
17. Recognize the stress inherent in many situations, such as mass-casualty scenes. (pp 70–71)
18. Recognize the possibility of violent situations and the steps to take to deal with them. (pp 72–73)
19. Describe how to recognize behavioral emergencies. (pp 73–74)
20. Discuss workplace issues such as cultural diversity, sexual harassment, and substance abuse. (pp 74–76)

Skills Objectives

1. Demonstrate how to properly remove gloves. (p 45, Skill Drill 2-1)
2. Demonstrate the steps necessary to take to manage a potential exposure situation. (p 49, Skill Drill 2-2)

Introduction

There is an ancient proverb, "Physician, heal thyself." As health care providers, physicians need to look after themselves—in all respects—so that they can minister to others. An ill physician is in no position to render care as he or she was trained to do. That dictum applies to all health care providers and goes well beyond just physical issues.

Your personal safety must always be foremost in your mind. If that is threatened, you will not ultimately be able to care for the patient.

As part of your training, you will learn how to recognize possible hazards to your health, safety, and well-being and how to protect yourself from them. These hazards vary greatly, ranging from personal neglect to environmental and human-made threats. You will learn how to cope with the mental and physical stress that result from caring for the sick and injured. Death and dying issues challenge you to deal with the realities of your own mortality and the emotions of the survivors.

Your emotional well-being and the patient's are intertwined, especially in high-stress rescues. This chapter discusses both caring for the well-being of the patient and caring for yourself.

General Health and Wellness

Wellness goes well beyond prevention of disease. Rather, it is a state of complete mental, physical, and social well-being. As a health care provider, you should model a lifestyle of health and wellness. This state of wellness must occur both at work, with protection from communicable disease and scene hazards, and at home by eating a balanced and healthy diet, participating in physical exercise, getting enough sleep, refraining from the use of tobacco, drugs, and excessive alcohol, and taking time to relax and enjoy life.

As an EMT, you will be called upon to work in less than ideal circumstances and situations. This may result in both acute and cumulative stress. Remember, your role as an EMT is to be prepared, anticipate needed resources, control the scene, and care for the patient. Once you arrive, the emergency is in the hands of a competent professional. The calm manner in which you approach the scene will help to calm the patient, family members, and bystanders.

Wellness and Stress Management

Anyone can respond to sudden physical stress for a short time. However, if stress is prolonged, and especially if physical action is not a permitted response, the body can quickly be drained of its reserves. This can leave you depleted of key nutrients, weakened, and more susceptible to illness.

Management of Acute Stress

Stress is defined as any event, thought, or action perceived as a threat. Even people who are completely healthy may be constantly dealing with stress. Though it is an undeniable and unavoidable part of life, understanding how stress affects you physiologically, physically, and psychologically can help you control your reactions and minimize the effects of stress.

Your job is to remain professional at all times. Regardless of how stressful the situation, you must focus on the following, in this order:

1. Personal safety
2. Scene safety, including safety of others
3. Patient care

YOU are the Provider PART 1

You have been working a regular EMS shift—24 hours on and 48 hours off—since you became a certified EMT less than 6 months ago. You receive a call at 0720 hours to 788 East Radcliffe for an unconscious child who is not breathing. You and your paramedic partner respond to the scene; an emergency medical responder (EMR) unit is dispatched at the same time. This is your first call involving a critically ill child.

1. How can you psychologically prepare yourself for this call?

Although stressful situations may test your limits, you must focus on patient care while ensuring a safe and secure scene. Utilize the help of others, including your partner, police, a supervisor, other additional personnel, or even bystanders, to help manage crisis situations. Stay calm while allowing patients to express their feelings. You may be inclined to express your personal opinion but it is your duty to remain professional and focused on patient care.

There are many methods of handling stress. Some are positive and healthy; others are harmful and destructive. Some estimates indicate Americans consume more than 10,000 tons of aspirin per year (more than 27 tons per day), and doctors in the United States prescribe to their patients muscle relaxants, tranquilizers, and sedatives more than 90 million times per year. Although these medications have legitimate uses, they do nothing to combat stress that may cause the medical problems described previously.

The term stress management refers to the tactics that have been shown to alleviate or eliminate stress reactions. These strategies may involve changing a few habits, changing your attitude, and perseverance Table 2-1.

A clue to the management of stress comes from the fact that it is not the event itself but the individual's reaction to it that determines how much it will strain the body's resources.

Words of Wisdom

An overabundance of stress must concern you. If your gut feeling is that things are out of balance, you may be right.

The following sections provide some suggestions for how to prevent the effects of stress from adversely affecting you.

Nutrition

Your body's three sources of fuel—carbohydrates, fat, and protein—are consumed in increased quantities during stress, particularly if physical activity is involved. The quickest source of energy is glucose, taken from stored glycogen in the liver. However, this supply will last less than a day. Protein, drawn primarily from muscle, is a long-term source of fuel. Tissues can use fat for energy. The body also conserves water during periods of stress. To do so, it retains sodium by exchanging and losing potassium from the kidneys. Other nutrients that are susceptible to depletion are the vitamins and minerals that are not stored by the body in substantial quantities. These include water-soluble B and C vitamins and most minerals.

Table 2–1 Strategies to Manage Stress

- Minimize or eliminate stressors as much as possible.
- Change partners to avoid a negative or hostile personality.
- Change work hours.
- Change the work environment.
- Cut back on overtime.
- Change your attitude about the stressor.
- Talk about your feelings with people you trust.
- Seek professional counseling if needed.
- Do not obsess over frustrating situations that you are unable to change, such as relapsing alcoholics and nursing home transfers; focus on delivering high-quality care.
- Try to adopt a more relaxed, philosophical outlook.
- Expand your social support system beyond your coworkers.
- Develop friends and interests outside emergency services.
- Minimize the physical response to stress by using various techniques, including:
  - Periodic stretching or yoga
  - Slow, deep breathing
  - Regular physical exercise (150 min per week, including cardiovascular effort)
  - Progressive muscle relaxation
  - Meditation
  - Limit intake of caffeine, alcohol, and tobacco use

As an EMT, you have little control of what stressors you will face on any given day. Consequently, stress in one form or another is an unavoidable part of your life. As you would study for a test, dress properly for a day of snow skiing, or train for a sporting event, you should physically prepare your body for stress. Physical conditioning and proper nutrition are the two variables over which you have absolute control. Muscles will grow and retain protein only with sufficient activity. Bones will not passively accumulate calcium. In response to the physical stress of exercise, bones store calcium and become denser and stronger. Regular, well-balanced meals are essential to provide the nutrients that are necessary to keep your body fueled **Figure 2-1**. Vitamin-mineral preparations that provide a balanced mix of all the nutrients may be necessary to supplement a less than perfectly balanced diet.

To perform efficiently, you must eat nutritious food. Food is the fuel that makes the body run. The physical exertion and stress that are a part of your job require a high energy output. If you do not have a ready source of fuel, your performance may be less than satisfactory. This can be dangerous for you, your partner, and your patient. Therefore, it is important for you to learn about and follow the guidelines of good nutrition.

In general, you should limit your consumption of sugar, fats, sodium, and alcohol. Candy and soft drinks contain sugar. These foods are quickly absorbed and converted to fuel by the body. But simple sugars also stimulate the body's production of insulin, which reduces blood glucose levels. For some people, eating a lot of sugar can actually result in lower energy levels.

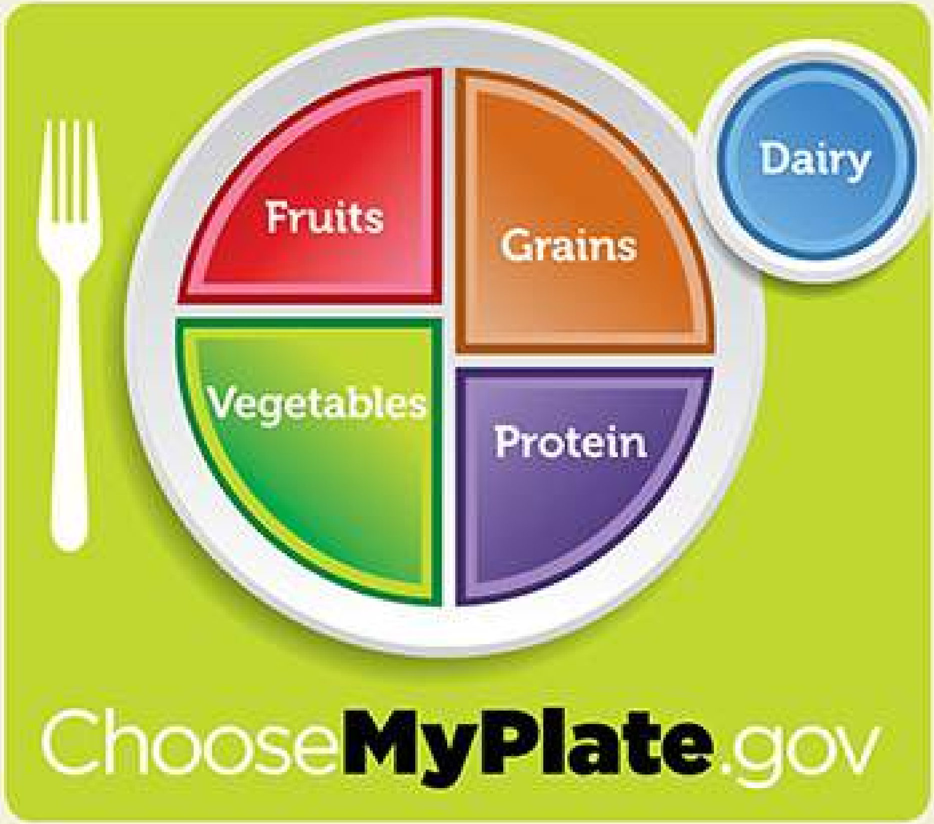

Figure 2-1 The USDA's MyPlate icon emphasizes healthy portions of vegetables, fruits, grains, proteins, and dairy.

Courtesy of the USDA Center for Nutrition Policy and Promotion.

Complex carbohydrates rank next to simple sugars in their ability to produce energy. Complex carbohydrates such as pasta, rice, and vegetables are among the safest, most reliable sources for long-term energy production. However, some carbohydrates take hours to be converted into usable body fuel.

Fats are also easily converted to energy, but eating too much fat can lead to obesity, cardiac disease, and other long-term health problems. The proteins in meat, fish, chicken, beans, and cheese take several hours to convert to energy. Consumption of fats should be limited to 10% of calories and should focus on monounsaturated and polyunsaturated fats while avoiding saturated fats or transfats. It is also important to limit cholesterol intake and salt (sodium) intake.

Carry an individual supply of high-energy food to help you maintain your energy levels **Figure 2-2**. Eat several small meals throughout the day to keep your energy resources at constant high levels. However, remember, overeating may reduce your physical and mental performance. After a large meal, the blood that is needed for the digestive process is not available for other activities.

You must also maintain an adequate fluid intake **Figure 2-3**. Hydration is important for proper functioning. Fluids can be easily replenished by drinking any nonalcoholic, caffeine-free fluid. Water is generally the best fluid available because the body absorbs it faster than any other fluid. Avoid fluids that contain high levels of sugar. These can actually slow the rate of fluid absorption by the body and cause abdominal discomfort. One indication of adequate hydration is frequent urination. Infrequent urination or urine that has a deep yellow color indicates dehydration.

Exercise and Relaxation

Regular exercise will enhance the benefits of maintaining good nutrition and adequate hydration. When you are in good physical condition, you can handle job stress more easily. Regular exercise will increase your strength and endurance. To maintain good health, you should engage in at least 30 minutes of physical activity at least 5 days per week. Exercise should be moderate or vigorous to have good health benefits. In other words, you should break a sweat **Figure 2-4**. You may also wish to practice relaxation techniques, meditation, and visual imagery.

Figure 2-2

Carry a supply of high-energy food with you so you can maintain your energy levels.

Your exercise routine should involve aspects of cardiovascular endurance, muscular strength building, and muscle flexibility. Endurance will ensure your cardiovascular system is able to provide your muscles and brain with needed oxygen. Strength and flexibility building ensures the body is able to handle the requirements that you will place on it by lifting patients, performing cardiopulmonary resuscitation (CPR), and moving heavy equipment.

Figure 2-3 Maintain an adequate fluid intake by drinking plenty of water or other nonalcoholic, caffeine-free fluids.

Figure 2-4 A regular program of exercise will increase strength and endurance.

Remember, if you do not use it, you will lose it. Plan activities ahead of time and use strategies that make your sessions convenient. Is there a gym or exercise facility near your home or en your route to work? Is there a walking path or a football stadium with a running track accessible?

Safe Lifting Practices. We have already discussed the physical requirements of being an EMT. Lifting 125 lb (57 kg) can be difficult if you do not exercise regularly. Lifting is one of the things you will do often, so safe lifting techniques are critical to your health and well-being. Back injuries are a common reason for on-the-job injuries within EMS. Chapter 8, *Lifting and Moving Patients*, discusses lifting and moving in depth. For your health and well-being, remember these tips:

- Preplan the move
- Bend your legs, not your waist
- Keep the weight close to your body
- Lift straight up using your legs, not your back

Sleep

Good productive sleep is as important as eating well and exercise in the maintenance of good health. Sleep should be regular and uninterrupted. The number of hours is not nearly as important as the quality of sleep. Unfortunately, you may not have the luxury of sleeping through the night. In lieu of a full night of sleep, cumulative sleep hours are very important, so taking short naps may help.

The signs that your sleep pattern is ineffective include:

- You fall asleep within seconds of lying down.

- You find yourself routinely fatigued within an hour or so after an EMS call. The excitement is over and now your adrenaline rush crashes.
- You are unable to make it through an entire day without severe fatigue.
- You are unable to concentrate on repetitive tasks such as driving or completing paperwork.

Actions you can take to improve your sleep include limiting your caffeine and alcohol intake and tobacco use. These agents have stimulating effects that can interrupt sleep. Since alcohol is both a stimulant and a depressant, routine or excessive use of alcohol can change sleep patterns, preventing deep sleep from occurring. Try to create as consistent a sleep cycle as possible. This may require naps. Many EMS providers are able to change their sleep pattern into several sleep episodes throughout the day.

If you are unable to get 8 straight hours of sleep, three sleep episodes of 2 to 3 hours each can provide similar effects. Each sleep episode needs to be more than 1 hour in length to allow for deep sleep. Finally, do not forget the effects of exercise and sleep. Routine exercise will promote the needed fatigue to slip into a restful sleep.

Disease Prevention

Besides sleep, diet, exercise, hydration, and all the other things that make up a healthy lifestyle, you need to be aware of your hereditary factors. Consider what you might know about your immediate family's and your ancestors' health. Alzheimer disease, chemical addiction, cancer, cardiac illness, hypertension, migraines, mental illness, and stroke all feature prominent hereditary factors. The most common of all hereditary factors are heart disease and cancer.

Share this information with your personal physician. Your physician is bound by the same oath of confidentiality that you are. Work with him or her to set up a schedule for health assessments, building them into your routine physical check-ups. Your physician should be your ally in screening you for these diseases and in assessing your lifestyle as well as your hereditary factors.

Knowing your hereditary factors will help you adjust your lifestyle to help prevent disease. For example, if you have a history of diabetes in your family, exercise and diet are critical to your well-being. Maintaining a healthy weight and a consistent exercise routine will help minimize your risk of this disease developing.

Smoking and Tobacco. If you don't already smoke, please don't start! If you do, please stop! Not only does this habit fly in the face of everything that EMS stands for, it also produces many of the most horrible cardiovascular and lung disasters that you will confront during your career. In addition, it sets an awful example for the public—especially to people who have breathing disorders such as asthma. And it makes you look and smell like anything but a professional caregiver.

Are you a smoker who is trying to quit? Several strategies can help you. First, try to cultivate a relationship with a mentor who was once truly addicted to tobacco but who has successfully quit smoking. Use that person as a support, and draw on his or her advice and encouragement. There are also programs that attack a smoker's psychologic dependency. These programs may include instructions and audio that provide ongoing support. Other options include therapy, hypnotism, and acupuncture.

Talk to your primary care physician. Your physician should be familiar with more techniques. All of these solutions are cheaper than cigarettes and their associated health risks.

While cigarette use among adults has declined from 42% in 1965 to 18% in 2012, cigarettes remain the most common form of tobacco use in the United States. Use of other tobacco products, including smokeless tobacco (chewing tobacco and snuff), is still common and has actually increased over the past several years. All forms of tobacco are harmful and must be avoided.

In recent years, electronic cigarettes (e-cigarettes) have become a popular alternative to tobacco cigarettes. Also called electronic nicotine delivery systems (ENDS) or personal vaporizers (PVs), these devices simulate smoking tobacco by producing an aerosol made by vaporizing a flavored liquid solution. Though studies indicate that e-cigarettes are less dangerous than their tobacco counterparts, the extent of their danger has not yet been determined. Consequently, these devices should be avoided.

Alcohol Abuse. Acceptable alcohol consumption is considered to be one or two drinks per day (one for women, two for men). Definitions of excessive drinking are shown in Table 2-2. In most cases, people who drink excessively are not alcoholics or alcohol dependent.

According to the Centers for Disease Control and Prevention (CDC), excessive alcohol use causes approximately 88,000 deaths per year in the United States with an economic cost of more than $200 billion per year. Approximately 75% of the total cost of alcohol abuse is attributed to binge drinking.

Table 2-2 Definitions of Excessive Drinking

	Binge Drinking	Heavy Drinking
Men	5 or more drinks during a single occasion	15 or more drinks per week
Women	4 or more drinks during a single occasion	8 or more drinks per week

Data From: Alcohol Use and Your Health. National Center for Chronic Disease Prevention and Health Promotion. Division of Population Health. Centers for Disease Control and Prevention. http://www.cdc.gov/alcohol/pdfs/alcoholyourhealth.pdf. Accessed 10/28/14.

Some studies have touted the health benefits related to alcohol, such as improved heart health from drinking red wine. The CDC notes that no one should start drinking or drink more frequently based on potential reported health benefits. While these benefits may exist, increased alcohol use may adversely impact other body systems, including the cardiovascular, hepatic, immune, and central nervous systems. Excessive alcohol use may also increase the risk of various cancers developing, including those of the mouth, throat, breast, esophagus, and liver.

Drug Use. Both prescription medications and illegal, or illicit, drugs may be abused or misused. Both are potentially dangerous and may lead to numerous additional health problems. According to the CDC, drug abuse costs the United States more than $190 billion annually in lost work productivity, health care, and crime.

Illicit drug use is both illegal and unhealthy, typically resulting in a snowball effect of bad outcomes. Many EMS agencies drug test their employees. Those who test positive for illegal drugs face suspension and/or dismissal. Needless to say, avoid all illegal drugs; take only those drugs prescribed for you personally by a physician, and take them only as directed. If any type of restricted schedule or narcotic drug is prescribed (usually while you are off duty), be sure to notify your employer of the situation.

Balancing Work, Family, and Health

As an EMT, you will often be called to assist the sick and injured any time of the day or night. Unfortunately, there is no rhyme or reason to the timing of illness, injury, or interfacility transfer. Volunteer EMTs may often be called away from family or friends during social activities. Shift workers may be required to be apart from loved ones for long periods of time. You should never let the job interfere excessively with your own needs. Find a balance between work and family; you owe it to yourself and to your family. It is important to make sure you have the time that you need to relax with family and friends.

It is also important to realize that coworkers, family, and friends often may not understand the stress caused by responding to EMS calls. As a result of a "bad call," you might not feel like going out to a movie or attending a planned family event. In these situations, help from a critical incident stress management team or information sessions conducted by your EMS unit's employee assistance program may assist you in resolving these issues.

When possible, rotate your schedule to give yourself time off. If your EMS system allows you to move from station to station, rotate to reduce or vary your call volume. Take vacations to lower stress and improve your physical health so you will be able to better respond the next time you are needed. If at any point you feel the stress of work is more than you can handle, seek help. You may want to discuss your stress informally with your family or coworkers. Help from more experienced team members can be invaluable. You may also wish to get help from peer counselors or other professionals. Seeking help does not make you weak in the eyes of others. Rather, it shows that you are in control of your life.

Infectious and Communicable Diseases

As an EMT, you will be called on to treat and transport patients with a variety of infectious or communicable diseases. An **infectious disease** is a medical condition caused by the growth and spread of small, harmful organisms within the body. A **communicable disease** is a disease that can be spread from one person or species to another. Immunizations, protective techniques, and simple handwashing can dramatically minimize the health care provider's risk of **infection**. When these protective measures are used, the risk of the health care provider contracting a serious disease is negligible.

Familiarize yourself with the following terminology related to infectious diseases. A **pathogen** is a microorganism that is capable of causing disease in a susceptible host. **Contamination** is the presence of infectious organisms or foreign bodies on or into objects such as dressings, water, food, needles, wounds, or a patient's body. **Exposure** is a situation in which a person has had contact with blood, body fluids, tissues, or airborne particles in a manner that may allow disease transmission to occur. **Personal protective equipment (PPE)** is protective equipment that an individual wears to prevent exposure to a pathogen or a hazardous material.

Words of Wisdom

All communicable diseases are infectious, but not all infectious diseases are easily communicable. For example, hepatitis B is an infectious disease that is communicable. However, *Salmonella* is infectious, but not communicable.

Routes of Transmission

Whereas all infections result from an abnormal invasion of body spaces and tissues by germs, different germs use different means of attack, or mechanisms of transmission. **Transmission** is the way an infectious disease is spread. There are several ways infectious diseases can be transmitted: contact (direct or indirect), airborne, foodborne, and vector-borne (transmitted through insects or parasitic worms).

Contact transmission is the movement of an organism from one person to another through physical touch. There are two types of contact transmission: direct and indirect. **Direct contact** occurs when an organism is moved from one person to another through touching without any intermediary.

The scenario of a vehicle crash can help you understand how transmission occurs through direct contact. The driver of the vehicle has **hepatitis** B and is bleeding from an arm injury. The EMT caring for the patient is not wearing gloves and has a small unnoticed cut on his hand. As he touches the patient, the hepatitis B virus moves from the victim's wound into the EMT's body through the cut on his hand, thus infecting him Figure 2-5. This is an example of direct contact where blood is the vehicle. **Bloodborne pathogens** are microorganisms that are present in human blood and can cause disease in humans. Another example of direct contact is sexual transmission. Patients who are infected with the **human immunodeficiency virus (HIV)** can transfer the virus to their partners during sexual intercourse.

Figure 2-5 Finger infection resulting from not wearing gloves during contact with a patient.

Words of Wisdom

Fungi are small, plantlike organisms such as yeast. Fungi cause many common conditions such as athlete's foot and jock itch. Protozoa are single-cell animal-like microorganisms. Protozoa cause malaria. Helminths are worms such as roundworms, pinworms, and hookworms. These worms are parasites that can infect people and cause serious health problems.

Indirect contact involves the spread of infection from the patient with an infection to another person through an inanimate object. The object that transmits the infection is called a fomite. Using the same patient from the example above, the EMT wore gloves. As the EMT was caring for the patient, blood got onto the ambulance stretcher. If the stretcher is not properly cleaned afterward, the virus remains on the stretcher and can be transmitted to someone else days later.

Needlesticks are another example of how infection spreads through indirect contact. In this case, the virus moves from the patient to the needle to the health care provider. This route of transmission was common many years ago before the advent of safety equipment such as needleless IV systems.

Airborne transmission involves spreading an infectious agent through mechanisms such as droplets or dust. The common cold is moved from person to person by coughing and sneezing. Interestingly, when a person sneezes, the moisture from the airway moves forcefully and quickly through a narrow opening. If the moisture droplets are large, they travel short distances and can be involved in direct contact transmission. If the moisture droplets are very small, they are turned into an aerosol and can now float in the air for long distances. Sneezing actually can transmit disease through direct contact and airborne routes **Figure 2-6**.

Because of airborne transmission, it is unsanitary to use your hands to cover a cough or sneeze because the organisms travel onto your hands. If you then touch a telephone, doorknob, or a patient, the organisms will travel. Using a tissue when coughing or sneezing is better for controlling the spread of organisms, but you then have a piece of paper full of organisms. One of the best techniques to avoid contaminating your hands is to cough or sneeze into your arm. Since you do not touch objects with your inner arms, the risk of moving organisms to an object or person is reduced **Figure 2-7**. The organisms are trapped in the fabric and will eventually die.

Foodborne transmission involves the contamination of food or water with an organism that can cause disease. When food is prepared, it is important to ensure raw meats do not come into contact with other foods to prevent the spread of bacteria. It is also important that food is prepared and stored properly at all times to minimize the possibility of illness. Proper cleaning of food preparation surfaces before and after use also helps to decrease the likelihood of transmitting foodborne bacteria.

Vector-borne transmission involves the spread of infection by animals or insects that carry an organism from one person or place to another. The Black Death in Europe and Asia in the Middle Ages killed more than 25 million people. This bacterial disease was caused by infected fleas that live on rats. As the rats moved, so did their fleas, carrying the bubonic plague. Other vector-borne diseases include rabies and Lyme disease.

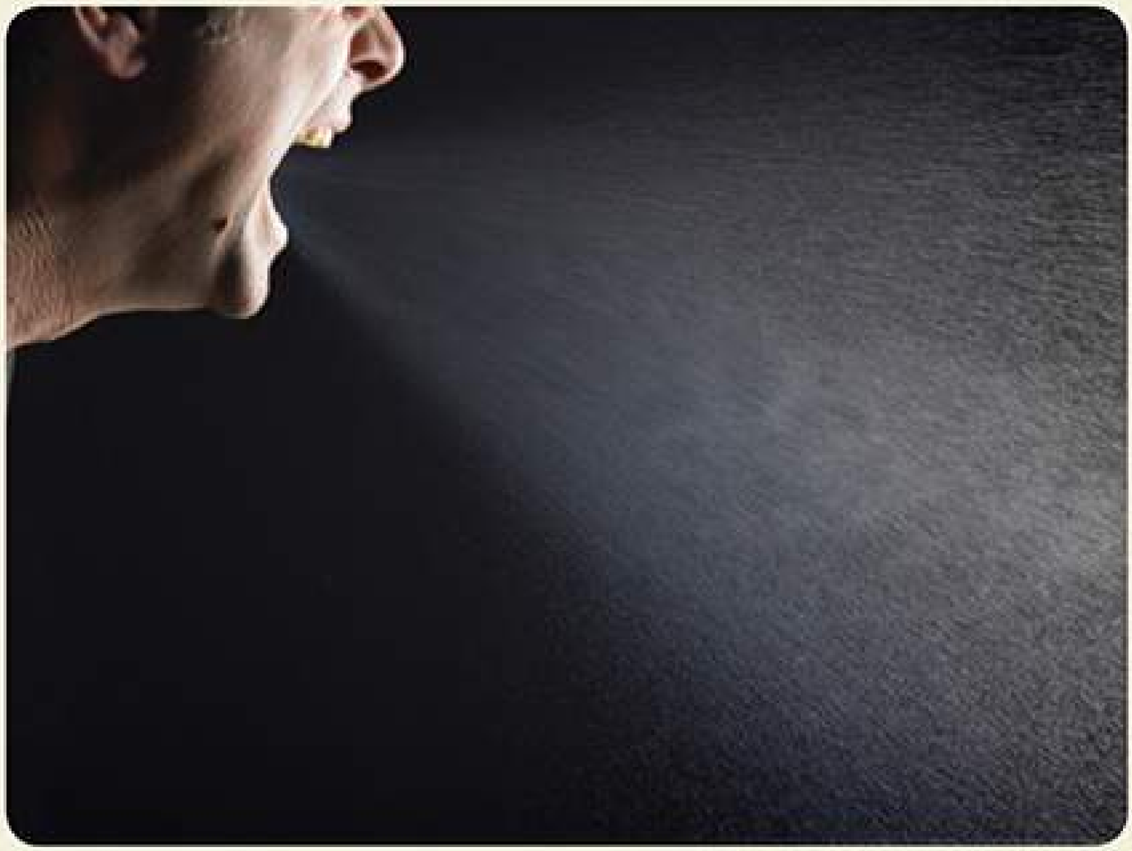

Figure 2-6 Coughing and sneezing create droplets and aerosols.

Risk Reduction and Prevention for Infectious and Communicable Diseases

Standard Precautions

The **Occupational Safety and Health Administration (OSHA)** develops and publishes guidelines concerning reducing hazards in the workplace. It is also responsible for enforcing these guidelines. OSHA requires all EMTs to be trained in handling bloodborne pathogens and in approaching the patient who may have an infectious or communicable disease. Training must be provided for issues including blood and body fluid precautions, airborne precautions, and contamination precautions.

Because health care workers are exposed to so many different kinds of infections, the **Centers for Disease Control and Prevention (CDC)** developed a set of **standard precautions** for health care workers to use in treating patients. Standard precautions are protective measures designed to prevent health care workers from coming into contact with objects, blood, body fluids, and other potential risks that could lead to exposure to germs. The CDC recommendation from 2007 is to assume that every person is potentially infected or can spread an organism that could be transmitted in the health care setting; therefore you must apply **infection control** procedures—procedures to reduce infection in patients and health care personnel. Table 2-3 summarizes the CDC recommendations. You must also notify your **designated officer** if you are exposed.

Figure 2-7 Coughing and sneezing techniques. **A.** Poor coughing and sneezing technique allows for spread of germs. **B.** Acceptable coughing and sneezing technique limits the spread of germs somewhat. **C.** Best coughing and sneezing technique minimizes the extent to which germs can spread.

Table 2-3 Standard Precautions for the Care of All Patients in All Health Care Settings, Centers for Disease Control and Prevention 2007

Component	Recommendations
Hand hygiene	▪ After touching blood, body fluids, secretions, excretions, or contaminated items ▪ Immediately after removing gloves ▪ Between patient contacts
Personal Protective Equipment (PPE)	
Gloves	▪ For touching blood, body fluids, secretions, excretions, or contaminated items ▪ For touching mucous membranes and nonintact skin
Gown	▪ During procedures and patient care activities when contact of the EMT's clothing/exposed skin to blood, body fluids, secretions, excretions, or contaminated items is anticipated
Mask, eye protection, face shield	▪ During procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, or excretions. Examples include suctioning or endotracheal intubation
Patient Care Environment	
Soiled patient care equipment	▪ Wear gloves ▪ Handle in a manner that prevents transfer of microorganisms to others and to the environment ▪ Hand hygiene
Environmental controls	▪ Have procedures for the routine care, cleaning, and disinfection of environmental surfaces ▪ Special attention to frequently touched surfaces within the ambulance (handrails, seats, cabinets, doors)
Textiles and laundry	▪ Handle in a manner that prevents transfer of microorganisms to others and to the environment
Needles and other sharp objects	▪ Do not recap, bend, break, or hand-manipulate used needles ▪ Use safety features when available (needleless IV systems) ▪ Place sharps in puncture-resistant containers
Special Circumstances	
Patient resuscitation	▪ Use mouthpiece, resuscitation bag, or other ventilation devices to prevent contact with mouth and oral secretions
Respiratory hygiene/cough etiquette	▪ Instruct symptomatic patients to cover mouth/nose when sneezing or coughing ▪ Use tissues and dispose in no-touch receptacle ▪ Perform hand hygiene after touching tissues ▪ Place surgical mask on patient/provider ▪ If mask cannot be used, maintain special separation (> 3 ft) if possible

Proper Hand Hygiene

Proper handwashing is the simplest yet most effective way to control disease transmission Figure 2-8. You should always wash your hands before and after contact with a patient, even if you wear gloves. The longer the germs remain with you, the greater the chance they will get through your barriers. Any breaks in the skin such as tiny cuts and abrasions are potential access points for pathogens. Although soap and water are not protective in all cases, in certain cases they provide excellent protection against further transmission from your skin to others.

Figure 2-8 When washing hands, rub your hands together for at least 20 seconds to work up a lather. Pay particular attention to your fingernails, between fingers, and the back of the hands.

Rinse your hands using warm water. If running water is not available, you may use waterless handwashing substitutes **Figure 2-9**. These solutions can kill many potential bacterial infections. If you use a waterless substitute in the field, make sure you wash your hands using soap and water at the hospital. Finally, dry your hands with a paper towel, and use the paper towel to turn off the faucet.

Gloves

Gloves and eye protection are the minimum standard for all patient care if there is any possibility for exposure to blood or body fluids. Vinyl, nitrile, and latex gloves provide adequate protection. Your department may prefer one type of glove over the other, or you may have the freedom to choose yourself. You should evaluate each situation and choose the glove that works best. (Some patients are allergic to latex. If you suspect you are allergic, consult your supervisor for options.) Vinyl gloves may be best for situations with minimal patient contact or nonsterile procedures, and nitrile or latex gloves may be best for invasive procedures where sterility is required. Change gloves if they have been exposed to motor oil, gasoline, or any petroleum-based product. Do not use petroleum jelly with latex gloves. Wear double gloves if there is substantial bleeding. You may also wear double gloves if you will be exposed to large volumes of other body fluids. Be sure to change gloves as you move from patient to patient. For cleaning and disinfecting the unit, you should use heavy-duty utility gloves **Figure 2-10**. You should never use lightweight latex or vinyl gloves for cleaning.

Figure 2-9 Use a waterless handwashing solution if running water is not available. Be sure to wash your hands with soap and water once you arrive at the hospital.

Figure 2-10 Use heavy-duty utility gloves to clean the unit. You should not use lightweight latex or vinyl gloves for cleaning.

Removing used latex or vinyl gloves requires a methodical technique to avoid contaminating yourself with the materials on the outside of the gloves. Skill Drill 2-1.

1. Begin by partially removing one glove. With your other gloved hand, pinch the first glove at the wrist—being certain to touch only the outside of the first glove—and start to roll it back off your hand, inside out. Leave the exterior of the fingers on that first glove exposed Step 1.
2. Use the gloved fingers to pinch the wrist of the second glove and begin to pull it off, rolling it inside out toward the fingertips as you did with the first glove Step 2.
3. Continue pulling off the second glove until you can pull the second hand free Step 3.
4. With your now-ungloved second hand, grasp the exposed inside of the first glove and pull it free of your first hand and over the now-loose second glove. Be sure that you touch only clean, interior surfaces with your ungloved hand Step 4.

Gloves are the most common type of personal protective equipment (PPE). In many EMS rescue operations, you must also protect your hands and wrists from injury. You may wear puncture-proof leather gloves, with latex gloves underneath. This combination will allow you free use of your hands with added protection from blood and body fluids. Remember that soiled latex or vinyl gloves are considered medical waste and must be properly disposed. Also remember many patients have life-threatening allergies to latex gloves. Leather gloves must be treated as contaminated material until they can be properly decontaminated.

Eye Protection and Face Shields

Eye protection is important in case blood splatters toward your eyes Figure 2-11. Blood splatters are a significant possibility in most trauma situations and many medical situations. Wearing goggles is your best protection. Providers who wear prescription eyeglasses will also need additional protection for their eyes. Prescription eyeglasses offer little side protection. Contact lenses do not offer any added protection from splashing. Face shields will also provide good eye protection Figure 2-12.

Skill Drill 2-1 Proper Glove Removal Technique

Step 1

Partially remove the first glove by pinching at the wrist. Be careful to touch only the outside of the glove.

Step 2

Remove the second glove by pinching the exterior with your partially gloved hand.

Step 3

Pull the second glove inside out toward the fingertips.

Step 4

Grasp both gloves with your free hand, touching only the clean, interior surfaces.

Gowns

Occasionally, you may need to wear a gown. A gown provides protection from extensive blood splatter. Gowns may be worn in situations such as field delivery of a baby or major trauma. However, wearing a gown may not be practical in many situations. In fact, in some instances, a gown may pose a risk for injury. Your department will likely have a policy regarding gowns. Be sure you know your local policy. There are times when a change of uniform is preferred because trying to clean off contaminants is difficult and sometimes impossible without professional cleaning and disinfection or disposing of the uniform entirely.

Figure 2-11 Wear eye protection to prevent blood splatter into your eyes.

Figure 2-12 The surgical mask/face shield combination.

Masks, Respirators, and Barrier Devices

Wearing masks is a complex issue, especially in light of OSHA and CDC requirements regarding protection from tuberculosis. You should wear a standard surgical mask if blood or body fluid spatter is a possibility. If you suspect a patient has an airborne disease, you should place a surgical mask on the patient. However, if you suspect the patient has tuberculosis, place a surgical mask on the patient and a particulate air respirator, such as an N95 mask, on yourself **Figure 2-13**. If the patient needs oxygen, place a nonrebreathing mask instead of a surgical mask on the patient and set the oxygen flow rate at 10 to 15 L/min. Do not place a particulate respirator on the patient; it is unnecessary and uncomfortable. A simple surgical mask will reduce the risk of transmission of germs from the patient into the air. Use of a particulate respirator should comply with OSHA standards, which state facial hair, such as long sideburns or a mustache, will prevent a proper fit. Particulate respirators must be fit-tested to ensure their efficacy.

Although there are no documented cases of disease transmission to rescuers as a result of performing unprotected mouth-to-mouth resuscitation on a patient with an infection, you should use a pocket mask or bag-valve mask **Figure 2-14**. Mouth-to-mouth resuscitation is rarely necessary in a work situation.

Remember, outside surfaces of these devices are considered contaminated after they have been exposed to the patient. You must make sure gloves, masks, gowns, and all other PPE items that have been exposed to infectious processes or blood are properly disposed of according to local guidelines. If you are stuck by a needle, get blood or body fluids in your eye, or have significant body fluid contact with the patient, immediately report the incident to your supervisor.

Figure 2-13

Wear a particulate respirator if you treat a patient you suspect has tuberculosis.

Figure 2-14 Barrier devices such as a pocket mask provide protection when providing mouth-to-mask ventilation.

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Proper Disposal of Sharps

Be careful when handling needles, scalpels, and other sharp items. The spread of HIV and hepatitis in the health care setting can usually be traced back to careless handling of sharps.

- Do not recap, break, or bend needles. Even the most careful providers may expose themselves through an accidental needlestick.
- Dispose of all sharp items that have been in contact with human secretions in approved, closed, rigid containers Figure

2-15.

Employer Responsibilities

Your employer cannot guarantee a 100% risk-free environment. The risk of being exposed to a communicable disease is a hazard of your job. You have a right to know about diseases that may pose a risk to you. Remember, though, your risk for infection is not high; however, OSHA regulations, especially for private and federal agencies, require that all employees be offered a workplace environment that reduces the risk for exposure. Note, in some states that have their own OSHA plans, state and municipal employees must also be covered.

Figure 2-15 Properly dispose of sharps in a closed, rigid, marked container.

In addition to OSHA guidelines, other national guidelines and standards, including those from the CDC and National Fire Protection Agency (NFPA) Infection Control Standard 1581, address reducing the risk of exposure to bloodborne pathogens (disease-causing organisms) and airborne diseases. These agencies set a standard of care for all fire and EMS personnel and apply whether you are a full-time paid employee or a volunteer. It is your responsibility to know your department's infection control plan and to use it Table 2-4.

▶ Establishing an Infection Control Routine

Infection control should be an important part of your daily routine. Follow the steps in Skill Drill 2-2 to manage potential exposure situations:

1. En route to the scene, make sure that PPE is out and available Step 1.
2. On arrival, make sure the scene is safe to enter, then perform a rapid scan of the patient, noting whether any blood or body fluids are present.

3. Select the proper PPE according to the tasks you are likely to perform. Typically gloves will be used for all patient contacts **Step 2**.

Table 2-4 Components of an Infection Control Plan

Determination of Exposure Risk

- Determines who is at risk for ongoing contact with blood and other body fluids
- Creates a list of tasks that pose a risk for contact with blood or other body fluids
- Includes personal protective equipment (PPE) required by OSHA

Education and Training

- Explains why a qualified individual is required to answer questions about communicable diseases and infection control, rather than relying on packaged training materials
- Allows for an instructor able to train EMTs regarding bloodborne and airborne pathogens, such as hepatitis B and C, human immunodeficiency virus, syphilis, and tuberculosis
- Ensures the instructor provides appropriate education, which is the best means for dispelling many myths surrounding these issues

Hepatitis B Vaccine Program

- Describes the vaccine offered, its safety and efficacy, record keeping, and tracking
- Addresses the need for postvaccine antibody titers to identify patients who do not respond to the initial three-dose vaccination series

Personal Protective Equipment (PPE)

- Lists the PPE offered and why it was selected
- Lists how much equipment is available and where to obtain additional PPE
- States when each type of PPE is to be used for each risk procedure

Cleaning and Disinfection Practices

- Describes how to care for and maintain vehicles and equipment
- Identifies where and when cleaning should be performed, how it is to be done, what PPE to use, and what cleaning solution to use
- Addresses medical waste collection, storage, and disposal

Tuberculin Skin Testing/Fit Testing

- Addresses how often employees should undergo skin testing
- Addresses how often fit testing should be done to determine the proper size mask to protect the EMT from tuberculosis
- Addresses all issues dealing with particulate respirator masks

Postexposure Management

- Identifies who to notify when an exposure occurs, forms to be filled out, where to go for treatment, and what treatment to give

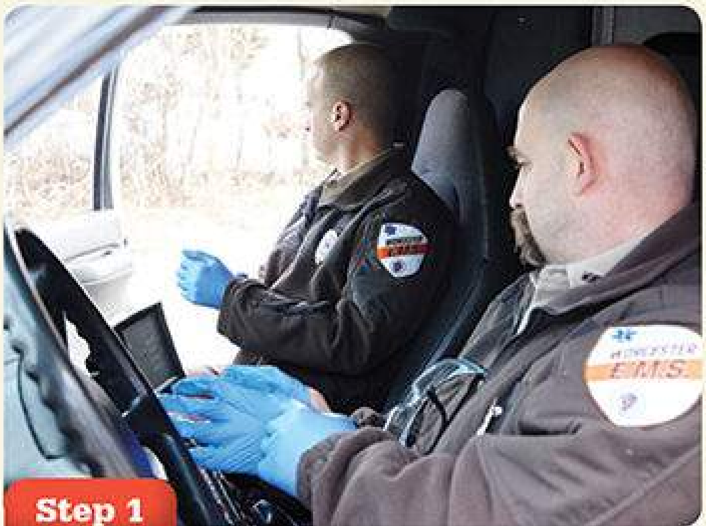
Compliance Monitoring

- Addresses how the service or department evaluates employee compliance with each aspect of the plan
- Ensures employees understand what they are to do and why it is important
- States that noncompliance should be documented
- Indicates what disciplinary action to take in the face of continued noncompliance

Record Keeping

- Lists all records to keep, how confidentiality will be maintained, and how, when, and by whom records can be accessed

Skill Drill 2-2 Managing a Potential Exposure



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Step 1

En route to the scene, make sure that PPE is out and available.

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Step 2

On arrival, make sure the scene is safe to enter, then perform a rapid scan of the patient, noting whether any blood or body fluids are present. Select the proper PPE according to the tasks you are likely to perform. Typically, gloves will be used for all patient contacts.

4. Change gloves and wash hands between patients; don PPE as quickly as possible to minimize time spent before initiating care. Remove gloves and other gear after contact with the patient, unless you are in the patient compartment. Remember that good hand hygiene is always necessary.
5. Limit the number of people who are involved in patient care if there are multiple injuries and a substantial amount of blood at the scene.
6. If you or your partner is exposed while providing care, try to relieve one another as soon as possible so that you can seek care, including basic first aid care such as cleaning and dressing a wound. Notify the designated officer and report the incident. This will also help to maintain confidentiality for both the patient and for you.

Be sure to routinely clean the ambulance after each run and on a daily basis. Cleaning is an essential part of the prevention and control of communicable diseases, ensuring removal of surface organisms that may remain in the unit. You should clean your unit as quickly as possible so it can be returned to service. Address the high-contact areas, including surfaces that were in direct contact with the patient's blood or body fluids or surfaces that you touched while caring for the patient after having contact with the patient's blood or body fluids. More information about decontaminating the ambulance can be found in Chapter 37, *Transport Operations*.

Whenever possible, cleaning should be done at the hospital. If you clean the unit back at the station, make sure you have a designated area with good ventilation. Any medical waste should be put in a red biohazard bag and disposed of at the hospital whenever possible. Any contaminated equipment that is left with the patient at the hospital should be cleaned by hospital staff or put in a red bag for transport and cleaning at the station.

You can use a bleach and water solution at a 1:10 dilution to clean the unit. The solution you mix should not have a strong odor of bleach if mixed correctly. A hospital-approved disinfectant that is effective against *Mycobacterium tuberculosis* can also be used. Use the cleaning solution in a bucket or use a pistol-handled spray container. Do not use alcohol or aerosol spray products to clean the unit. Pay attention to disinfectant directions.

Bleach solutions and most disinfectant agents will require air drying to be effective. Do not routinely go back over sprayed surfaces and dry them. Allow the sprayed surfaces to air dry unless otherwise indicated in the product directions.

Remove contaminated linen and place it into an appropriate bag for handling. Each hospital may have a different system for handling contaminated linen; you should learn hospital or department protocols Figure 2-16.

Figure 2-16 Contaminated linen and other wastes should be bagged appropriately and disposed of according to your local protocols.

Any reusable medical equipment should be properly cleaned and sterilized per your department's standard operating procedures. Keep in mind that in hospitals entire departments are devoted to sterilizing medical instruments. Proper sterilization requires the right tools and the right skills, so always carefully follow your department's procedures.

Learn the regulations defining medical waste in your area. The disposal of infectious waste, such as needles, sharps, and heavily soiled dressings, may vary from hospital to hospital and from state to state.

Immunity

Even if germs do reach you, you are not necessarily at risk for infection. For example, you may be **immune**, or resistant, to those particular germs. Immunity is a major factor in determining which **hosts** (the organism or the individual that is attacked by the infecting agent) become ill from which germs Table 2-5. One way to gain immunity from many diseases today is to be immunized, or vaccinated, against them. Vaccinations have almost eliminated some childhood diseases, such as measles and polio.

Another way in which the body becomes immune to a disease is to recover from an infection from that germ. Afterward, the body's immune system recognizes and repels that germ when it shows up again. Once exposed, healthy people will develop lifelong immunity to many common pathogens. For example, a person who contracts and becomes infected with the hepatitis A virus may be ill for several weeks, but because immunity will develop, the person will not get the illness again; however, sometimes, the immunity is only partial. Partial immunity protects against new infections. But germs that remain in the body from the first illness may still be able to cause the same disease again when the body is stressed or has some impairment in its immune system. For example, tuberculosis can cause a mild, unnoticeable infection before the body builds up a partial immunity. If the infection is never treated, the infection may be reactivated when immunity is weakened; however, these people are protected against a new infection from another person.

YOU are the Provider — PART 2

You arrive at the scene, enter the residence, and find two EMRs performing cardiopulmonary resuscitation (CPR) on the child, a 4-year-old girl. The child's mother tells you that when she went to wake up her daughter, she was unconscious and not breathing. She called 9-1-1 and started CPR. Your partner quickly assesses the child and asks you to open the jump kit.

Recording Time: 0 Minutes	
Appearance	Cyanotic; motionless
Level of consciousness	Unconscious and unresponsive
Airway	Small amount of vomitus in her mouth
Breathing	Absent
Circulation	Carotid pulse, absent; skin, cool and cyanotic

With CPR continuing, your partner prepares the cardiac monitor and asks you to suction the child's mouth and manage her airway. You quickly and effectively accomplish your assigned task, but notice that you are sweating profusely and can feel your heart racing.

2. What is stress? How does it manifest?
3. What phase of the stress response are you experiencing right now?

Table 2-5 Immunity to Infectious Diseases

Type of Immunity	Characteristics	Examples	Comments
Lifelong	The illness will not recur.	Measles Mumps Polio Rubella Hepatitis A Hepatitis B	Infection or vaccination provides long-term immunity from getting a new infection. A live vaccine is required only for measles.
Partial	The person who has recovered from a first infection is unlikely to get a new infection from another person but may develop illness from germs that lie dormant from the initial infection.	Chickenpox Tuberculosis	Infection provides lifelong immunity to the patient from acquiring a new infection, but the original illness may recur, or it may recur in a different way. In the case of chickenpox, which is caused by the herpes zoster virus, an infection may recur years later in the form of shingles.
None	Exposure confers no protection from reinfection. The infection may wear down the patient's resistance.	Gonorrhea Syphilis Human immuno-deficiency virus (HIV) infection	No vaccine is available. Repeated infections are common. For example, there is effective immediate treatment for gonorrhea, and the germs may be eradicated; however, reinfection is likely if the high-risk practices continue (eg, unprotected sex). For syphilis, the lack of immunity allows the germs to continue to cause damage within the host.

Humans seem unable to mount an effective immune response to some infections, such as HIV, which is an infection with the human immunodeficiency virus that can progress to acquired immunodeficiency syndrome (AIDS).

Although hepatitis A immunization is not required by OSHA, you may wish to be vaccinated as a preventive measure. Hepatitis A vaccination is not necessary if you have had hepatitis A in the past. All these vaccines are effective and rarely cause side effects.

Remember, germs that cause no symptoms in one person may cause serious illness in another.

Immunizations

As an EMT, you are at risk for acquiring an infectious or communicable disease. Using basic protective measures can minimize the risk. You are responsible for protecting yourself, so take an active role in achieving that goal.

Prevention begins by maintaining your personal health. Annual health examinations should be required for all EMS personnel. A history of all your childhood infectious diseases should be recorded and kept on file. Childhood infectious diseases include chickenpox, mumps, measles, rubella, and whooping cough. You must be immunized against these diseases unless you already had the disease or have been previously vaccinated against it.

OSHA has developed requirements for protection from occupational exposure to bloodborne pathogens and needlesticks. Each employer whose employees may reasonably be expected to come in contact with blood or other potentially infectious materials must develop an infection control plan designed to minimize occupational exposure. As part of these requirements, employers are required to offer the hepatitis B vaccine at no cost to employees with risk of occupational exposure. Employees who decline the vaccine must sign a waiver indicating their refusal to take the vaccine and may later decide to take the vaccine at the employer's expense. Further, the CDC recommends the following immunizations for health care workers:

- Hepatitis B (as required by OSHA)
- Influenza (yearly)
- Measles, mumps, and rubella (MMR) (typically a one-time vaccination)
- Varicella (chickenpox) vaccine or having had chickenpox
- Tetanus, diphtheria, pertussis (Tdap) (every 10 years)

Most of these vaccinations are given to infants and children as part of their routine series of immunizations. It is imperative that you keep all these vaccinations up to date to help protect you as well as your family and patients. Health care workers who are routinely exposed to meningitis (often those who work in an institutional setting) should receive one dose of meningococcal vaccine.

Another vaccine being investigated is *Staphylococcus aureus*. This vaccine is not currently on the CDC list of recommended vaccines, but may be included soon. You should also have a skin test for tuberculosis before you begin working as an EMT. The purpose of this test is to identify anyone who has been exposed to tuberculosis in the past. Testing should be repeated yearly.

If you know you will be transporting a patient who has a communicable disease, you have a definite advantage. This is when information in your health record will be valuable. If you have already had the disease or been vaccinated, you are not at risk. However, you will not always know whether a patient has a communicable disease. Therefore, you should always follow standard precautions if there is the possibility of exposure to blood or other body fluids.

General Postexposure Management

The likelihood of you becoming infected during routine patient care is low. In the event that you are exposed to blood or other body substances despite all of your precautions, there are still preventative measures that you can take to protect your health. If you are exposed to a patient's blood or bodily fluids, first turn over patient care to another EMS provider. When it is safe to do so, clean the exposed area with soap and water. If your eyes were exposed, rinse them with water for at least 20 minutes as soon as possible.

Next, activate your department's infection control plan. This usually involves contacting a supervisor or your department's infection control officer to assist you. This person will help you to navigate the postexposure protocols.

You will need to be screened to determine if there was a significant exposure to possible bloodborne pathogens. Just because you were exposed to a patient's blood or body fluids does not mean that there is a risk of infection. Typically, you will need a follow-up evaluation by a physician to determine if a significant exposure occurred. If the exposure was significant, blood may be drawn from both you and the patient to determine if any infectious agents were present.

You will have to complete an exposure report. Questions in the report may include: When did the event happen? What were you doing when you were exposed? What did you do after you were exposed? Completing this paperwork will help relay critical information to the right people, resulting in help for you and possibly new protocols to help prevent another incident in the future.

Time is important! If you are exposed, let your supervisor or infection control officer know immediately. Some diseases will act quickly whereas others may lay dormant for a long time. The best way to reduce your risk of contracting a work-related disease is through early activation of your department's infection control plan.

Words of Wisdom

You should be aware of the procedures you are required to follow if you are involved in an exposure during your clinical or field experience. If you don't know, ask your instructor.

Scene Safety

The personal safety of all those involved in an emergency situation is very important. In fact, it is so important that it is best you internalize the steps necessary to preserve personal safety so your actions become automatic. A scene that appears safe initially can develop into a hazardous situation at any moment. Take care to notice any suspicious person or activity at the scene, as your first priority is your own safety. A second accident at the scene or an injury to you or your partner creates more problems. Delays in emergency medical care for patients increase the burden on other EMTs and may result in unnecessary injury or death.

You should begin protecting yourself as soon as you are dispatched. Before you leave the scene, begin preparing yourself mentally and physically. Make sure you wear seat belts (including both the lap belt and shoulder harness) en route to the scene. Also make sure to wear seat belts and shoulder harnesses at all times during transport unless patient care makes it impossible **Figure 2-17**. Don the appropriate PPE prior to departing the ambulance. Many EMS units have mandatory seat belt policies for the driver at all times, for all EMTs during transit to the scene, and for anyone who is riding with a patient.

Safety Tips

An important safety measure is to always wear seat belts in the ambulance, including when you are en route to the scene and during transport.

Protecting yourself at the scene is also very important. A second accident may damage the ambulance and may result in injury to you, your partner, or additional injury to the patient. The scene must be well marked **Figure 2-18**. If law enforcement has not already done so, you should make sure the proper warning devices are placed at a sufficient distance from the scene. This will alert motorists coming from both directions that a crash has occurred. When you must work in a traffic lane, park a heavy vehicle such as a fire engine (if available) in a position that blocks traffic in the lane where you are working. Park the ambulance at a safe but convenient distance from the scene. Before attempting to access patients who are trapped in a vehicle, check the vehicle's stability. Then take any necessary measures to secure it. Do not rock or push on a vehicle to find out whether it will move. This can overturn the vehicle or send it crashing into a ditch. If you are uncertain about the safety of a crash scene, wait for appropriately trained personnel to arrive before approaching.

Figure 2-17 Wear seat belts and shoulder harnesses whenever you are riding in the ambulance, including when you are responding on a call.

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When working at night, you must have plenty of light. Poor lighting increases the risk of injury to both you and the patient. It also results in poor emergency medical care. Wearing reflective emblems or clothing will help to make you more visible at night and decrease your risk of injury **Figure 2-19**.

Scene Hazards

In the course of your career as an EMT, you will be exposed to many hazards. Some situations will be life threatening. In these cases, you must be properly protected, or you must take steps to avoid the hazard completely.

Hazardous Materials

Your safety is the most important consideration at a hazardous materials incident. On your arrival, you should look at the scene and try to read any labels, placards, and identification numbers from a distance, perhaps using binoculars. Placards are used on transportation vehicles and buildings, and labels are used on individual packages containing hazardous materials. The placards or labels are colored and diamond-shaped **Figure 2-20**. You should never approach any object marked with a placard or label. Remember, some hazardous materials may not be properly marked.

Figure 2-18 Make sure the crash scene is well marked to prevent a second crash that may damage the ambulance or result in injury to you, your partner, or the patient.

Figure 2-19 The ANSI (American National Standards Institute) and ISEA (International Safety Equipment Association) require EMS personnel to wear reflective vests or clothing that meet Class 2 or 3 standards on roadways. You can also wear emblems or clothing to help make you more visible at night and improve your safety in the dark.

A specially trained and equipped hazardous materials team will be called to the scene to handle disposal of materials and removal of patients. You should not begin caring for patients until they have been moved away from the scene and are decontaminated or the scene is safe for you to enter.

The US Department of Transportation (DOT) Emergency Response Guidebook isan important resource when dealing with a hazardous materials incident **Figure 2-21**. It lists common hazardous materials and the proper procedures for scene control and the emergency care of patients. Some state and local government agencies may also have information about hazardous materials commonly present in their areas. A copy of the guidebook and other information relevant to your area should be available in your unit or at the dispatch center; you can also download a copy at the US DOT Pipeline and Hazardous Materials Safety Administration website. With these references, you should be able to begin proper emergency management as soon as the hazardous material is identified. Do not go into an area and risk exposure to yourself or your partner.

Safety Tips

There are all kinds of things that can injure you when you are caring for patients. Your best protection against being injured is to carefully size up the scene and constantly check for potential hazards. Don't be foolish and blindly rush in before conducting a proper assessment.

The following are general guidelines you should follow when dealing with scenes involving hazardous materials:

- Do not enter the scene if there is evidence of hazardous materials.
- Remain upwind and uphill of the scene.

- Keep your distance. This may mean retreating if you become aware of the true nature of the situation.
- Quickly contact dispatch.
- Request additional resources.
- Do not enter the scene until instructed to by trained hazardous materials responders.

Electricity

Electrical shock can be produced by human-made sources (power lines) or natural sources (lightning). No matter what the source, you must evaluate the risk to you and your patient before you begin patient care.

Power Lines. Do not touch downed power lines. Dealing with power lines is beyond the scope of EMT training. You should mark off a danger zone around the downed lines. Energized, or live, power lines, especially high-voltage lines, behave in unpredictable ways. You need in-depth training to operate the equipment that is used in an electrical emergency. The equipment has specific storage needs and requires careful cleaning. Dirt or other contaminants can make this equipment useless or dangerous.

At the scene of a motor vehicle crash aboveground and below-grade power lines may become hazards. Disrupted overhead wires are usually a visible hazard. You must be very careful even if you do not see sparks coming from the lines. Visible sparks are not always present in charged wires. The area around downed power lines is always a danger zone. This danger zone extends well beyond the immediate accident scene.

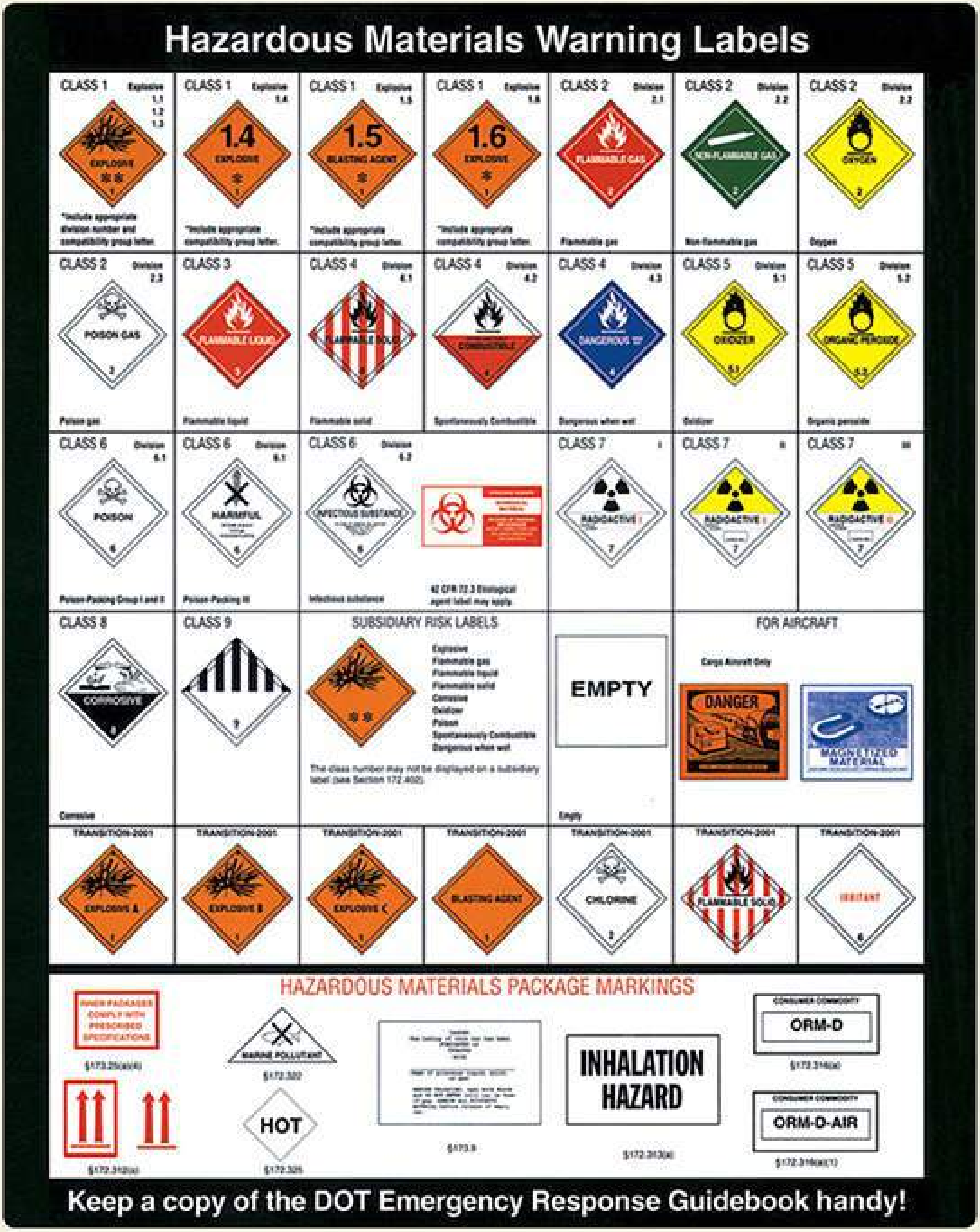

Figure 2-20 Hazardous materials safety placards and labels are colored and diamond-shaped.

Courtesy of the U.S. Department of Transportation.

Use the utility poles as landmarks for establishing the perimeter of the danger zone. The danger zone must be a restricted area. Remember, the safety zone is one span of the power pole's distance. Only emergency personnel, equipment, and vehicles are allowed inside this area. Do not approach downed wires or touch anything that downed wires are in contact with until qualified personnel have concluded that no risk of electrical injury exists. This may mean you are unable to access a severely injured victim of a motor vehicle crash even though you can see and talk to him or her.

If you must enter this type of situation, be sure to wear the proper protective equipment according to the type of incident. A helmet and turnout gear **Figure 2-22** are typically required, but you cannot count on turnout gear for protection from electrical hazards. Other protective equipment may be needed.

Lightning. Lightning is a complex natural phenomenon. It is unwise to think that lightning never strikes in the same place twice. If the right conditions remain, a repeat strike in the same area can occur.

Lightning is a threat in two ways: through a direct hit and through ground current. After the lightning bolt strikes, the current drains along the earth, following the most conductive pathway. Although you should avoid high ground to avoid a direct strike, to avoid being injured by a ground current, stay away from drainage ditches, moist areas, small depressions, and wet ropes. If you are involved in a rescue operation, you may need to delay rescue until the storm passes. Recognize the warning signs just before a lightning strike. As your surroundings become charged, you may feel a slight tingling sensation on your skin, or your hair may even stand on end. In this situation, a strike may be imminent. Move immediately to the lowest possible area.

If you are caught in an open area, make yourself the smallest possible target for a direct hit or for ground current. To avoid being hit by the initial strike, stay away from projections from the ground, such as a single tree. Drop all equipment, particularly metal objects, that project above your body. Avoid fences and other metal objects. These structures can transmit current from the initial strike over a long distance. Position yourself in a low crouch. This position exposes only your feet to the ground current. If you sit, both your feet and your buttocks are exposed. Place an object made of nonconductive material, such as a blanket, under your feet. Get inside a car or your unit, if possible, as vehicles will protect you from lightning.

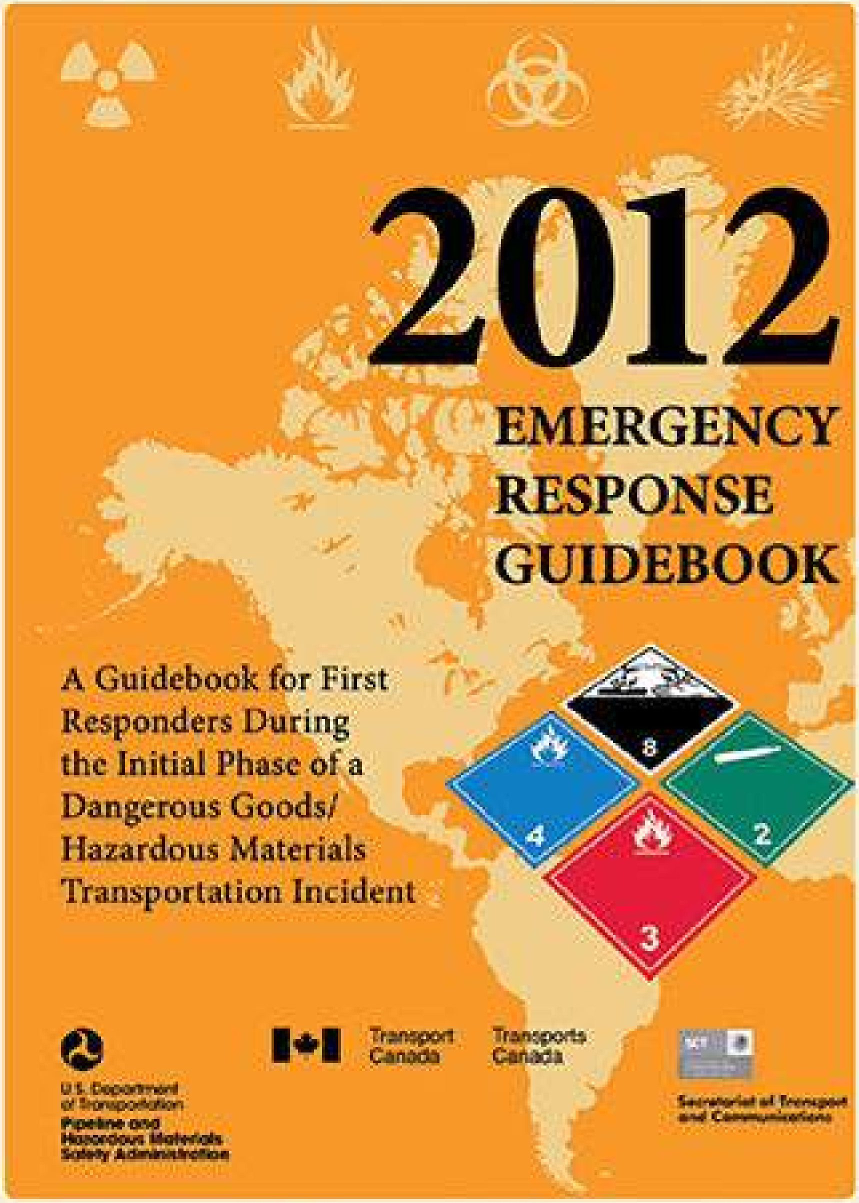

Figure 2-21 The DOT *Emergency Response Guidebook* lists many hazardous materials and the proper procedures for scene control and emergency care of patients.

Courtesy of the U.S. Department of Transportation.

Fire

You will often be called to the scene of a fire. Therefore, you should understand some basic information about fire, if you do not know it already. There are seven common hazards in a fire:

- Smoke
- Oxygen deficiency
- High ambient temperatures
- Toxic gases
- Building collapse
- Equipment
- Explosions

Figure 2-22 Wear a helmet made of a certified electrical nonconductor material, making sure that the chin strap is fastened securely.

Smoke is made up of particles of tar and carbon. These particles irritate the respiratory system on contact. Most smoke particles are trapped in the upper respiratory system, but many smaller particles enter the lungs. Some smoke particles not only irritate the airway, but may also be deadly. You must be trained in the use of appropriate airway protection, such as a disposable short-term device, or, if you are a fire fighter, a self-contained breathing apparatus, and have it available at all fire scenes **Figure 2-23**.

Fire consumes oxygen. Particularly in confined spaces fire may consume most of the available oxygen. This will make breathing difficult for anyone in that space. The high ambient temperatures in a fire can result in thermal burns and damage to the respiratory system. Breathing air that is heated above 120°F (49°C) can damage the respiratory system.

A typical building fire emits a number of toxic gases, including carbon monoxide, cyanide, and carbon dioxide. Carbon monoxide is a colorless, odorless gas that is responsible for more fire deaths each year than any other by-product of combustion. Carbon monoxide combines with the hemoglobin in your red blood cells about 200 times more readily than does oxygen. It blocks the ability of the hemoglobin to transport oxygen to your body tissues. Cyanide is a product of the combustion of many materials that burn. Inhaling cyanide prevents cells from using oxygen. In sufficiently high concentrations, it causes signs and symptoms of shock and severe hypoxia leading to death. Carbon dioxide is also a colorless, odorless gas. Exposure causes increased respirations, dizziness, and sweating. Breathing concentrations of carbon dioxide greater than 10% to 12% will result in death within a few minutes.

Figure 2-23 EMTs who are also fire fighters should be trained in the use of self-contained breathing apparatus and have it available if working near fire scenes.

During and after a fire, there is always a possibility that all or part of the burned structure will collapse. Often, there are no warning signs. As an EMS provider, you should never enter a burning building without proper breathing apparatus and approval. Always follow the instructions of the incident commander and safety officer at the scene, and never undertake any task (ie, enter a burning structure or initiate search and rescue) unless you have been properly trained to do so. Hasty entry into a burning structure may result in serious injury and possibly death. Once inside a burning building, you are subject to an uncontrolled, hostile environment. Fires are not selective about their victims. You must be extremely cautious whenever you are near a burning structure or one in which a fire has just been placed under control.

Fuel and fuel systems of vehicles that have been involved in crashes are also a hazard. Although this rarely happens, any leaking car fuel may ignite under the right conditions. If you see or smell a fuel leak, or people are trapped in the vehicle, you must coordinate appropriate fire protection equipment. Gasoline and other auto fluids are considered hazardous materials.

Make sure you are properly protected if there is or has been a fire in the vehicle. Wear appropriate respiratory protection and thermal protection because the smoke from a vehicle fire contains many toxic by-products. The use of appropriate protective gear at a crash scene can reduce your risk of injury. Avoid using oxygen in or near a vehicle that is smoking, smoldering, or leaking fuel.

Vehicle Crashes

Vehicle crashes are common events for EMS providers. These environments provide some of the most unstable and potentially lethal situations you will face. Traffic hazards are the first risk to consider. As you drive your ambulance to the scene of the crash, it is important to keep several things in mind. What is the flow of traffic near and around the crash? How will you safely leave and move about the scene? Ideally, you should park your ambulance in a manner where you can easily leave the scene. Keep in mind that additional fire, rescue, and police vehicles may also be parked in the same area or they may be blocking your exit. Hydraulic and hose lines are just two examples of common blockages you may encounter.

If you are the first to arrive at the scene, use the ambulance itself as a shield to protect the scene. The ambulance can be relocated for easier exit once additional help arrives. Park at least 100 feet away from all crash sites.

As you approach the scene, be very conscious about the flow of traffic. If needed, request police assistance to shut down the roadway. This will ensure a safe scene as you work with patients. Be aware of any fluids leaking from the vehicles because they can be flammable. A more common problem with leaking fluids is slipping and sliding on the roadway.

How is the vehicle positioned? Is it stable? Cars and trucks can come to rest in a wide array of positions. As the center of gravity of the vehicle is raised, its ability to fall onto you increases. The standard approach for all vehicle crashes should be for firefighters to first stabilize the vehicle to ensure safety for the passengers and any EMS providers.

Are there other hazards such as power lines? Downed lines can generate lethal electrical charges many feet away from vehicle crashes. If there are lines down, you should assume they are power lines, and do not approach. Call for additional resources to manage this hazard. Be aware that most electrical companies will not shut down power to the grid. Though this seems like a logical solution, many injuries can be caused by an unscheduled power outage. If people in their homes are on ventilators or other lifesaving medical devices, this could create another emergency situation when the power is shut off.

Look closer at the scene. Where are the occupants? Does violence appear to be present? Is there a good risk of violence? As you look at the vehicle, are there weapons inside? Do the passengers look suspicious? If you feel there may be violence or if violence is obvious, have the police dispatched to assist you.

With proper equipment and training, you may enter the vehicle itself. Air bags can be another hazard. If the air bag has not deployed, there is a risk that it may accidently activate while you are in the vehicle. Air bags are typically rendered inoperable by the fire department when the power is cut from the car battery.

Your protective clothing will help you to remain safe while working in and around the vehicle crash. The risk of injuries from glass and sharp metal objects cannot be underestimated. Make sure if you are working inside the vehicle you have sufficient protective gear.

Protective Clothing: Preventing Injury

Wearing protective clothing and other appropriate gear is critical to your personal safety. Become familiar with the protective equipment that is available to you. Then you will know what clothing and gear are needed for the job. You will also be able to adapt or change items as the situation and environment change. Remember, protective clothing and gear provide protection only when they are in good condition. It is your responsibility to inspect your clothing and gear. Learn to recognize how wear and tear can make your equipment unsafe. Be sure to inspect equipment before you use it; ideally, this is done before reaching the scene so care is not delayed.

Clothing that is worn for rescue must be appropriate for the activity and the environment where the activity will take place. For example, turnout gear worn for firefighting may be too restrictive for working in a confined space. In every situation involving blood and/or other body fluids, follow standard precautions. You must protect yourself and your patient by wearing gloves and eye protection, as well as any additional protective clothing that may be needed. EMS coats should provide a body fluids barrier if they were purchased after 1998.

Safety Tips

The American National Standards Institute (ANSI) requires all EMS providers to utilize a high-visibility public safety vest while on or near the roadway.

YOU are the Provider — PART 3

The cardiac monitor reveals the child does not have cardiac activity (asystole). With CPR ongoing, your partner intubates the child and an intravenous (IV) line is inserted. The child's mother, who is standing back watching your efforts, is crying and keeps yelling at you, "Why isn't my daughter waking up! Why aren't you saving her!"

Recording Time: 5 Minutes	
Respirations	Absent
Pulse	Absent
Skin	Cool and cyanotic

Blood pressure	Not obtainable
Oxygen saturation (Spo_2)	Not obtainable

4. How should you respond to the mother?
5. What stage of the grieving process is the mother experiencing?

Cold Weather Clothing

When dressing for cold weather, you should wear several layers of clothing. Multiple layers provide much better protection than a single thick cover. You have more flexibility to control your body temperature by adding or removing a layer. Cold weather protection should consist of at least the following three layers:

1. A thin inner layer (sometimes called the transport layer) next to your skin. This layer pulls moisture away from your skin, keeping you dry and warm. Underwear made of polypropylene or polyester material works well. Wool is the best fiber. The goal is to wick moisture away from the skin.
2. A thermal middle layer of bulkier material for insulation. Wool has been the material of choice for warmth, but newer materials, such as polyester pile, are also commonly used.
3. An outer layer that resists chilling winds and wet conditions, such as rain, sleet, or snow. The two top layers should have zippers to allow you to vent some body heat if you become too warm.

When choosing protective clothing, you should pay attention to the type of material from which it is made. Cotton should be avoided in cold, wet environments. Cotton tends to absorb moisture, causing chilling from wetness. For example, if you wear cotton trousers and walk through wet grass, the cotton soaks up the moisture from the grass. This will chill you in cold weather. However, cotton is appropriate in warm, dry weather because it absorbs moisture and pulls heat away from the body.

As an outer layer in cold weather, you might consider plastic-coated nylon, as it provides good waterproof protection. However, it can also hold in body heat and perspiration, which makes you wet both inside and out. Newer, less airtight materials allow perspiration and some heat to escape while the material retains its water resistance. Avoid flammable or meltable synthetic material anytime there is any possibility of fire.

Turnout Gear

Turnout or bunker gear is a fire service term for protective clothing designed for use in structural firefighting environments **Figure 2-24**. Turnout gear provides some protection by using different layers of fabric or other material to provide protection from the heat of fire. It also helps to reduce trauma from impact or cuts and keeps water away from the body. Like most protective clothing, turnout gear adds weight and reduces range of motion to some degree.

Figure 2-24 Turnout or bunker gear is protective clothing designed for use in firefighting.

The exterior fabrics provide increased protection from cuts and abrasions. They also act as a barrier to high external temperatures. In cold weather, an insulated thermal inner layer of material that helps to retain body heat is recommended.

Turnout gear or a bunker jacket provides minimal protection from electrical shock. However, it does protect you from heat, fire, possible flashover, and flying sparks. The front opening of the jacket should be fastened, and the jacket should be worn with the collar up and closed in front to protect your neck and upper chest. Proper fit is important so that you can move freely.

Gloves

Firefighting gloves provide the best protection from heat, cold, and cuts **Figure 2-25**. Yet these gloves reduce manual dexterity. In addition, firefighting gloves will not protect you from electrical hazards. In rescue situations, you must be able to freely use your hands to operate rescue tools, provide patient care, and perform other duties. Wearing puncture-proof leather gloves and latex gloves underneath will permit free use of your hands and offer added protection from both injury and body fluids.

Figure 2-25 Firefighting gloves protect your hands and wrists from heat, cold, and injury.

Helmets

You should wear a helmet any time you are working in a fall zone. A fall zone is an area where you are likely to encounter falling objects. The helmet should provide top and side impact protection. It should also have a secure chin strap **Figure 2-26**. Objects will often fall one after another. If the strap is not secure, the first falling object may knock off your helmet. This leaves your head unprotected as the remaining objects fall.

Construction-type helmets are not well suited for rescue situations. They offer minimal impact protection and have inadequate chin straps. Modern fire helmets offer impact protection. However, the projecting brim at the back of the neck may get in your way in a rescue situation. In cold weather, a great loss of body heat occurs if you are not wearing a hat or helmet. An insulated hat made from wool or a synthetic material can be pulled down over the face and the base of the skull to reduce heat loss in extremely cold weather.

You should always wear a helmet with a chin strap and face shield in situations involving electrical hazards. The shell of the helmet should be made of a certified electrical nonconductor. The chin strap should not stretch. In fact, it should fasten securely so the helmet stays in place if you are knocked down or a power line hits your head. You should also be able to lock the face shield on the helmet. This will protect your face and eyes from power lines and flying sparks. A standard fire turnout helmet should meet all of these needs.

Figure 2-26 A helmet with top and side impact protection.

▶ Boots

Boots should protect your feet. They should be water resistant, fit well, and be flexible so that you can comfortably walk long distances. If you will be working outdoors, you should choose boots that cover and protect your ankles, keeping out stones, debris, and snow. Steel-toed boots are preferred **Figure 2-27**. In cold weather, your boots must also protect you from the cold. Leather is one of the best materials for boots. However, other materials, such as any waterproof, windproof, and breathable fabrics, are also very good. The soles of your boots must provide traction. Lug-type soles may grip well in snow, but they become very slippery when caked with mud.

Figure 2-27 Boots should cover and protect your ankles keeping out stones, debris, and snow. Steel-toed boots are preferred.

Properly fitted boots and shoes are extremely important, because a minor annoyance can develop into a disabling injury. Painful blisters may develop if your feet slip around inside your boots, so, make sure you have enough room to wiggle your toes.

Boots should be puncture-resistant, protect the toes, and provide foot support. It may be difficult to obtain a good fit with firefighting boots; shoe inserts or sock layering may be needed to ensure a comfortable fit. Make sure the tops of your boots are sealed off to keep rain, snow, glass, or other materials from getting into your boots. Moisture increases blistering—wool or wicking socks help prevent feet from becoming wet.

Socks will keep your feet warm and provide some cushioning for you as you walk. In cold weather, two pairs of socks are generally preferable to one thick pair. A thin sock next to the foot helps to wick perspiration away to a thicker, outer sock. This tends to keep your feet warmer, drier, and generally more comfortable. When you purchase new shoes or boots, you may want to try them on while wearing the two pairs of socks to ensure a proper fit.

Eye Protection

The human eye is very fragile, and permanent loss of sight can occur from very minor injuries. You need to protect your eyes from blood and other body fluids, foreign objects, plants, insects, and debris from extrication. You may wear eyeglasses with side shields during routine patient care.

However, when tools are being used during extrication, you should wear a face shield or goggles. In these instances, prescription eyeglasses do not provide adequate protection. In snow or white sand, particularly at higher altitudes, you must protect your eyes from ultraviolet exposure. Specially designed eyeglasses or goggles can provide this. In addition, your eye protection must be adaptable to the weather and the physical demands of the task. It is critical that you have clear vision at all times.

Ear Protection

Exposure to loud noises for long periods of time can cause permanent hearing loss. Certain equipment, such as helicopters, some extrication tools, and sirens, produces high levels of noise. Wearing soft foam industrial-type earplugs usually provides adequate protection.

Skin Protection

Your skin needs protection against sunburn while you are working outdoors. Long-term exposure to the sun increases the possibility of skin cancer. It may be considered simply an annoyance, but sunburn is a type of burn. In reflective areas such as sand, water, and snow, your risk of sunburn increases. Protect your skin by applying a sunscreen with a minimum sun protection factor (SPF) of 15.

Body Armor

The policy for most departments directs EMTs to avoid situations that may involve gun violence. EMS responders in some areas wear body armor (bulletproof vests) for personal protection. Several types of body armor are available. They range from extremely lightweight and flexible to heavy and bulky. The lighter vests do not stop large-caliber bullets. However, they offer more flexibility and are preferred by most law enforcement personnel. Lighter vests are commonly worn under a uniform shirt or jacket. The larger, heavier vests are worn on the outside of your uniform. Vests may not be practical to wear on a daily basis. They are also costly, and do not protect against rifle ammunition or stabbing attacks.

Long/Loose Hair, Rings, Jewelry

You need to be careful wearing long, unsecured hair, loose rings, and jewelry. For example, these items can become caught in machinery during extrication. Due to the multitude of unusual situations in which EMTs may find themselves, many EMS services have restrictive policies regarding hair, rings, and jewelry. You should tie hair up neatly, limit the number of rings worn, and wear only a watch on the wrist.

Caring for Critically Ill and Injured Patients

When you are caring for a critically ill or injured patient, the patient needs to know who you are and what you are doing. Let the patient know you are attending to his or her immediate needs and these are your primary concerns at this moment **Figure 2-28**. As soon as possible, explain to the patient what is going on. Confusion, anxiety, and other feelings of helplessness will be decreased if you keep the patient informed from the start. Never assume a patient cannot hear you. Avoid making unprofessional comments during resuscitation, and treat all patients with dignity and respect.

Figure 2-28 Let the patient know immediately that you are there to help.

Responses of the Critical Patient

Patients who are dying as a result of trauma, an acute medical emergency, or a terminal disease will feel threatened. That threat may be related to their concern about survival. These concerns may involve feelings of helplessness, disability, pain, and separation Table 2-6.

Anxiety

Anxiety is a response to the anticipation of danger. The source of the anxiety is often unknown, but in the case of seriously injured or ill patients, the source is usually recognizable. What may increase the anxiety are the unknowns of the current situation. Patients may ask the following questions:

- What will happen to me?
- What are you doing?
- Will I make it?
- What will my disabilities be?

Patients who are anxious may have the following signs and symptoms:

- Emotional upset
- Sweaty and cool skin (diaphoretic)
- Rapid breathing (hyperventilating)
- Fast pulse (tachycardic)
- Restlessness

Table 2-6 Concerns of the Dying, Critically Ill, or Injured Patient

▪ Anxiety
▪ Pain and fear
▪ Anger and hostility
▪ Depression
▪ Dependency
▪ Guilt
▪ Mental health problems
▪ Receiving unrelated bad news

- Tension
- Fear
- Shakiness (tremulous)

For the anxious patient, time seems to be extended; seconds seem like minutes, and minutes seem like hours. Anxiety is never helpful to a patient and can cause real physiologic harm. It is your job to do everything you can to reduce your patient's anxiety and help your patient cope with what may be the most terrifying experience in his or her lifetime.

Pain and Fear

Pain and fear are closely interrelated. Pain is often associated with illness or trauma. Fear is generally thought of in relation to the oncoming pain and the outcome of the illness or trauma. It is often helpful to encourage patients to express their pains and fears, because expression begins the process of adjustment to the pain and acceptance of the emergency medical care that may be necessary. Some patients find it difficult to openly admit their fear. The fear may be expressed as bad dreams, withdrawal, tension, restlessness, butterflies in the stomach, or nervousness. In some cases, it may be expressed as anger.

Often you may be tempted to make light of a patient's pain and fear. It is easier to say to the stroke patient, "Oh, you'll be OK," than, "I'm sure you are really scared right now because you are not able to talk, but you should know I am doing everything I can to help you." Making a connection with your patient through eye contact and the squeeze of a hand can often do more to allay fear than the most eloquent words.

Anger and Hostility

You may find your patient is expressing anger with very demanding and complaining behavior. Often, this may be related to the fear and anxiety of the emergency medical care that is being given. In other situations, the fear is so acute that the patient may want to express anger toward you or others but is unable to do so because of the dependency factor. If you find you are the target of the patient's anger, make sure you are safe; do not take the anger or insults personally. Be tolerant, and do not become defensive.

Anger may also be expressed physically, and you may be the target of the displaced aggression. If the patient or a relative becomes so emotionally upset that you are physically assaulted or you believe this could happen, back out of the situation. Such hostility must be contained. If emergency medical care is not possible under these circumstances, law enforcement intervention is required.

Depression

Depression is a natural physiologic and psychologic response to illness, especially if the illness is prolonged, debilitating, or terminal. Whether the depression is a temporary sadness or clinical depression that is long-term, there is, of course, little you can do to alleviate the pain of depression during the brief time the patient is being treated and transported. The best you can do in treating and transporting a patient experiencing depression is to be compassionate, supportive, and nonjudgmental.

Dependency

Dependency usually takes longer to develop than during the very brief relationships developed in EMS. When medical care is given to any individual, a sense of dependency may develop. Patients who are placed in this position may feel helpless and become resentful. The resentfulness may arouse feelings of inferiority, shame, or weakness. Make every attempt to remain supportive and compassionate.

Guilt

Many patients who are dying, their families, or the caregivers of those patients may feel guilty over what has happened to them. Occasionally family members or long-term caregivers may feel a degree of relief when an extended illness is finally over. That relief may later turn into guilt. Most of the time, however, no one can explain these feelings.

The magnitude of the guilt may be very great. Sometimes, feelings of guilt can result in a delay in seeking emergency medical care. Again, understanding the complex emotions that often come to the surface during times of emergency and stress may help you cope with some of the intense and often seemingly bizarre behavior you will encounter in your role as an EMT.

Mental Health Problems

As an EMT, you will be called on to treat and transport patients with mental health problems. These problems may be the cause of the patient's distress or may be caused by the stresses of physical illness or injury. Mental health problems such as disorientation, confusion, or delusions may develop in the dying patient. In these instances, the patient may display behavior inconsistent with normal patterns of thinking, feeling, or acting. Common characteristics of such behavior may include the following:

- Loss of contact with reality
- Distortion of perception—patients may have difficulty judging such common factors as time, distance, and relationships
- Regression—patients may regress to an earlier stage in their development, often infancy or childhood
- Diminished control of basic impulses and desires—patients may act out on their urges without being able to exercise the normal judgment expected of adults. For example, patients may become violent or inappropriately affectionate.
- Abnormal mental content, including delusions and hallucinations

The normal course of dying can cause a patient to seem disoriented. In some long-term situations, generalized personality deterioration may occur (see Chapter 22, *Psychiatric Emergencies,* for a discussion on mental health).

Receiving Unrelated Bad News

A patient who is in critical condition or is dying may not want to hear unrelated bad news, such as the death of someone close to him or her. Such news may depress the patient or cause the patient to give up hope.

Techniques for Communicating With the Critical Patient

Avoid Sad and Grim Comments

EMTs, other safety personnel, family members, and bystanders must avoid making grim comments about a patient's condition. Remarks such as "This is a bad one" or "The leg is badly damaged, and I think he will lose it" are inappropriate. These remarks may upset or increase the patient's anxiety and compromise possible recovery outcomes. This is especially true for the patient who may be able to hear but cannot respond.

Orient the Patient

You should expect a patient to be disoriented in an emergency situation. The aura of the emergency situation—lights, sirens, smells, and strangers—is intense. The impact and effect of injuries or acute illness may cause the patient to be confused or unsettled. It is important for you to orient the patient to his or her surroundings **Figure 2-29**. Use brief, concise statements such as "Mr. Smith, you have had an accident, and I am now splinting your arm. I am John Foxworth of the New Britain

EMS; I will be caring for you."

Be Honest

When approaching any patient, you must decide how much information each patient is able to understand and accept. You should be honest without further shocking the patient or giving unnecessary information or information that may not be understood. Simply explain what you are doing, and allow the patient to be part of the care being given; this can relieve feelings of helplessness as well as some of the fear.

Initial Refusal of Care

On occasion you may encounter a patient who refuses emergency medical care and insists you do nothing or leave him or her alone. In these cases, it is important to impress upon the patient the seriousness of his or her condition without causing undue alarm. If you say, "Everything will be okay," when it is obvious that it is not okay, you are not being truthful. Generally, seriously ill or injured patients know they are in trouble; however, many people refuse care because of their inability to pay their medical expenses. Depending on department policy, the patient may be able to make payment arrangements.

Figure 2-29 The aura of an emergency situation can be confusing and frightening to the patient.

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Allow for Hope

In trauma and acute medical conditions, patients may ask you whether they are going to die. At these times, you may feel at a loss for words. You may also know, on the basis of past experience or in view of the seriousness of the present situation, that the prognosis is poor. But it is not your decision to tell the patient that he or she is dying. Statements such as "I don't know if you are going to die; let's fight this one out together" or "I am not going to give up on you, so do not give up on yourself" can be helpful to the patient.

These statements transmit a sense of trust and hope, and they let the patient know you are doing everything possible to save his or her life. If there is the slightest chance of hope remaining, you want that message transmitted in your attitude and in the statements you make to the patient.

Locate and Notify Family Members

Many patients will be concerned and ask you to notify their family or others close to them. The patient may not be able to assist you in doing this. You should make sure an appropriate and responsible person makes an effort to locate the desired persons. Assuring the patient that someone is going to make these notifications may be a significant part of the patient's care because it will help to calm the patient.

Injured and Critically Ill Children

Injured and critically ill children who have life-threatening conditions should be cared for the same as any adult patient would, insofar as assessing airway, breathing, and circulation (ABCs) and addressing immediate life threats. Due regard should be given to variations in height, weight, and size when providing emergency medical care to pediatric patients. Because of the increased commotion and the extraordinary nature of the emergency scene for a child, it is important that a relative or responsible adult accompany the child at all times to relieve anxiety and assist in care as appropriate.

Dealing With the Death of a Child

The death of a child is a tragic and dreaded event. It will not be unusual for you to think about the fact that the dead or dying child still has a lot more to do in life and should have many more years to live. In our society, we assume only older people are supposed to die. Today, children die less frequently than they did in the past, so many people are unprepared for what they will feel when a child dies. You may think about your own children, related children, and children of close friends. And you may think, "Why should this child, who is only 5 years old, die?"

Answering the difficult questions of your own mortality will help you deal with the death of a child. Still, the death of a child will never be an easy subject to talk about. This will be especially so for the child's family, and as an EMT involved in a call that involves the death of a child, you will also likely experience stress.

One of your responsibilities may be to help the family through the initial period after the death. As an EMT, until more definitive and professional help can be arranged, you may be in the best position to help the family begin to cope with their loss. How a family initially deals with the death of a child will affect its stability and endurance. You can help a family through their initial period of grief and provide information about follow-up counseling and support services that are available.

Helping the Family

Whether the child has just died in your presence or was dead when you arrived, acknowledging the death is important. This should be done in a private place, even if that is inside an ambulance. Often, the parents cannot believe the death is real, even if they have been preparing for it, as in the case of a terminal illness such as leukemia.

Reactions vary, but shock, disbelief, and denial are common emotions and reactions. Some parents show little emotion at the initial news. If it is possible and appropriate, find a place where the mother and father can hold the child. This is important in the parents' grieving process; it helps to lessen the sense of disbelief and makes the death real. Even if the parents do not ask to see the child, you should tell them that they may do so. Your decision in permitting the parents to see the child may need some discretion on your part. For example, in the case of a traumatic death in which there is significant disfigurement of the body, that decision might have to be delayed. The delay may involve waiting for support services or contacting the family physician or others who can help the parents through this difficult situation. This situation may also involve preparing the parents for what they will see and the changes brought on by rigor mortis or asphyxiation, for example.

Sometimes, you do not need to say much. In fact, silence can sometimes be more comforting than words. You can express your own sorrow. Do not overload grieving parents with a lot of information; at this point, they cannot handle it. Nonverbal communication, such as holding a hand or touching a shoulder, may be more valuable. Let the family's actions be your guide to what is appropriate. If you sense the parents want to talk, it is important for you to encourage them to talk about their feelings.

Words of Wisdom

Patients don't care what you know until you show you care. Most patients are not technical experts. They will judge your treatment based on how you behave toward them.

Death and Dying

Life expectancy has dramatically increased. In fact over two-thirds of all deaths occur among those age 65 years and older. The number one cause of all deaths today is attributed to heart disease. According to the Centers for Disease Control and Prevention, from the age of 1 year to 44 years, trauma and unintentional injuries are the leading cause of death. Unlike in the past, the typical human encounter with death has changed. Death is less likely to occur in the home setting. Today, death occurs in the hospital, a hospice facility or a convalescent home, at the workplace, or on the highway, and death is likely to occur either quite suddenly or after a prolonged terminal illness. For these reasons, we are less familiar with death than our ancestors were. While we all know we are going to die someday, some time, we tend to deny death. Illness can be much more drawn-out and much more removed from daily life. Life support systems and impersonal care remove the whole experience of death from most people's awareness. The mobility of families also makes it less likely there will be extended family support when death does occur.

You may have significant painful personal experience with death. No matter what the frequency of response to emergency calls, death is something that every EMT will face at some time. For some of you, it may be infrequent. Others, in urban settings, may see death many times in responding to motor vehicle crashes, drug overdoses, suicides, or homicides. You may have to deal with the mass-casualty incident of an airplane crash or a hazardous materials incident. In all these situations, coming to grips with your thoughts, understandings, and adjustment to death is not only important personally, but also a function of delivering emergency medical care.

The Grieving Process

Everyone working as an EMT will experience grief at one time or another. This section discusses how to handle patient grief, as well as how to cope with your own grief that may result from a difficult call.

The death of a human being is one of the most difficult events for another human being to accept. If the survivor is a relative or close friend of the deceased, it is even more difficult. Emotional responses to the loss of a loved one or friend are appropriate and should be expected. In fact, it is expected you will feel emotional about the death of a patient. Feelings and emotions are part of the grieving process. All of us experience these feelings after a stressful situation that causes us personal pain.

In 1969, Dr Elisabeth KÃ¼bler-Ross published *On Death and Dying,* which revealed her theory on the stages of grief people go through. They are as follows:

1. **Denial.** Refusing to accept diagnosis or care, unrealistic demands for miracles, or persistent failure to understand why there is no improvement.
2. **Anger, hostility.** Projecting bad news onto the environment and commonly in all directions, at times almost at random. The person lashes out. Someone must be blamed, and those who are responsible must be punished. This is usually an ugly phase, and may even be inappropriately directed toward the EMT.
3. **Bargaining.** Attempting to secure a prize for good behavior or promising to change. "I promise to be a 'perfect patient' if only I can live until 'x' event."
4. **Depression.** Internalizing anger, hopelessness, and the desire to die. It rarely involves suicidal threats, complete withdrawal, or giving up long before the illness seems terminal. The patient is usually silent.
5. **Acceptance.** Accepting the impending death of the patient, or accepting the death of a loved one.

The stages may follow one another, occur simultaneously, or a person may jump back and forth between stages. The stages may last different amounts of time.

Even though the event (death) has not yet happened, the patient knows that it will happen. The patient has no control over this process. The patient will die whether or not he or she is ready to die. As an EMT, you may encounter situations in which the patient is close to death, and you may need to provide reassurance and emotional care.

YOU are the Provider — PART 4

The child is placed onto the stretcher and loaded into the ambulance. Her mother is secured in the front seat of the ambulance. One of the first responders drives the ambulance so that both you and your partner can continue attending to the child. With resuscitative efforts continuing, you depart the scene and proceed to the hospital. The child's condition is reassessed en route.

Recording Time: 11 Minutes

Level of consciousness	Unconscious and unresponsive
Respirations	Absent
Pulse	Absent
Skin	Cool and cyanotic
Blood pressure	Not obtainable
Spo_2	Not obtainable

6. How can poorly managed stress affect your physical well-being?
7. How can you mitigate the stress associated with the job?

What Can the EMT Do?

As patients and bystanders are grieving, you can do helpful things and make simple suggestions. Ask whether there is anything that you can do that will be of help, such as calling a relative or religious advisor. Provide gentle and caring support. Reinforcing the reality of the situation is important. This can be accomplished by merely saying to a grieving person, "I am so sorry for your loss." It is not important that you have a well-rehearsed script, for it is not likely that your exact words or consolations will be remembered. Being honest and sincere are important.

Some statements of consolation tend to be trite, and some suggest a kind of silver lining behind the clouds. Although they may be said with the intention of making the person feel better about a situation, they can also be viewed as an attempt to diminish the person's grief. The grieving person needs to be validated. Statements like these can indicate our inability to comprehend the profound sadness of grief because you have not experienced that kind of loss. If you have not experienced a death, it is okay to say so; do not pretend you have.

Attempts to take grief away too quickly are not good. If you do not know how the person really feels, you should not say so. People may be offended by responses that give advice or explanations about the death **Table 2-7**. Statements such as "Oh, you shouldn't feel that way" are judgmental. If you judge what the grieving person is feeling, it is likely that he or she will stop talking with you. People feel what people feel. It is as simple and clean as that. Remember, anger is a stage of grieving. The anger may be directed at you. The anger seems irrational to everyone but the person grieving; therefore, it is necessary that you maintain a professional attitude and let the person grieve in his or her own way.

Statements and comments that suggest action on your part are generally helpful. These statements imply a sense of understanding; they focus on the grieving person's feelings. It is not necessary to go into an extensive discussion. All you need to do is be sincere and say, "I am so sorry for your loss. I just want you to know that I am thinking about you." What people really appreciate is somebody who will listen to them. Simply ask, "Would you like to talk about how or what you are now feeling?" Then accept the response.

Table 2-7 Responding to Grief

Don't say . . .	Try instead . . .
Give it time. Things will get better.	I'm sorry for your loss.
You should not question God's will.	It is okay to be angry.
You have to get on with your life.	It must be hard to accept.
You have to keep on going.	That must be painful for you.
You can always have another child.	Tell me how you are feeling.
You're not the only one who suffers.	If you want to cry, it's okay.
The living must go on.	People really cared for . . .
I know how you feel.	

Dealing With the Patient and Family Members

There is no right or wrong way to grieve. Each person will experience grief and respond to it in his or her own way. Family members may express rage, anger, and despair. Many people will be rational and cooperative. Their concerns will usually be relieved by your calm, efficient manner. Your actions and words, even a simple touch, can communicate caring. While you must treat all patients with respect and dignity, use special care with dying patients and their families. Be concerned about their privacy and their wishes, and let them know you take their concerns seriously. However, it is best to be honest with patients and their families; do not give them false hope.

Stress Management on the Job

EMS is a high-stress job. Understanding the causes of stress and knowing how to deal with stress is critical to your job performance, health, and interpersonal relationships. To prevent stress from negatively affecting your life, you need to understand what stress is, its physiologic effects, what you can do to minimize these effects, and how to deal with stress on an emotional level.

Stress is the impact of stressors on your physical and mental well-being. Stressors include emotional, physical, and environmental situations or conditions that may cause a variety of physiologic, physical, and psychologic responses. The body's response to stress begins with an alarm response, followed by a stage of reaction and resistance, and then recovery or, if the stress is prolonged, exhaustion. This three-stage response is referred to as the general adaptation syndrome.

The physiologic responses involve the interaction of the endocrine and nervous systems, resulting in chemical and physical responses. This is commonly known as the fight-or-flight response. Positive stress, such as exercise, as well as negative forms of stress, such as shift work, long hours, or the frustration of losing a patient, all have the same physiologic manifestations. These include the following:

- Increased respirations and heart rate
- Increased blood pressure
- Dilated venous vessels near the skin surface (causes cool, clammy skin)
- Dilated pupils
- Tensed muscles
- Increased blood glucose levels
- Perspiration
- Decreased blood flow to the gastrointestinal tract

Situations that are stressful for EMS providers include the following:

- Dangerous situations
- Physical and psychologic demands
- Critically ill or injured patients
- Dead and dying patients
- Overpowering sights, smells, and sounds
- Multiple patient situations
- Angry or upset patients, family, bystanders
- Unpredictability and demands of EMS
- Noncritical/non-9-1-1 patients

As you examine this list, you will see some situations are clearly stressful: a car crash where a child is killed or a terrorist attack. Other situations may seem confusing. You may ask yourself why caring for noncritical patients is considered stressful. You need to manage a large array of patients. One person's definition of an emergency may be quite different from another's. As you begin your career in EMS, you may envision that all of your calls will be exciting life-and-death calls where you are able to save lives. In reality most patients are not critical and the care they need becomes rather routine. This can create stress in people who are unable to make the transition from the TV image of emergency medicine to its reality.

Words of Wisdom

As with most things in life, EMS comes down to balance. You need to understand that not all of the patients you care for will be critically ill or injured. This does not mean that they do not need care, only that they need a different kind of care. A thoughtful word or a hand on a shoulder can be powerful medicine. Care for each person, regardless of his or her complaint, as a person. Be satisfied with the rewards of simple compassion and you will find a home in EMS for many years to come.

A new stressor for those who work in EMS is hospital wait times. Emergency departments (EDs) around the country are dealing with greater numbers of patients. Coupled with shortages of personnel, including nurses, this increased patient load can lead to delays in care. This is where EMS comes into potential conflict. When the ambulance arrives at the hospital with a noncritical patient, the ED may not be able to accept the patient right away. As a result, you may need to sit for hours in the ED hallway, waiting for a bed to open up so your patient can be transferred. This situation can certainly generate stress.

Reactions to stress can be categorized as acute, delayed, or cumulative. **Acute stress reactions** occur during a stressful situation. You feel nervous and excited, and your ability to focus increases. This focus can be very helpful in managing a crisis situation. But if the stress of the situation becomes too great, you are at risk of being caught up in the emotional and physical reactions to stress. Picture stress as a wave in the ocean. If the crest of the wave is too high, you can potentially drown if the stress goes unrecognized and is not relieved.

Delayed stress reactions manifest after the stressful event. During the crisis, you are able to focus and function, but after things have calmed down, you may be left with nervous, excited energy that continues to build and becomes a distraction. With both acute and delayed reactions, the important question to ask yourself is how did you manage these feelings during the stressful event? Were you able to continue, managing the stress well and taking it in stride? Or, were you unable to manage the stress well, resulting in delayed stress reactions?

Cumulative stress reactions are the most important to understand. After the stressful event is over, are you able to shake off the effects? Are you still tired? Cumulative stress occurs when you are exposed to prolonged or excessive stress. You fight to remain in control and you are successful, but you are starting to grow tired. Now the next stressful situation occurs. Each time, you find it harder to recover because the effects of the previous stress are tiring.

Cumulative stress can have physical symptoms such as fatigue, changes in appetite, gastrointestinal problems, or headaches. It may cause insomnia or hypersomnia, irritability, inability to concentrate, and hyperactivity or underactivity. Additionally, it may present with psychologic reactions such as fear, dull or nonresponsive behavior, depression, guilt, oversensitivity, anger, irritability, and frustration. A fast-paced lifestyle compounds these effects by not allowing a person to rest and recover after periods of stress. Prolonged or excessive stress has been proven to be a strong contributor to heart disease, hypertension, cancer, alcoholism, and depression.

Many people are subject to cumulative stress, whereby insignificant stressors accumulate to a larger stress-related problem. In the emergency services environment (EMS, police, fire fighters), stressors may also be sudden and more severe. Some events are unusually stressful or emotional, even by EMS standards. These acute severe stressors result in what is referred to as critical incident stress. Events that can trigger critical incident stress include the following:

- Mass-casualty incidents
- Serious injury or traumatic death of a child
- Crashes with injuries, caused by an emergency services provider while responding to or from a call
- Death or serious injury of a coworker in the line of duty

Posttraumatic stress disorder (PTSD) may develop after a person has experienced a psychologically distressing event. It is characterized by reexperiencing the event and overresponding to stimuli that recalls the event. Stressful events in EMS are sometimes psychologically overwhelming. Some of the symptoms include depression, startle reactions, flashback phenomena, and dissociative episodes (eg, amnesia of the event).

A process called **critical incident stress management (CISM)** was developed to address acute stress situations and potentially decrease the likelihood that PTSD will develop after such an incident **Figure 2-30**. The process theoretically is used to confront the responses to critical incidents and defuse them, directing the emergency services personnel toward physical and emotional equilibrium. CISM can occur formally, as a debriefing for those who were on scene. In such situations, trained CISM teams of peers and mental health professionals may facilitate this. Additionally, CISM can occur at an ongoing scene in the following circumstances:

Figure 2-30 Critical incident stress management is sometimes used to help providers relieve stress.

- When personnel are assessed for signs and symptoms of distress while resting
- Before reentering the scene
- During a scene demobilization in which personnel are educated about the signs of critical incident stress and given a buffer period to collect themselves before leaving

Safety Tips

Coworkers often notice a change in behavior or attitude before a supervisor does. This is especially true in EMS, where close relationships develop between people who work together and share rooms, meals, and social interactions. Being a friend means helping a friend. Talk to your partner about changes in his or her behavior you may notice. If you are the EMT having trouble dealing with a crisis, remember, you are not alone. Talk with your partner.

Defusing sessions are the first to occur. These sessions are held during the event or immediately afterward. A group informally discusses events that they experienced together. Defusing sessions are designed to educate the participants as to the expectations over the next few days and give guidance on proper techniques to manage the feelings they may be experiencing. One example is to discourage drinking alcohol during this stressful time.

Debriefing sessions are held within 24 to 72 hours of a major incident. These meetings are held by a CISM team consisting of peers and mental health professionals. At the debriefing session, pent up emotions can be properly expressed. It is more likely you will be ready to express your emotions more freely a few days following the event.

One of the important rules associated with the debriefing session is to not turn it into an operational critique. No one is right. No one is wrong. No one is to blame. Only emotions about the specific event are to be relayed. These debriefing sessions may also have to be repeated at a later time.

CISM programs are located throughout the United States. You can locate a CISM in your area via the Internet, or it can be requested through your employer. The International Critical Incident Stress Foundation, Inc. is dedicated to limiting the effects of stress on EMS providers through education and support services. For more information, go to the Foundation's website at www.icisf.org.

CISM is an excellent service but not effective for everyone. Some providers are not receptive to openly discussing psychologically traumatic memories. When the individual's behavior is noticeably different after the event and CISM is not an option, private counseling by a mental health professional may be valuable.

Supporting patients in emergency situations is difficult. It is stressful for them and for you. You are vulnerable to all the stresses that go with your profession. It is critical that you recognize the signs of cumulative stress so it does not interfere with your work or life away from work, including your family life. The signs and symptoms of cumulative stress may not be obvious at first. Rather, they may be subtle and not present all the time Table 2-8.

Emotional Aspects of Emergency Care

At times, even the most experienced health care provider has difficulty overcoming personal reactions and proceeding without hesitation. You may have patients that need to be removed from life-threatening situations, or you need to provide life support measures to patients who are severely injured. You may also be called on to recover human remains from highway accidents, aircraft disasters, or explosions Figure 2-31. In all of these situations, you must be calm and act responsibly as a member of the emergency medical care team. You must also realize that even though your personal emotions must be kept under control, these are normal feelings. You must deal with these feelings. The struggle to remain calm in the face of horrible circumstances contributes to the emotional stress of the job.

Table 2-8 Warning Signs of Stress

- Irritability toward coworkers, family, and friends
- Inability to concentrate
- Difficulty sleeping, increased sleeping, or nightmares
- Feelings of sadness, anxiety, or guilt
- Indecisiveness
- Loss of appetite (gastrointestinal disturbances)
- Loss of interest in sexual activities
- Isolation
- Loss of interest in work
- Increased use of alcohol
- Recreational drug use
- Physical symptoms such as chronic pain (headache, backache)
- Feelings of hopelessness

Figure 2-31 As an EMT, you may be asked to recover and remove bodies from incident sites.

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Stressful Situations

Many situations, such as mass-casualty scenes, serious vehicle crashes, excavation cave-ins, house fires, infant and child trauma, amputations, abuse of an infant, child, spouse, or older person, and the death of a coworker or other public safety personnel, will be stressful for everyone involved. During these situations, you must exercise extreme professional care in both your words and your actions at the scene. Words that do not seem important, or that are said jokingly, may hurt someone. Conversations at the scene must be professional. You should not say, "Everything will be all right," or "There is nothing to worry about." A person who is trapped in a wrecked car, hurting from head to foot and worried about a loved one, knows that all is not well. What will reassure the patient is your calm and caring approach to the emergency situation. Whether you are a brand new EMT or a seasoned veteran, patients expect you to bring some sense of order and stability to the terrifying chaos that has suddenly engulfed them. Briefly explain your plan of action to assist the patient in the crisis. Inform the patient that you need his or her help and the assistance of family members or bystanders to carry out your plan of action.

How a patient reacts to injury or illness may be influenced by certain personality traits. Some patients may become highly emotional over what may seem to be a minor problem. Others may show little or no emotion, even after serious injury or illness. Many other factors influence how a patient reacts to the stress of an EMS incident. Among these factors are the following:

- Socioeconomic background
- Fear of medical personnel
- Alcohol or substance abuse
- History of chronic disease
- Mental disorders
- Reaction to medication
- Age

- Nutritional status
- Feelings of guilt
- Past experience with illness or injury

You are not expected to always know why a patient is having an unusual emotional response. However, you can quickly and calmly assess the actions of the patient, family members, and bystanders. This assessment will help you to gain the confidence and cooperation of everyone at the scene. In addition, you should use a professional tone and show courtesy, along with sincere concern and efficient action. These simple considerations will go far to relieve worry, fear, and insecurity on the part of everyone involved. Your calm reassurance will inspire confidence and cooperation. Compassion is also important, but you must be careful. Your professional judgment takes priority over compassion. For example, suppose a screaming child with no obvious life-threatening injuries is covered with another patient's blood. This frightened child appeals to your sense of compassion and thus gets your attention. In the meantime, an unconscious, nonbreathing adult nearby could die from lack of care.

YOU are the Provider — PART 5

Full resuscitative efforts are continued en route; however, the child has failed to respond to appropriate advanced life support (ALS) and basic life support (BLS) treatment. The child is reassessed and a radio report is called in to the receiving facility.

Recording Time: 18 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	Absent
Pulse	Absent
Skin	Cool and cyanotic
Blood pressure	Not obtainable
Spo_2	Not obtainable

The child is delivered to the emergency department (ED) and care is transferred to the attending physician. After an additional 15-minute period of resuscitative efforts in the ED, the child is pronounced dead. Later that evening, you find your paramedic partner in his dorm; he is crying and tells you he does not want to talk right now.

8. Does the death of a child affect the EMT or paramedic differently than the death of an adult? If so, how?
9. How can you help your partner?

Special Populations

When children are seriously ill or injured, family members and other people at the scene may be frantic. You should remain calm and confident in your skills because this may be all that is needed to provide reassurance to those at the scene.

Patients must be given the opportunity to express their fears and concerns. You can easily relieve many of these concerns at the scene. Usually, patients are concerned about the safety or well-being of others who are involved in the accident and about the damage or loss of personal property. Your responses must be discreet and diplomatic, giving reassurance when appropriate. If a loved one has been killed or critically injured, you should wait, if possible, until clergy or the ED staff can give the patient the news. They can provide the necessary psychological support the patient needs after receiving this type of news.

Words of Wisdom

Calm reassurance on your part will inspire confidence and cooperation. Compassion can also be an important component of your care, but you must be careful that your compassion does not misdirect you to provide inappropriate care. Your professional judgment needs to take priority.

Some patients, especially children and older adults, may be terrified or feel rejected when separated from family members by uniformed EMS providers. Other patients may not want family members to share their stress, see their injury, or witness their pain. It is usually best if parents are transported with their children and relatives accompany older patients. Medical attention for a child often requires adult consent. Treatment may be delayed if a caregiver is not transported with the child.

Religious customs or needs of the patient must also be respected. Some people will cling to religious medals or charms, especially if you make any attempt to remove them. Other people will express a strong desire for religious counsel, baptism, or last rites if death is near. You must try to accommodate these requests. Some people have religious convictions that strongly oppose the use of medications, blood, and blood products. If you obtain such information about your patient, it is imperative that you report it to the next level of care.

In the event of a death, you must handle the body with respect and dignity. It must be exposed as little as possible. Learn your local regulations and protocols about moving the body or changing its position, especially if you are at a possible crime scene. Even in these situations, CPR and appropriate treatment must be given unless there are obvious signs of death.

Uncertain Situations

There will be times when you are unsure whether a true medical emergency exists. In these cases, contact medical control about the need to transport. If you cannot reach medical control, it is always best to transport the patient. For both ethical and medicolegal reasons, a physician must examine all patients who are transported and judge the degree of medical need.

Words of Wisdom

It is always best to assure the patient is an active participant in the medical care he or she receives. Give your patient the information he or she needs to make an informed decision. You will find that patients who are participating in their own care are more likely to be satisfied with the care they receive.

You must also realize that even the most minor symptoms may be early signs of severe illness or injury in your patient. Symptoms of many illnesses can be similar to those of substance abuse, hysteria, or other conditions. You must accept the patient's complaints and provide appropriate care until you are able to transfer care of the patient to the next level (eg, paramedic, nurse, or physician). Your local protocols will direct your actions in these uncertain situations. When in doubt, err on the side of caution, acquire the patient's consent, and transport the patient to a medical facility.

Violent Situations

The safety of you and your team is of primary concern. Civil disturbances, large gatherings of hostile or potentially hostile people, domestic disputes, and crime scenes, especially those involving gangs, can create many hazards for EMS personnel. Several agencies will respond to large civil disturbances. In these instances, it is important for you to know who is in command and will be issuing orders **Figure 2-32**. However, you and your partner may be on your own when a group of people seems to grow larger and become increasingly hostile. In these cases, you should call law enforcement immediately if they are not already present. You may need to wait for law enforcement to arrive before you can begin treatment or safely approach a patient.

Remember, you and your partner must be protected from the dangers at the scene before you can provide patient care. Law enforcement must make sure the scene is safe before you and your partner enter. A crime scene often poses potential problems for EMS personnel. If the perpetrator is still somewhere on the scene, this person could reappear and threaten you and your partner or attempt to further injure the patient you are treating. Bystanders who are trying to be helpful may interfere with your emergency medical care. Family members may be very distraught and not understand what you are doing when you attempt to splint an injured extremity and the patient cries out that what you are doing hurts. Be sure you have adequate assistance from the appropriate public safety agency in these situations.

Sometimes EMTs will be at a scene where a dangerous situation is underway, such as a hostage situation or riot. In these instances, it may be necessary for you to be protected from projectiles such as bullets, bottles, and rocks. Law enforcement personnel will ordinarily provide for concealment or cover of personnel who are responding to the incident. **Cover** involves the tactical use of an impenetrable barrier for protection, while **concealment** involves hiding behind objects to limit a person's visibility of you. You should not be placed in a position that will endanger your life or safety during such incidents. Do not depend on someone else for your safety.

Figure 2-32 Several agencies may respond to a scene. It is important for you to know who is in command and will be issuing orders.

Remember, your personal safety is of the utmost importance. You must thoroughly understand the risks of each environment you enter. Whenever you are in doubt about your safety, do not put yourself at risk. Never enter an unstable environment, such as a shooting, a brawl, a hostage situation, or a riot. Therefore, as part of your scene size-up, evaluate the scene for the potential for violence. If further violence is a possibility, call for additional resources. Failure to do so may put you and your partner at serious risk. When appropriate, allow law enforcement personnel to secure the scene before you approach; they have the necessary experience and expertise in handling these situations.

It is important for you to remember that if you believe an event is a crime scene, you must attempt to maintain the chain of evidence. Make sure you do not disturb the scene unless it is absolutely necessary in caring for the patient.

Behavioral Emergencies

The category of behavioral emergencies covers a wide range of situations. This catchall phrase includes emergencies that do not have a clear physical cause and that result in unusual behavior. Often, the cause turns out to be physical; hypoglycemia, head trauma, hypoxia, and toxic ingestion can all cause altered mental status. Patients with psychiatric diseases, such as certain bipolar disorders or schizophrenia, may have altered sensorium or exhibit abnormal behavior.

Although most behavioral emergencies do not pose a threat to you, the potential of a threat to either the patient or yourself still exists and you should use caution.

Consider these questions as you evaluate the patient in terms of a behavioral or psychiatric emergency that may lead to a violent patient reaction:

- How does this patient respond to you? Are your questions answered appropriately? Are the patient's vocabulary and expressions what you would expect under the circumstances?
- Is the patient withdrawn or detached? Is the patient hostile or friendly? Overly friendly?
- Does the patient understand why you are there?

- How is the patient dressed? Is the dress appropriate for the time of the year and occasion? Are the clothes clean? Dirty?
- Does the patient appear relaxed, stiff, or guarded? Are the patient's movements coordinated or jerky and awkward? Is there hyperactivity? Are the patient's movements purposeful, for example, in putting on his or her clothes? Are the actions aimless, such as sitting and rocking back and forth in a chair?
- Has the patient harmed herself or himself? Is there damage to the surroundings?
- What are the patient's facial expressions? Are they bland or flat, or are they expressive? Does the patient show joy, fear, or anger to appropriate stimuli? If so, to what degree?

It might not be possible for you to gather all of the information that these questions suggest. Sometimes, a patient who is experiencing a behavioral emergency will not respond at all. In those cases, the patient's facial expressions, pulse and respirations, tears, sweating, and blushing may be significant indicators of his or her emotional state. Also see Chapter 22, *Psychiatric Emergencies*, which provides greater depth about psychiatric emergencies.

Workplace Issues

As our society continues to grow more culturally diverse, some groups that may have been satisfied in the past to accept and participate in the traditions of mainstream American cultural may seek instead to assert, preserve, and nurture their differences. And, as our society grows more culturally diverse, so do EMS workplaces. There will be challenges as these changes continue to occur. If you have any concerns working with any particular group of people, you need to address this before finishing your EMT training. You are required to provide an equal standard of care to all patients and also need to be able to work efficiently and effectively with other health care professionals from a variety of different backgrounds.

Cultural Diversity on the Job

Each individual is different, and you should communicate with coworkers and patients in a way that is sensitive to everyone's needs **Figure 2-33**. Look at cultural diversity as assets, and make the most of the differences among people in EMS, thus improving our ability to provide optimum patient care. As the public safety workplace becomes more culturally diverse, changes may occur that could be considered disruptive.

Figure 2-33 Communicate with coworkers in a way that is sensitive and respectful to individual differences.

Alternatively, failure to diversify the workforce in the face of a culturally diverse patient population can lead to cultural incompetence. Diversity is an effective way to strengthen a public safety workforce.

For many years, EMS and public safety have been dominated by Caucasian men. This trend is declining, as more women and minorities are working in public safety. The proactive EMT understands the benefits of using cultural diversity to improve patient care and expects to work alongside coworkers with varying backgrounds, attitudes, beliefs, and values and to accept their differences.

Cultural diversity in EMS allows you to enjoy the benefits of accentuating the skills of a broad range of people. When you accept each coworker as an individual, the need to fit them into rigid roles is eliminated. To be more sensitive to cultural diversity issues, you must first be aware of your own cultural background. Ask yourself, “What are my own issues relative to race, color, religion, and ethnicity?” Because culture is not restricted to different nationalities, you should also consider age, disability, gender, sexual orientation, marital status, work experience, and education.

In sports, you play to your team’s strengths. For example, in football, offensive lines have a fast side and a strong side, and they run plays toward either side depending on the situation. As part of an effective EMS team, you can make it part of your team’s culture to play to your strengths. This may be difficult to do, but once you begin the process, the benefits in terms of improved patient care are immeasurable.

It is important to strive for cultural competency with coworkers as well as patients. For example, some cultures avoid eye contact with others. Understanding the language, mannerisms, colloquialisms (eg, ordinary or local conversation), and practices that exist in the community you serve will make you a more effective EMT.

Your Effectiveness as an EMT

To be an effective EMT, you need to discover the diverse cultural needs of your coworkers, as well as your patients and their families. Although it is unrealistic to expect you to become a cross-cultural expert with knowledge about all ethnicities, you should learn how to relate effectively.

Teamwork is essential in public safety and EMS. To work effectively as a team, you need to communicate to resolve cultural diversity issues.

As a health care professional, you should strive to be a role model for new EMTs by showing them the value of diversity. If you are working with a coworker or patient from a particular cultural group, be aware of any opinion you may have formed about that group. Do not assume there is a language barrier, and do not appear patronizing by saying, “Some of my best friends are....” There are legitimate differences in how various cultures respond to stress. For example, you should be prepared to accept that people of different cultures might respond differently to the death of a loved one.

When you are working with patients or calling the hospital on the radio, other EMTs may be sensitive to how you treat patients from their cultural group. Therefore, when referring to patients, you should use the appropriate language. Avoid using terms such as, “cripple,” “deformed,” “deaf,” “dumb,” “crazy,” and “retard” to describe patients. The word “handicapped” even has a negative connotation. Instead, use the term “disabled,” and describe the specific disability.

You might want to consider taking multilingual training classes. This will not only be useful in communicating with your coworkers; it will also help improve communication with your patients and sensitize you to the cultural richness of the people who are using the language.

Even the perception of discrimination can weaken morale and motivation and negatively affect the goal of EMS. Therefore, to achieve the benefits of cultural diversity in the EMS workplace, you must understand how to communicate effectively with coworkers from various backgrounds.

Avoiding Sexual Harassment

The number of sexual harassment lawsuits skyrocketed in the 1990s because of increased media attention to the problem. Furthermore, guilty verdicts encouraged others to bring lawsuits concerning conduct that once would have gone unchallenged.

Sexual harassment is any unwelcome sexual advance, request for sexual favors, or other verbal or physical conduct of a sexual nature when submitting is a condition of employment, submitting or rejecting is a basis for an employment decision, or such conduct substantially interferes with performance and/ or creates a hostile or offensive work environment. Remember, even an overheard conversation can be construed as sexual harassment.

There are two types of sexual harassment: quid pro quo (the harasser requests sexual favors in exchange for something else, such as a promotion) and hostile work environment (jokes, touching, leering, requests for a date, talking about body parts).

Sexual harassment incidents include complaints of a hostile work environment. Remember, it does not matter the intent of the harasser. What matters is the perception of the act and the impact the behavior has on someone else. For many years, it was not uncommon to walk into a fire station and see sexually suggestive posters, calendars, or cartoons and to hear sexual jokes or comments. This situation is changing because it is not acceptable professional practice.

Because EMTs and other public safety professionals depend on each other for their safety, it is especially important for you to develop nonadversarial relationships with coworkers. Most EMS facilities and fire stations have separate bunkrooms for men and women. If this is not the case at your facility, you should discuss this with your supervisor and talk openly with coworkers of the opposite gender to allow for their privacy.

If you are concerned about a particular behavior, it may be helpful to ask yourself these questions: “Would I do or say this in front of my spouse, significant other, or parents?” “Would I want my family members to be exposed to this behavior?” “Would I want my behavior videotaped and shown on the evening news?”

If you have been harassed, you should report it according to local policy and procedure and keep notes of what happened and what was said. If you are asked to go out on a date, say, “I’m not interested.” If remarks or touching offend you, say, “Please don’t say/do that to me; it offends me.”

Substance Abuse

In the past, part of the fire service ritual was to go back to the fire station after the fire, clean and maintain the equipment, and discuss the call. At some locations, having a few beers was not uncommon. EMS today is very different from the ambulance service of 20 years ago.

Drug and alcohol use in the workplace causes an increase in accidents and tension among workers, but most important, it can lead to poor treatment decisions. EMS personnel who use or abuse substances such as alcohol or marijuana are more likely to have problems with their work habits, and their driver’s licenses may be revoked as a result. They may be absent from work more often than other workers. If the use or abuse has occurred within hours before the start of their shift, their ability to render emergency medical care may be lessened because of mental or physical impairment. Because of the seriousness of substance abuse or misuse, many EMS systems now require their personnel to undergo periodic random tests for illegal drug use. Since public safety workers depend so much on coworkers for their own safety, it is even more important that ways be found to manage this problem.

As an EMT, you will witness firsthand the tremendous effects of violence, trauma, and disease. Beyond CISM, members of the public safety community have a way of covering for each other. It is important to understand the problem behavior will usually get worse before it gets better. Unfortunately, the stereotypical image of the alcoholic or addict lying in the gutter in an urban part of town often blinds EMS personnel to the existence of a coworker's drug or alcohol problem. Not all people with a substance abuse problem fit the stereotype.

As a member of the EMS team, you are responsible for responding to the community's emergency medical needs. Hazards in the EMS workplace are many. If you or one of the members of your team has an alcohol or other drug problem, these risks are increased. Furthermore, drug use that occurs off the job does not necessarily decrease the risk if a team member is showing up at work still under the influence of substance abuse. While it varies from state to state, a drug-related or alcohol-related arrest can result in the revocation of some or all driving privileges and even loss of EMT licensure. Because of the tremendous risk potential, it is critical that you seek help or find a way to confront your partner or coworker even though there will be great pressure to allow the behavior to continue. Addicts and alcoholics are skillful at covering up their behavior. You might even decide not to bother your coworker because you feel he or she has caught too many tough calls lately and needs to blow off some steam. Do not let this happen.

Find a way to confront someone who has a substance abuse problem. Because of the tremendous hazards to patients, the public, and other team members, you have a legitimate right to confront coworkers with drug and alcohol problems.

When confronting a coworker, make it clear to the coworker that if the problem is personal, it is the coworker's responsibility to take care of it. But you also have the power to assist this person. In many workplaces, coworkers are often in a position to notice a change in a coworker's behavior or attitude before a supervisor does. This is especially true in EMS because of the close relationship that develops between people who work together for many hours and share rooms and meals. This may allow you to help someone before his or her job performance is negatively affected.

Safety Tips

Trust is your business. You will be given the privilege—and it is a privilege—to care for patients in their time of highest need. You must demonstrate that trust through consistent professionalism. Remember, you have support to help you make the right choice: your partner, your supervisor, your family.

To help reduce the potential for drug and alcohol use in the EMS workplace, become informed about alcohol and other drugs. Beyond following company policy, you and your coworkers can agree among yourselves what constitutes unacceptable behavior. The best time to confront these issues is usually after a call. Management sets the tone on these issues, but senior EMTs can also emphasize to new EMTs that drug and alcohol abuse will not be tolerated.

Employee assistance programs (EAPs) are often available for EMS personnel. These agencies are contracted with the EMS department to provide a wide array of mental health, substance abuse, crisis management, and counseling services. Talk with your supervisor about resources that are available at your EMS department. Early intervention is the best bet to ensure a safe, alcohol- and drug-free workplace.

Suicide Prevention

A combination of cumulative stress and acute, intense stress can weigh heavily on EMS providers. While awareness of EMS provider suicide has grown over the years, you should understand and select strategies to deal with stress in a constructive manner. If you encounter any suicidal ideations or if a colleague expresses such ideations, you should seek help, including professional counseling.

Injury and Illness Prevention

According to the Bureau of Labor Statistics, approximately 4.1 million serious injuries and 4,500 deaths occur in US workplaces with a direct cost of more than $50 billion each year.

Many companies, as well as EMS departments, have established injury and illness prevention programs to determine workplace hazards and implement a plan to mitigate those hazards. Each injury and illness prevention program should include these six interrelated and interdependent elements:

- Management leadership
- Worker participation

- Hazard identification and assessment
- Hazard prevention and control
- Education and training
- Program evaluation and improvement

Data show that injury and illness prevention programs pay dividends for the companies that implement them. Thirty-four states require companies to have such programs. OSHA developed a Voluntary Protection Program (VPP) to help companies actively mitigate risk and protect their employees. Find out if your company has an injury and illness prevention program and learn how you can participate.

YOU are the Provider — SUMMARY

1. How can you psychologically prepare yourself for this call?

Regardless of your years of experience in EMS, you must prepare yourself psychologically and logistically when responding to *every* call.

You will experience anxiety during your response to the scene; this is a normal human reaction to a stressful event. The key is to recognize this and to remain focused on the critical tasks that lie ahead. Instead of reacting negatively, channel your anxiety into a positive psychologic drive that will make you even more determined to provide the best emergency medical care possible.

You and your partner should have a plan; clearly delineate each of your roles when you arrive at the scene. Discuss the skills and interventions that may need to be performed, the equipment that will be required, and whether additional resources will be needed. Doing so will help minimize confusion at the scene and the psychologic stress it causes.

2. What is stress? How does it manifest?

Stress is the body's physiologic response to any kind of demand—good or bad—and is triggered by one or more stressors. A stressor is any emotional, physical, or environmental situation that causes a variety of physiologic, physical, and psychologic responses.

The body's response to stress begins with an alarm response. When stress is placed on the body—in this case, attempting to resuscitate a child in cardiac arrest—the nervous system releases adrenaline into the bloodstream, causing the fight-or-flight response. The alarm response is followed by a phase of reaction and resistance, and then recovery or, if the stress is prolonged and ineffectively managed, exhaustion. This three-stage response to stress is called the general adaptation syndrome.

3. What phase of the stress response are you experiencing right now?

You are in an acutely stressful situation—attempting to resuscitate a child in cardiac arrest—and are experiencing the alarm response. Your nervous system is releasing adrenaline into the bloodstream, which is triggering the fight-or-flight response and causing your symptoms (eg, sweating, heart racing). As a result, your body has responded with a burst of energy that allows you to carry out your assigned task of suctioning the child's mouth and managing her airway (the "fight" response). If you were experiencing the "flight" response, you would either freeze or try to escape the situation altogether. The ability to effectively do your job—despite experiencing the symptoms of stress—indicates you are able to work under pressure.

4. How should you respond to the mother's question?

Anger is often expressed by very demanding behavior and/or yelling. In this case, anger is a predictable response given the seriousness of the situation.

Clearly, the situation looks grim, so in a calm, professional, and caring manner, reassure her that, although the situation is serious, you and your team are doing everything possible to save her child's life. Be honest, do not give her false hope, and do not make promises you cannot deliver—for example, "Everything will be alright," or "There's nothing to worry about." Your actions and words, even a simple touch, can communicate caring.

5. What stage of the grieving process is the mother experiencing?

The child's mother is actually simultaneously experiencing two stages of the grieving process—denial and anger. There are five stages of the grieving process: denial, anger, bargaining, depression, and acceptance. Not all people grieve in this order, and not all people experience all stages of the grieving process.

A person in denial refuses to accept the seriousness of the situation, makes unrealistic demands for miracles, or persistently fails to understand why there is no improvement in his or her loved one's condition.

Anger is usually the ugliest stage of the grieving process. During this phase, the person lashes out—usually at the EMS provider. Someone must be blamed, and those who are responsible must be punished. Anger often manifests as hostility toward the provider. Some people may become physically abusive, in which case law enforcement should be summoned to the scene.

6. How can poorly managed stress affect your physical well-being?

Most people can respond to sudden stress for a short time. However, prolonged or poorly managed stress can quickly drain the body of its reserves. This leaves it depleted of key nutrients, weakened, and more susceptible to disease.

In addition to the emotional damage that poorly managed stress can cause (eg, depression, guilt, persistent anxiety), it has been proven to be a strong contributor to heart disease, hypertension, cancer, alcoholism, and drug abuse, among others.

7. How can you mitigate the stress associated with the job?

Before you can manage stress, you must first recognize its signs and symptoms and identify the stressors involved. Some stressors can be changed or eliminated altogether; others cannot. Caring for critically sick or injured patients is difficult. It is stressful for them, but also for you. It is critical to recognize the manifestations of stress so it does not interfere with your job or personal life.

The signs of chronic stress are not always obvious at first; they may be subtle and not present all the time. Warning signs include irritability toward coworkers, family, and friends; difficulty concentrating; insomnia, hypersomnia, or nightmares; anxiety; indecisiveness; loss of appetite; decreased sex drive; and loss of interest in work, among others.

There are many useful and healthy strategies for managing stress; they may involve changing a few habits or your attitude. Behavioral tactics that have been shown to alleviate or eliminate the body's stress response include changing or eliminating the stressors (this is not always possible, especially in EMS), changing work hours, cutting back on overtime, changing your attitude about the stressor, developing a social network that does not involve your coworkers, and spending more time with your family.

There are also a number of exercises you can use to minimize the physical response to stress, such as periodic stretching; slow, deep breathing; regular physical exercise; and progressive muscle relaxation. If you are experiencing difficulty managing the stress associated with your job, you should consider seeing a professional counselor.

The key to successful stress management is to find a strategy that works for you and to use that strategy frequently and consistently. Remember, the signs of stress are not always present; you may not feel stressed, despite the fact that you are.

8. Does the death of a child affect the EMT or paramedic differently than the death of an adult? If so, how?

The death of any patient is a tragic event. However, in our society, we assume only older people are supposed to die, so most people are unprepared for what they will feel when a child's death does occur—including EMS personnel. It is common for EMS providers to feel they did not do everything possible for the child, despite the fact that they indeed provided their best resuscitative efforts.

It is normal to feel sadness and depression following the death of a child; however, unlike the death of an older person, these feelings are often more profound. Children only account for about 10% of all EMS calls; therefore, the death of a child—expected or not—often catches the EMT off guard, resulting in a greater degree of stress and anxiety compared to what is experienced following the death of an adult.

9. How can you help your partner?

Your partner's behavior is consistent with a critical incident stress reaction. Many people are prone to cumulative stress. In the emergency services field, stressors are often sudden and more severe; therefore, many events are unusually stressful or emotional, even by emergency services standards.

So, how do you help your partner? If he does not wish to talk, do not force the issue. He needs time to collect his thoughts and to grieve—just like the parents. However, you should reassure him that you are willing to listen; some people experience relief just by talking to a coworker, family member, or friend. In other cases, he or she may need to speak to a counselor.

You should alert your supervisor to your partner's crisis. If he is not emotionally fit to provide safe and effective emergency care, he should be replaced for the rest of the shift. In some cases, a grieving EMT or paramedic will become angry if his or her crisis is reported to the supervisor. However, you should reassure him or her that you reported the incident out of concern for his or her physical and emotional well-being. EMS personnel do not just look out for each other during an EMS call; they should also look out for each other after the call—even if it is just as a "sounding board."

EMS Patient Care Report (PCR)

Date: 4-3-16	**Incident No.:** 020109	**Nature of Call:** Child not breathing		**Location:** 788 E. Radcliffe	
Dispatched: 0720	**En Route:** 0720	**At Scene:** 0725	**Transport:** 0752	**At Hospital:** 0808	**In Service:** 0845

Patient Information

Age: 4 **Sex:** F **Weight (in kg [lb]):** 19 kg (42 lb)	**Allergies:** None **Medications:** None **Past Medical History:** None **Chief Complaint:** Cardiopulmonary arrest

Vital Signs

Time: 0726	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0731	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0736	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0741	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0747	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0753	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable
Time: 0801	**BP:** Unobtainable	**Pulse:** Absent	**Respirations:** Absent	**Spo_2:** Unobtainable

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Cardiac monitoring, IV, medication therapy, intubation

Narrative

9-1-1 dispatch for an unconscious child not breathing. On arrival at the scene, found two EMRs performing CPR on a 4-year-old girl. The child's mother stated when she went to wake up her child, she was unconscious, unresponsive, and not breathing; she called 9-1-1 and began CPR. The mother denies her child has any significant past medical history or drug allergies. She further denies any recent trauma or potentially toxic ingestion. After 2 minutes of CPR, reassessment revealed the child remained apneic and pulseless. Continued two-rescuer CPR and applied the cardiac monitor, which revealed asystole. Paramedic on scene successfully performed endotracheal intubation. An IV line was established and medications were administered per protocol. Performed resuscitative efforts at the scene for approximately 10 minutes, and then loaded the child into the ambulance and began transport. The child's mother accompanied her to the hospital, and was secured in the passenger's seat of the ambulance. Continued CPR and appropriate medication therapy en route. The child's condition remained unchanged; she remained apneic and pulseless and the electrocardiogram continued to show asystole. Delivered the child, whose condition remained unchanged, to the emergency department staff and gave verbal report to the attending physician.

Provided emotional support to the child's mother and then returned to service.**End of report**

Prep Kit

Ready for Review

- Your health and wellness are the foundation for your career; without these, you cannot provide care. Wellness includes your mental, physical, and social well-being.
- Components of wellness include protection from communicable disease and scene hazards; proper nutrition; sufficient exercise and relaxation; sufficient sleep; refraining from tobacco and drug use and excessive alcohol; and taking time to relax and enjoy life.
- Every patient encounter should be considered to be potentially dangerous. It is essential that you take all available precautions to minimize exposure and risk to scene hazards and infectious and communicable diseases.
- A communicable disease is any disease that can be spread from person to person or animal to person.
- Infectious diseases can be transmitted by contact (direct or indirect), or they are airborne, foodborne, or vector-borne.
- Even if you are exposed to an infectious disease, your risk of becoming ill is small.
- Whether or not an acute infection occurs depends on several factors, including the amount and type of infectious organism and your resistance to that infection.
- You can take several steps to protect yourself against exposure to infectious diseases, including:
  - Keeping up to date with recommended vaccinations
  - Following standard precautions at all times
  - Handling all needles and other sharp objects with great care
- Because it is often impossible to tell which patients have infectious diseases, you should avoid direct contact with the blood and body fluids of all patients.
- You should know what to do if you are exposed to an airborne or bloodborne disease. Your department’s designated officer will be able to help you follow the protocol set up in your area.
- Infection control should be an important part of your daily routine. Be sure to follow the proper steps when dealing with potential exposure situations.
- If you think you may have been exposed to an infectious disease, see your physician (or your employer’s designated physician) immediately.
- Scene hazards include potential exposure to the following:
  - Hazardous materials
  - Electricity
  - Fire
- At a hazardous materials incident, your safety is the most important consideration. Never approach an object labeled with a hazardous materials placard or label. Use binoculars to read the placards or labels from a safe distance.
- Do not begin caring for patients until they have been moved away from the scene and decontaminated by the hazardous materials team or the scene has been made safe for you to enter.
- There are seven common hazards in a fire:
  - Smoke
  - Oxygen deficiency
  - High ambient temperatures
  - Toxic gases
  - Building collapse
  - Equipment
  - Explosions
- Wearing protective clothing and specialized gear is another important component in preventing injury.
- Part of your role is to know how to care for critically ill and injured patients. Becoming familiar with interpersonal communication techniques to use in these situations will allow you to communicate with patients and their families in an optimal way.
- You will encounter death, dying patients, and the families and friends of those who have died. Your appropriate response to grief can have a significant impact on those you work with.
- Recognizing the signs of stress is important for all EMTs. When signs of stress such as fatigue, anxiety, anger, feelings of hopelessness, worthlessness, or guilt, and other such indicators manifest themselves, behavioral problems can develop.

- Violent situations such as civil disturbances, domestic disputes, and crime scenes can create many hazards for EMS personnel. If you see the potential for violence during a scene size-up, call for additional resources.
- Common workplace issues include cultural diversity, sexual harassment, and substance abuse. You should know what to do to avoid or address these situations.

Vital Vocabulary

acute stress reactions Reactions to stress that occur during a stressful situation.

airborne transmission The spread of an organism via droplets or dust.

bloodborne pathogens Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus and human immunodeficiency virus (HIV).

Centers for Disease Control and Prevention (CDC) The primary federal agency that conducts and supports public health activities in the United States. The CDC is part of the US Department of Health and Human Services.

communicable disease A disease that can be spread from one person or species to another.

concealment The use of objects to limit a person's visibility of you.

contamination The presence of infectious organisms on or in objects such as dressings, water, food, needles, wounds, or a patient's body.

cover The tactical use of an impenetrable barrier for protection.

critical incident stress management (CISM) A process that confronts the responses to critical incidents and defuses them, directing the emergency services personnel toward physical and emotional equilibrium.

cumulative stress reactions Prolonged or excessive stress.

delayed stress reactions Reactions to stress that occur after a stressful situation.

designated officer The individual in the department who is charged with the responsibility of managing exposures and infection control issues.

direct contact Exposure or transmission of a communicable disease from one person to another by physical contact.

exposure A situation in which a person has had contact with blood, body fluids, tissues, or airborne particles in a manner that suggests disease transmission may occur.

foodborne transmission The contamination of food or water with an organism than can cause disease.

general adaptation syndrome The body's response to stress that begins with an alarm response, followed by a stage of reaction and resistance, and then recovery or, if the stress is prolonged, exhaustion.

hepatitis Inflammation of the liver, usually caused by a viral infection, that causes fever, loss of appetite, jaundice, fatigue, and altered liver function.

host The organism or individual that is attacked by the infecting agent.

human immunodeficiency virus (HIV) Acquired immunodeficiency syndrome (AIDS) is caused by HIV, which damages the cells in the body's immune system so that the body is unable to fight infection or certain cancers.

immune The body's ability to protect itself from acquiring a disease.

indirect contact Exposure or transmission of disease from one person to another by contact with a contaminated object.

infection The abnormal invasion of a host or host tissues by organisms such as bacteria, viruses, or parasites, with or without signs or symptoms of disease.

infection control Procedures to reduce transmission of infection among patients and health care personnel.

infectious disease A medical condition caused by the growth and spread of small, harmful organisms within the body.

Occupational Safety and Health Administration (OSHA) The federal regulatory compliance agency that develops, publishes, and enforces guidelines concerning safety in the workplace.

pathogen A microorganism that is capable of causing disease in a susceptible host.

personal protective equipment (PPE) Protective equipment that blocks exposure to a pathogen or a hazardous material.

posttraumatic stress disorder (PTSD) A delayed stress reaction to a prior incident. Often the result of one or more unresolved issues concerning the incident, and may relate to an incident that involved physical harm or the threat of physical harm.

transmission The way in which an infectious disease is spread: contact, airborne, by vehicles, or by vectors.

standard precautions Protective measures that have traditionally been developed by the CDC for use in dealing with objects, blood, body fluids, and other potential exposure risks of communicable disease.

vector-borne transmission The use of an animal to spread an organism from one person or place to another.

Assessment *in Action*

You and your partner are dispatched to a sick person. On arrival you find a conscious patient who reports a fever, night sweats, and a cough. The patient also reports a history of tuberculosis. Your partner is assessing the patient, and you notice he has not taken standard precautions by donning personal protective equipment. Lately you have noticed your partner is disinterested in his work and is coming in late, taking unnecessary risks, and has taken to sitting alone at the station and not socializing with other members of the team. The job has been stressful lately; call volume has increased and you rarely have any downtime between calls.

1. What standard precautions should your partner have taken with this patient?

   A. Gloves only
   B. Gloves and surgical mask
   C. Gloves and particulate mask
   D. Gloves, mask, and gown

2. If your partner becomes infected with this patient's illness, what type of transmission would this occur through?

A. Vector-borne
B. Foodborne
C. Indirect contact
D. Airborne

3. Because your partner did not use standard precautions, he has potentially been exposed to an infectious disease. What should he do?

A. Ignore it because the risk of contamination is small.
B. Report it to the hospital staff so they can isolate the patient.
C. Report it to the infection control officer.
D. Sanitize any equipment that was in contact with the patient.

4. On the basis of your partner's actions, what is he most likely experiencing?

A. Acute stress reaction
B. Cumulative stress reaction
C. Posttraumatic stress disorder
D. Delayed stress reaction

5. Which of the following signs and symptoms are *not* usually associated with stress?

A. Headaches
B. Risk taking
C. Night sweats
D. Isolation

6. How can you help your partner to manage his stress?

A. Suggest that he relax and have a few drinks after his shifts.
B. Suggest a vacation.
C. Suggest that the supervisor give him time off.
D. Suggest that he participate in physical activity away from the workplace.

7. Which of the following is *not* a recommended way to manage stress?

A. Alcohol
B. Exercise
C. Proper diet
D. Sleep

8. What are the long-term physical effects of stress?

9. What are the long-term psychologic effects of stress?

10. Discuss the implications of your partner's actions in this scenario.

CHAPTER

3

Medical, Legal, and Ethical Issues

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National EMS Education Standard Competencies

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal, and ethical issues to the provision of emergency care.

Medical/Legal and Ethics

› Consent/refusal of care (pp 85–90)
› Confidentiality (p 90)
› Advanced directives (pp 90–92)
› Tort and criminal actions (pp 98–100)
› Evidence preservation (p 102)
› Statutory responsibilities (pp 94–98)
› Mandatory reporting (pp 101–102)
› Ethical principles/moral obligations (pp 102–103)
› End-of-life issues (pp 92–94)

Knowledge Objectives

1. Define consent and how it relates to decision making. (p 85)
2. Compare expressed consent, implied consent, and involuntary consent. (pp 86–87)
3. Discuss consent by minors for treatment or transport. (p 87)
4. Describe local EMS system protocols for using forcible restraint. (p 88)
5. Discuss the EMT's role and obligations if a patient refuses treatment or transport. (pp 88–90)
6. Describe the relationship between patient communications, confidentiality, and the Health Insurance Portability and Accountability Act (HIPAA). (p 90)
7. Discuss the importance of do not resuscitate (DNR) orders and local protocols as they relate to the EMS environment.

(pp 90–92)
8. Describe the physical, presumptive, and definitive signs of death. (pp 92–93)
9. Explain how to manage patients who are identified as organ donors. (p 94)
10. Recognize the importance of medical identification devices in treating the patient. (p 94)
11. Discuss the scope of practice and standards of care. (pp 94–97)
12. Describe the EMT's legal duty to act. (pp 97–98)
13. Discuss the issues of negligence, abandonment, assault and battery, and kidnapping and their implications for the EMT. (pp 98–99)
14. Explain the reporting requirements for special situations, including abuse, drug- or felony-related injuries, childbirth, and crime scenes. (pp 101–102)
15. Define ethics and morality and their implications for the EMT. (pp 102–103)
16. Describe the roles and responsibilities of the EMT in court. (pp 103–105)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

A basic principle of emergency care is to do no further harm. As an EMT, you will usually have the opportunity to do considerably more for your patients than simply preventing further injury. A thorough understanding of medical, legal, and ethical issues related to EMS is essential. EMTs who act in good faith, follow an appropriate standard of care, and provide compassionate care usually avoid professional legal problems.

EMTs provide **emergency medical care**—immediate care or treatment. EMTs may be the first link in the chain of prehospital care. As the scope and nature of emergency medical care become more complex, litigation involving participants in EMS systems will likely increase. Providing competent emergency medical care that conforms to the standard of care will help you to avoid both civil and criminal actions. Consider the following situations:

- While transporting a patient to the hospital, he states, "I don't want to go to the hospital anymore. You have to let me out."
- You begin treating a child you suspect might be the victim of abuse, and a parent commands you to stop.
- Your partner takes out his smartphone to post something about the last emergency call.

What should you do? Even when emergency medical care is properly rendered, there are times when you may be sued by a patient who seeks monetary compensation. Administrative action, such as suspension of your state EMT certificate, may be brought against you for failure to abide by the regulations of your state EMS agency. For these reasons, you must understand the various legal aspects of emergency medical care.

You must also consider ethical issues. As an EMT, should you stop and treat patients who were involved in an automobile crash while you are en route to another emergency call? Should you begin CPR on a patient who, according to the family, has terminal cancer? Should you begin treatment on a child with obvious signs of death because the parents are begging you to do something?

Consent

Typically, consent is required from every conscious adult before care can be started. A person receiving care must give permission, or **consent**, for treatment. An adult who is conscious, rational, and capable of making informed decisions has a legal right to refuse care, even though ill or injured. A patient may also consent to some aspects of care and deny consent for others. If the patient refuses care, you may not care for the patient. In fact, doing so may be grounds for both criminal and civil action. Consent can be expressed (actual) or implied.

The foundation of consent is decision-making capacity. **Decision making capacity** is the ability of a patient to understand the information you are providing, coupled with the ability to process that information and make an informed choice regarding medical care. It is important to keep in mind that the law allows the patient to make choices that may seem medically unsound and that might endanger the patient's life. The right of a patient to make decisions concerning his or her health is known as **patient autonomy**. The terms *decision making capacity* and *competence* are often used interchangeably but there is a distinction: competence is generally regarded as a legal term and determinations regarding competence are typically made by a court of law, whereas decision making capacity is the term more commonly used in health care to determine whether or not a patient is capable of making health care decisions.

YOU are the Provider — PART 1

At 1720 hours, you are dispatched to a grocery store at 1175 N. Main Street for a man with a severe headache. You respond to the scene, which is located only a few miles away. The weather is clear, the temperature is 90°F (32°C), and the traffic is heavy.

1. Why is it essential that you obtain consent to treat the patient once you arrive?
2. Should you assess the patient's competency or decision making capacity once you arrive?

The following factors should be considered when determining a patient's decision-making capacity:

- Is the patient's intellectual capacity impaired by mental limitation or any type of dementia?
- Is the patient of legal age (18 years of age in most states)?
- Is the patient impaired by alcohol or drug intoxication or serious injury or illness?
- Does the patient appear to be experiencing significant pain?
- Does the patient have a significant injury that could distract him from a more serious injury? (For example, a significant non-life-threatening injury can cause extreme pain and distract the patient from neck pain, which could indicate a more serious problem.)
- Are there any apparent hearing or visual problems?
- Is a language barrier present? Do you and your patient speak the same language?
- Does the patient appear to understand what you are saying? Does he or she ask rational questions that demonstrate an understanding of the information you are trying to share?

You should be familiar with various types of consent. These include expressed consent, implied consent, and involuntary consent.

Expressed Consent

Expressed consent (or actual consent) is the type of consent given when the patient verbally or otherwise acknowledges that he or she wants you to provide care or transport. Expressed consent may be nonverbal. For example, if you ask a patient if you can check his or her blood pressure and the patient extends an arm to you, the patient is expressing consent nonverbally.

To be valid, the consent the patient provides must be **informed consent**, which means that you explained the nature of the treatment being offered, along with the potential risks, benefits, and alternatives to treatment, as well as potential consequences of refusing treatment, and the patient has given consent. Often, the prehospital environment requires that consent be obtained more quickly than in the hospital setting. Paramedics will often provide additional information if advanced life support interventions are necessary. In such cases, there is a greater potential for side effects and other adverse responses associated with drug administration and other forms of advanced care.

Informed consent is valid if given orally, but it may be difficult to prove at a later point in time. Rarely do EMS providers have patients sign a consent form, so it is always advisable to document consent in your run report. Having someone witness the patient's consent may be helpful if the issue of consent is later challenged in court.

Remember, a patient may agree to certain types of emergency medical care but not to others. The patient's right to refuse treatment is discussed later in this chapter.

Implied Consent

When a person is unconscious or otherwise incapable of making a rational, informed decision about care, and unable to give consent, the law assumes that the patient would consent to care and transport to a medical facility if he or she were able to do so Figure 3-1. Patients who are intoxicated by drugs or alcohol, mentally impaired, or suffering from certain conditions such as head injury might be included in this category. The legal principle that allows treatment under such circumstances is called **implied consent**. Implied consent applies only when a serious medical condition exists and should never be used unless there is a threat to life or limb. For this reason, the principle of implied consent is known as the **emergency doctrine**. Sometimes what represents a "serious threat" may be unclear. This may result in legal proceedings and a **medicolegal** judgment, which should be supported by your best efforts to obtain consent and a thoroughly documented run report. In most instances, the law allows a spouse, a close relative, or next of kin to give consent for an injured person who is unable to do so, and you should make every effort to obtain consent from an available relative before treating based on implied consent;

however, treatment should never be delayed when the patient has imminently life-threatening injuries. It is also important to understand that if a patient being treated based on implied consent were to regain consciousness and appear capable of making an informed decision, the doctrine of implied consent would no longer apply. This often occurs with calls involving diabetic emergencies, overdoses, syncope, and seizures.

Figure 3-1 When a serious threat to life exists and the patient is unconscious or otherwise unable to give consent, the law assumes that the patient would give consent to care and transport to the hospital.

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▶ Involuntary Consent

Assisting patients who are mentally ill, developmentally delayed, or who are in behavioral (psychologic) crisis is complicated. An adult patient who is mentally incompetent is not able to give informed consent. From a legal perspective, this situation is similar to those involving minors. Consent for emergency care should be obtained from someone who is legally responsible for the patient, such as a guardian or conservator. In many cases, however, such permission will not be readily obtainable. Many states have protective custody statutes allowing such a person to be taken, under law enforcement authority, to a medical facility. Under certain conditions, law enforcement and prison officials are legally permitted to give consent for any individual who is incarcerated or has been placed under arrest. However, a prisoner who is conscious and capable of making decisions does not necessarily surrender the right to make medical decisions and may refuse care. Know the provisions in your area and involve online medical control in the process.

▶ Minors and Consent

Because a minor might not have the wisdom, maturity, or judgment to give consent, the law requires that a parent or legal guardian, when available, give consent for treatment or transport **Figure 3-2**. In every state, when a parent cannot be reached to provide consent, health care providers are allowed to give emergency care to a child. In some states, a minor can consent to receive medical care, depending on the minor's age and maturity. A great deal of confusion surrounds the issue of emancipated minors. **Emancipated minors** are people who, despite being under the legal age in a given state (in most cases the age is 18 years), can be legally treated as adults based on certain circumstances. For example, many states consider minors to be emancipated if they are married, if they are members of the armed services, or if they are parents. A minor who is a parent may also give consent for his or her own child. In addition, a minor is usually considered emancipated if living away from and no longer relying on his or her parents for support. A court may issue an order declaring a minor to be emancipated but this is not commonly seen. You should know your state's laws concerning the issues surrounding emancipation.

Figure 3-2 The law requires that a parent or a legal guardian give consent for treatment or transport of a minor. However, you must never withhold lifesaving care.

If a minor is injured and requires medical treatment in a school or camp setting, teachers and school officials may act **in loco parentis**, which means in the position or place of a parent, and can legally give consent for treatment of the minor if a parent or guardian is not available. You should still make an effort to obtain consent from a parent or legal guardian whenever possible; however, if a true emergency exists and the parent or legal guardian is not available, the consent to treat the minor is implied, just as with an adult. You must never withhold lifesaving care for a minor because a person authorized to provide consent is not available.

It is important to reach the parent or guardian as quickly as possible. Even though lifesaving interventions will not be delayed, it is possible other interventions at the hospital could be delayed until consent is obtained. Follow local protocol or consult medical control to determine if someone acting in loco parentis will need to accompany the child during transport and be present at the receiving hospital until a parent or guardian arrives.

Forcible Restraint

Forcible restraint is sometimes necessary when you are confronted with a patient who is in need of medical treatment and transportation but is combative and presents a significant physical risk of danger to himself, rescuers, or others **Figure 3-3**. Such behavior may result from an underlying psychiatric or behavioral condition, the effects of drugs, or a medical condition such as a head injury or hypoxia. Physically preventing such people from initiating any physical action is legally permissible and may be required before emergency care can be rendered. Typically, you should consult medical control for authorization to restrain or contact law enforcement personnel who have the authority to restrain people. In some states, only a police officer may forcibly restrain an individual. You should be knowledgeable about local laws. Restraint without legal authority exposes you to potential civil and criminal penalties. Restraint may be used only in circumstances of risk to the patient or others. When a patient is combative and poses a risk to the rescuer, it is advisable to wait for law enforcement to arrive on scene before attempting to treat the patient.

Your service should have clearly defined protocols to deal with situations involving restraint. It is important to remember that if the patient is conscious and the situation is not urgent, consent is required. Restraints should only be considered if the patient has a medical condition that appears serious or if he or she suffers from an apparent behavioral disorder that poses a risk to the patient or others. After restraints are applied, they should not be removed en route unless they pose a risk to the patient, even if the patient promises to behave. It is essential you protect the patient's airway and monitor the patient's respiratory status while restrained to avoid asphyxia, aspiration, and other complications.

Figure 3-3 Be sure that you know the local laws about forcible restraint of a patient. In some states, only a police officer has the authority to restrain a patient.

The Right to Refuse Treatment

Adults who are conscious, alert, and appear to have decision making capacity have the right to refuse treatment or withdraw from treatment at any time. This is true even if doing so may result in death or serious injury. Such patients present you with a dilemma. Should you provide care against their will? Should you leave them alone? Calls involving refusal of treatment pose a high risk of litigation in EMS and require you to proceed very cautiously. You must be familiar with local policies regarding refusal of care. In all such cases, you should involve online medical control and document this consultation. A patient's decision to either accept or refuse treatment should be based on information that you provide. This information should include your assessment of what might be wrong with the patient, a description of the treatment that you feel is necessary, any possible risks of treatment, the availability of alternative treatments, and the possible consequences of refusing treatment. Be sure that the patient understands everything that you say and encourage the patient to ask questions. All of this information should be included in your patient care report. Many jurisdictions have pre-printed refusal forms to ensure that all of these items are documented or acknowledged.

When treatment is refused, you must assess the patient's ability to make an informed decision. Ask and repeat questions, assess the patient's answers, and observe the patient's behavior. If the patient appears confused or delusional, you cannot assume that the decision to refuse is an informed refusal. Patients who have attempted suicide, or conveyed suicidal intent, should not be regarded as having normal mental capacity. Remember, a single assessment finding will not usually enable you to determine whether the patient is capable of making an informed decision about health care. As with most medical conditions, it is the constellation of findings that will support your conclusion. When in doubt, providing treatment is a much more defensible position than failing to treat a patient. Do not endanger yourself to provide care, and use the assistance of law enforcement to ensure your own safety.

Before leaving the scene where a patient has refused care, you should again encourage the patient to permit treatment and remind him or her to call 9-1-1 if he or she changes his or her mind or his or her condition worsens. Advise the patient to contact his or her personal physician as soon as possible. It is essential for you to ask the patient to sign a refusal of treatment form and to thoroughly document all refusals. Your documentation should include any assessment findings that you were able to make and all efforts that you made to obtain consent. Your documentation should also include a description of possible consequences of refusing treatment and transport. The patient's signature should be witnessed by a family member or police officer to help protect you from a later claim for negligence or abandonment. Both of these terms are discussed later in this chapter. A signed patient refusal form does not guarantee your protection against legal action, though it can help defend you when legal actions arise. Also, it is wise, and often required by local protocol, that you notify medical control of your actions; medical control can help guide your decisions.

You may also be faced with a situation in which a parent refuses to permit treatment of an ill or injured child. In this situation, you must consider the emotional impact of the emergency on the parent's judgment. As with most cases of refusal, you can usually resolve the situation with patience and calm persuasion. You may also need the help of others, such as ALS personnel, medical control, or law enforcement officials.

When you are not able to persuade the patient, guardian, or parent to proceed with treatment, you must obtain the signature of the individual who is refusing treatment on an official release form that acknowledges refusal. Document any assessment findings, the emergency care that you provided, your efforts to obtain consent, your consultation with medical control, and the responses to your efforts. You should also obtain a signature from a witness to the refusal. Make every effort to have a responsible person, such as a police officer, serve as a witness to these events. Retain the documents with your records—they will be important in the event a legal claim is filed later. If the patient refuses to sign a release form, inform medical control and thoroughly document the situation and the refusal. In some cases, parents who have refused medical care for a child have been charged with child neglect. You might be called as a witness in such cases and you must be sure that all documentation is thorough and accurate. Remember, your safety is your first priority. Act in the best interest of your patient, but do not place yourself in danger attempting to care for a patient who is refusing care.

YOU are the Provider — PART 2

On arriving at the scene, you find the patient, a 32-year-old man, sitting on the sidewalk outside the grocery store. He is grabbing both sides of his head, but looks up and acknowledges your presence. You begin to assess the patient as your partner opens the jump kit and prepares to take his vital signs.

Recording Time: 0 Minutes	
Appearance	Grabbing both sides of his head; in obvious pain
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions or foreign bodies
Breathing	Increased respiratory rate; adequate depth
Circulation	Radial pulses, bilaterally strong and regular; skin is pink, warm, and dry

Without talking to the patient, your partner begins to take his blood pressure and applies the pulse oximeter to his finger.

3. Are you legally authorized to treat this patient? Why or why not?
4. How does informed consent differ from implied consent?

Words of Wisdom

When a patient, parent, or guardian refuses treatment or transport, protect yourself with both a thorough patient care report (PCR) and an official refusal form. Have the patient or other refusing party sign the form, document what you have done to ensure an informed refusal, and note the involvement of medical control in the situation. Be sure to submit the refusal form with your PCR.

Confidentiality

Communication between you and the patient is considered confidential and generally cannot be disclosed without permission from the patient or a court order. Confidential information includes the patient history, assessment findings, and treatment provided. Disclosure of such information without proper authorization may result in liability for **breach of confidentiality**. In most states, records may be released when a legal subpoena is presented or the patient signs a written release. Patient information may also be shared with third-party billing personnel; this is not considered a breach of confidentiality.

HIPAA

HIPAA is the acronym for the Health Insurance Portability and Accountability Act of 1996. Although this act had many aims, the section of the act that most affects EMS relates to patient privacy. The aim of this section of the act is to strengthen laws for the protection of the privacy of health care information and to safeguard patient confidentiality. It provides guidance on what types of information is protected, the responsibility of health care providers regarding that protection, and the penalties for breaching that protection.

HIPAA considers all patient information that you obtain in the course of providing medical treatment to a patient to be **protected health information (PHI)**. This includes not only medical information, but also any information that can be used to identify the patient. As an EMT, you have an obligation to guard all protected health information from unlawful disclosure, either written or verbal.

PHI may be disclosed for purposes of treatment, payment, or operations. This means you are permitted to report your assessment findings and treatment to other health care providers directly involved in the care of the patient. Information may be used for internal quality improvement and training programs, but all identifying information must first be removed. There are also certain situations when you may be legally mandated to report your findings, such as in the case of child abuse or when you receive a subpoena. In most situations, except for treatment purposes, only the minimum amount of information necessary should be released. Failure to abide by the provisions of the HIPAA laws can result in civil and/ or criminal action against your response agency and against you personally. Each EMS system is required to have a policy and procedure manual and a privacy officer who can answer questions. You can expect to receive further training on how this act impacts your specific response agency.

Words of Wisdom

Do *not* use a personal electronic device, such as a cell phone, to capture information from a call. Digital images such as photos of a patient's injuries or vehicle, or recordings made by crew members during a patient call, are considered protected health information (PHI) and a confidential part of the patient report. *Never* post PHI on social media.

Advance Directives

As an EMT, you will respond to calls in which a patient is dying from an illness. When you arrive at the scene, you may find that family members do not want you to try to resuscitate the patient. Without valid written documentation from a physician, such as an advance directive or a **do not resuscitate (DNR) order** (also known as a "do not attempt resuscitation" order), you may be placed in a very difficult position. A **competent** patient is able to make rational decisions about his or her well-being. An **advance directive** is a written document that specifies medical treatment for a competent patient, should he or she become unable to make decisions. Advance directives are most commonly used when a patient becomes comatose. An advance directive is often referred to as a living will but may also be referred to as a **health care directive**. Not all advance directives are directions to withhold care. Such care may include nutrition and medication for pain.

DNR orders give you permission not to attempt resuscitation **Figure 3-4**. Laws differ from state to state; however, to be valid, DNR orders must meet the following requirements:

PREHOSPITAL MEDICAL CARE DIRECTIVE

(side one)

IN THE EVENT OF CARDIAC OR RESPIRATORY ARREST, I REFUSE ANY RESUSCITATION MEASURES INCLUDING CARDIAC COMPRESSION, ENDOTRACHEAL INTUBATION AND OTHER ADVANCED AIRWAY MANAGEMENT, ARTIFICIAL VENTILATION, DEFIBRILLATION, ADMINISTRATION OF ADVANCED CARDIAC LIFE SUPPORT DRUGS AND RELATED EMERGENCY MEDICAL PROCEDURES.

Patient: ______________________________ Date: ____________

(Signature or mark)

Attach recent photograph here or provide all of the following information below:

Date of Birth ____________

Sex ________ Race ________

Eye Color ____________

Hair Color ____________

PHOTO

Hospice Program (if any) ______________________________

Name and telephone number of patient's physician ____________________

____

(side two)

I have explained this form and its consequences to the signer and obtained assurance that the signer understands that death may result from any refused care listed above (on reverse side).

______________________________ Date ____________

(Licensed health care provider)

I was present when this was signed (or marked). The patient then appeared to be of sound mind and free from duress.

______________________________ Date ____________

(Witness)

A

Outside the Hospital Do - Not - Resuscitate Identification Card

Patient's Full Name ______________________________

I affirm that I have authorized an Outside the Hospital Do - Not - Resuscitate Order for this patient and have documented the grounds for the order in this patient's medical file.

Attending Physician Signature ______________________

Attending Physician (print) ______________________

Address ____________________ **Phone** ____________

Date ______________________________

I, ____,

(name)

authorize emergency medical services personnel to withhold or withdraw cardiopulmonary resuscitation from me in the event I suffer cardiac or respiratory arrest.

I understand this means that if my heart stops beating or I stop breathing, no medical procedure to restart heart function or breathing will be instituted.

I understand that I may revoke this order at anytime.

Patient or Patient's Representative

Signature ______________________________

Date ______________________________

B

Figure 3-4 **A.** An example of a wallet-sized DNR order. **B.** An example of a pocket-sized DNR order.

- Clear statement of the patient's medical problem(s)
- Signature of the patient or legal guardian
- Signature of one or more physicians or other licensed health care providers
- In some states, DNR orders contain an expiration date. DNR orders with expiration dates must be dated in the preceding 12 months to be valid.

You may also encounter Physician Orders for Life-Sustaining Treatment (POLST) and Medical Orders for Life-Sustaining Treatment (MOLST) forms when caring for patients with terminal illnesses. These explicitly describe acceptable interventions for the patient in the form of medical orders. These forms must be signed by an authorized medical provider in order to be valid; this may be a physician, physician assistant, or nurse practitioner, and varies by state. If you encounter these documents, contact medical control for guidance.

Some patients may have named surrogates to make decisions for them regarding their health care, in the event that they are incapacitated and unable to make such decisions for themselves. Such designations may be referred to as **durable powers of attorney for health care** or **health care proxies**. There are many different types of powers of attorney and not all are authorized to exercise medical decision making. When presented with a power of attorney at the scene of a medical emergency, you must read it carefully to ascertain its meaning and validity. If there is any question, you should contact online medical control for assistance. Do not delay emergency care while efforts to interpret the power of attorney are made. Keep in mind that a patient who remains conscious and competent does not surrender the right to make medical decisions. The person named in the power of attorney or health care proxy is only authorized to make decisions when the patient is no longer capable of doing so.

Remember, DNR does not mean "do not treat." Even in the presence of a DNR order, you are still obligated to provide supportive measures (oxygen, pain relief, and comfort) to a patient who is not in cardiac arrest. Each agency, in consultation with its medical director and legal counsel, must develop a protocol to follow in these circumstances.

There are a growing number of hospice (end of life) home health programs, so you may be faced with these situations often. Specific guidelines vary from state to state, but the following four statements may be considered general guidelines:

1. Patients have the right to refuse treatment, including resuscitative efforts, provided that they are able to communicate their wishes.
2. A written order from a physician is required for DNR orders to be valid in a health care facility.
3. You should periodically review state and local protocols and legislation regarding advance directives.
4. When you are in doubt or the written orders are not present, you have an obligation to resuscitate.

When presented with an advance directive, you should never become annoyed with family members and allow yourself to wonder, "Why did they bother to call 9-1-1 if they don't want us to do anything?" The patients, and their families, should be treated with the utmost respect and empathy. If information and support is what they called you for, be sure to provide it—it is part of your job.

Physical Signs of Death

Determination of the cause of death is the medical responsibility of a physician. There are both definitive and presumptive signs of death. In many states, death is defined as the absence of circulatory and respiratory function. Many states have also adopted "brain death" provisions; these provisions refer to irreversible cessation of all functions of the brain and brain stem. Questions often arise as to whether to begin basic life support. In the absence of physician orders, such as DNR orders, the general rule is: If the body is still intact and there are no definitive signs of death, initiate emergency medical care.

Hypothermia is a general cooling of the body in which the internal body temperature becomes abnormally low. People have survived hypothermic incidents with temperatures as low as 64°F (18°C). In cases of hypothermia, the patient should not be considered dead until he or she is warm and dead. When the patient's condition in unclear, or if you are unsure if you should initiate care, it is best to begin CPR immediately and contact medical control for guidance. Remember, not all incidents of hypothermia occur outdoors; for example, an older patient in a home without heat or who has been lying on a cold floor could be hypothermic.

Presumptive Signs of Death

Most medicolegal authorities will consider the presumptive signs of death that are listed in Table 3-1 adequate, particularly when they follow a severe trauma or occur at the end stages of long-term illness such as cancer or other prolonged diseases.

These signs would not be adequate in cases of sudden death due to hypothermia, acute poisoning, or cardiac arrest. Usually, in these cases, some combination of the signs is needed to declare death, not just one of them alone.

YOU are the Provider — PART 3

Your partner reports that the patient's blood pressure is very high. The patient tells you that he has "blood pressure problems" and experiences a bad headache whenever he does not take his Prinivil—the medication he takes for his blood pressure. He does not want to go to the hospital and tells you that the clerk called 9-1-1, not him.

Recording Time: 4 Minutes	
Respirations	24 breaths/min; regular and unlabored
Pulse	110 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	200/110 mm Hg
Oxygen saturation (Spo_2)	98% (on room air)

5. What should you do when a patient refuses treatment and/or transport?
6. What questions should you ask yourself to help determine whether you can transport this patient against his will?

Words of Wisdom

EMT Oath

"Be it pledged as an Emergency Medical Technician, I will honor the physical and judicial laws of God and man. I will follow that regimen which, according to my ability and judgment, I consider for the benefit of patients and abstain from whatever is deleterious and mischievous, nor shall I suggest any such counsel. Into whatever homes I enter, I will go into them for the benefit of only the sick and injured, never revealing what I see or hear in the lives of men unless required by law.

I shall also share my medical knowledge with those who may benefit from what I have learned. I will serve unselfishly and continuously in order to help make a better world for all mankind.

While I continue to keep this oath unviolated, may it be granted to me to enjoy life, and the practice of the art, respected by all men, in all times. Should I trespass or violate this oath, may the reverse be my lot.

So help me God."

Written by Charles B. Gillespie, MD
Adopted by the National Association of Emergency Medical Technicians, 1978.

Table 3-1 Presumptive Signs of Death

- Unresponsiveness to painful stimuli
- Lack of a carotid pulse or heartbeat
- Absence of chest rise and fall
- No deep tendon or corneal reflexes
- Absence of pupillary reactivity
- No systolic blood pressure
- Profound cyanosis
- Lowered or decreased body temperature

Definitive Signs of Death

Definitive or conclusive signs of death that are obvious and clear to even nonmedical people include the following:

- Obvious mortal damage, such as decapitation
- **Dependent lividity**: blood settling to the lowest point of the body, causing discoloration of the skin **Figure 3-5**
- **Rigor mortis**, the stiffening of body muscles caused by chemical changes within muscle tissue. It develops first in the face and jaw, gradually extending downward until the body is in full rigor. The rate of onset is affected by the body's ability to lose heat to its surroundings. The rate of heat loss in a thin body is faster than in a fat body. A body on a tile floor has faster heat loss than a body wrapped up in a blanket in a bed. Rigor mortis occurs sometime between 2 and 12 hours after death
- **Putrefaction** (decomposition of body tissues). Depending on temperature conditions, this occurs sometime between 40 and 96 hours after death

Figure 3-5 Dependent lividity is an obvious sign of death caused by discoloration of the body from pooling of the blood to the lower parts of the body.

Medical Examiner Cases

Involvement of the medical examiner, or the coroner in some states, depends on the nature and scene of the death. In most states, when trauma is a factor or the death involves suspected criminal or unusual situations such as hanging or poisoning, the medical examiner must be notified **Figure 3-6**. When the medical examiner or coroner assumes responsibility of the scene, that responsibility supersedes all others at the scene, including the family's. The following are a few examples of deaths that may be considered medical examiner cases:

- When the person is dead on arrival (DOA) (sometimes referred to as dead on scene [DOS])
- Death without previous medical care or when the physician is unable to state the cause of death
- Suicide (self-destruction)
- Violent death
- Poisoning, known or suspected

Figure 3-6 When trauma is a factor or the death involves an unusual or a suspected criminal situation, the medical examiner is required to investigate.

- Death resulting from accidents
- Suspicion of a criminal act
- Infant and child deaths

You should make every attempt to limit your disturbance of a scene involving a death. Once you have adequately determined death based on local protocols, remove yourself from the scene. This is especially important if there is anything potentially suspicious about the death.

If emergency medical care has been initiated, be sure to keep thorough notes of what was done or found. These records may be important during a subsequent investigation.

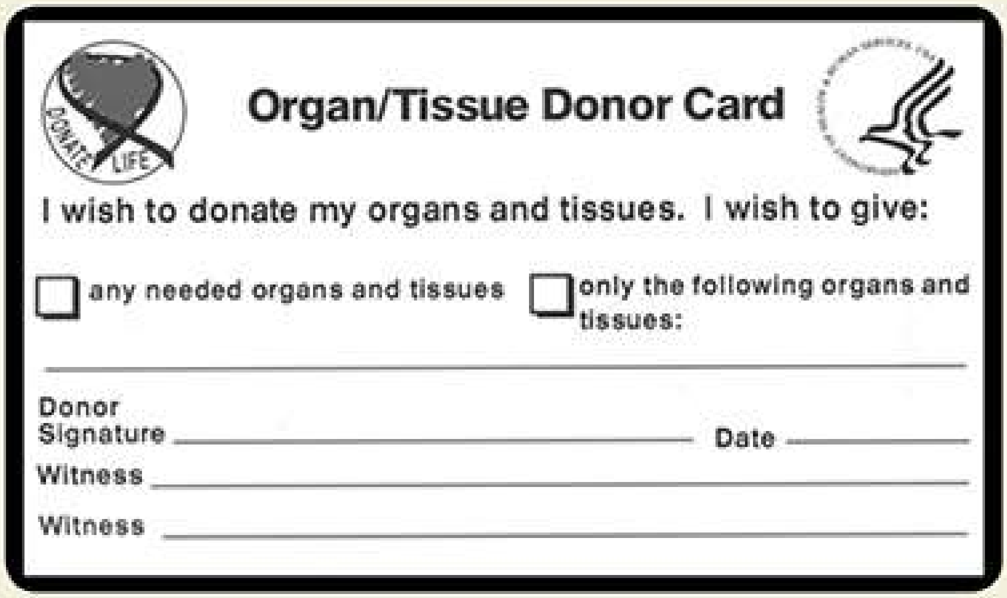
In such instances, there is no urgent reason to move the body. The only immediate action that is required of you is to cover the body and prevent its disturbance. Local protocol will determine your ultimate action in these instances.

Special Situations

Organ Donors

You may be called to a scene involving a potential organ donor. Consent to organ donation is voluntary and knowing. Consent is evidenced by either a donor card or a driver's license indicating that the individual wishes to be a donor Figure 3-7. You may need to consult with medical control when faced with this situation.

In specific circumstances, a patient who is not successfully resuscitated may be a potential organ donor. Certain centers can procure organs, including the kidneys and liver, in certain situations. These situations typically occur after in-hospital cardiac arrest but may be associated with certain specific out-of-hospital cardiac arrest situations that occur in close proximity to specialized centers. Be aware of your local centers and their protocols and capabilities.


Organ/Tissue Donor Card

I wish to donate my organs and tissues. I wish to give:

☐ any needed organs and tissues ☐ only the following organs and tissues:

Donor Signature ______ Date ______

Witness ______

Witness ______

Figure 3-7 The patient may be carrying a donor card or driver's license indicating that he or she wishes to be an organ donor.

Courtesy of the U.S. Department of Health and Human Services.

You should treat a potential organ donor in the same way that you would any other patient needing treatment. Use all means necessary to keep that patient alive. Organs that are often donated, such as a kidney, heart, or liver, need oxygen at all times; you must give oxygen to the possible donor or the organs will be damaged and become useless.

Remember, your priority is to save the patient's life. Be sure to learn what the specific protocols are in your area regarding special situations such as organ donation.

Medical Identification Insignia

Many patients will carry important medical identification and information, often in the form of a bracelet, necklace, key chain, or card that identifies patient history information. This may include a DNR order or information related to medications taken, allergies, diabetes, epilepsy, or some other serious condition Figure 3-8. Some patients wear medical bracelets with a USB flash drive, which contains pertinent patient information, such as drug interactions, allergies, or emergency contact information. This information is often stored as a PDF file that can be read on most computers.

Scope of Practice

The scope of practice, which is most commonly defined by state law, outlines the care you are legally able to provide for the patient. Your medical director further defines the scope of practice by developing protocols and standing orders. The medical director gives you the legal authorization to provide patient care through telephone or radio communication (online) or standing orders and protocols (off-line). It is your responsibility as an EMT to know your scope of practice and follow it. You and other EMS personnel have a responsibility to provide proper, consistent patient care and to report problems, such as possible liability or exposure to infectious disease, to your medical director immediately.

Figure 3-8 The patient may be carrying a medical identification card or wearing a bracelet or necklace that may indicate important medical information and possible DNR orders. In the case of MedicAlert, the EMS provider can obtain stored patient history information from the MedicAlert Foundation.

Courtesy of the MedicAlert Foundation®. © 2006, All Rights Reserved. MedicAlert® is a federally registered trademark and service mark.

If you carry out procedures for which you are not authorized, you are practicing outside your scope of practice, which may be considered negligence or, in some states, even a criminal offense. The scope of practice should not be confused with the standard of care.

Standards of Care

The law requires you to act or behave toward other people in a definite, definable way, regardless of the activity involved. Under given circumstances, you have a duty either to act or not. Generally speaking, you must be concerned about the safety and welfare of others when your behavior or activities have the potential for causing others injury or harm **Figure 3-9**. The manner in which you must act or behave is called a **standard of care**.

Standard of care is established in many ways, among them local customs, statutes, ordinances, protocols, medical literature, textbooks, administrative regulations, and case law. In addition, professional or institutional standards have a bearing on determining the adequacy of your conduct.

Figure 3-9 Act or behave toward others in a way that shows your concern about their safety and welfare.

Standards Imposed by Local Custom

The standard of care is how a reasonably prudent person with similar training and experience would act under similar circumstances, with similar equipment, and in the same or similar place. For example, the conduct of an EMT who is employed by an ambulance service is to be judged in comparison with the expected conduct of other EMTs from comparable ambulance services in the same geographic area. These standards are often based on locally accepted protocols.

As an EMT, you will not be held to the same standard of care as physicians or other more highly trained professionals. In addition, your conduct must be judged in the light of the given emergency situation, taking into consideration the following factors:

- Any issues concerning the safety of the patient or rescuer
- General confusion at the scene of the emergency
- The needs of other patients
- The type of equipment available

In this context, an **emergency** is a serious situation, such as an injury or an illness that arises suddenly, threatens the life or welfare of a person or group of people, and requires immediate intervention.

Prevailing customs within a community are important elements in determining the standard of emergency care within that community. This means the accepted standard of care can change from one community to another. Examples of prevailing customs include how hospital destinations are selected, when EMS helicopters are used, and protocols for cervical spine immobilization **Figure 3-10**.

Figure 3-10 In emergency situations, you will care for those with potentially life-threatening injuries or illnesses by practicing a standard of care—the accepted level of care expected in your profession for your level of training.

▶ Standards Imposed by Law

In addition to local customs, standards of emergency medical care may be imposed by statutes, ordinances, administrative regulation, or case law. In many jurisdictions, violating one of these standards is said to create presumptive negligence. Therefore, you must become familiar with the particular legal standards that may exist in your state. In many states, this may take the form of treatment protocols published by a state agency.

▶ Professional or Institutional Standards

In addition to standards imposed by law, professional or institutional standards may be admitted as evidence in determining the adequacy of an EMT's conduct. Professional standards include recommendations published by organizations and societies that are involved in emergency medical care. Institutional standards include specific rules and procedures of the EMS system, ambulance service, or organization to which you are affiliated.

Two notes of caution: First, you must be familiar with the standards of your organization. Second, if you are involved in formulating standards for a particular agency, they should be reasonable and realistic so that they do not impose an unreasonable burden on EMTs. Regardless, providing the best emergency medical care should be every EMT's goal.

YOU are the Provider **PART 4**

The patient consents to EMS treatment and transport after you tell him he could be experiencing a serious medical emergency. You place the patient onto the stretcher. While loading the patient in the ambulance, the clerk asks, "What's wrong with him? Did I do the right thing?"

Recording Time: 10 Minutes	
Level of consciousness	Conscious and alert
Respirations	22 breaths/min; regular and unlabored
Pulse	104 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	194/108 mm Hg
Spo_2	99%

En route to the hospital, you dim the lights in the ambulance, apply a cool compress to his forehead, and ensure that he is in a comfortable position. You then obtain his patient information and medical history.

7. Does HIPAA affect the medical care you provide to your patients? What information are you allowed to discuss with family members, bystanders, the media, and others?

8. How do you respond to the clerk's question in a professional manner without violating HIPAA regulations?

Many standards of care may be imposed on you. State health department regulations usually govern the scope and level of training. Court decisions have resulted in case law defining standards of care. Professional standards are also imposed. For example, the International Liaison Committee on Resuscitation (ILCOR), along with its member the American Heart Association (AHA), updates the standard for basic life support (BLS) and cardiopulmonary resuscitation (CPR) on a regular basis **Figure 3-11**.

Ordinary care is a minimum standard of care. In general, it is expected that any EMT who offers assistance will exercise reasonable care and act prudently. If you act reasonably, according to the accepted standard, the risk of a civil lawsuit is small. If you apply the standard practices you have been trained to use, you can likely avoid liability. For example, various organizations have defined standards for performing CPR. If you deviate from these standards, you may be liable for civil and possibly criminal prosecution. In addition, state regulatory agencies that oversee EMS operations can sanction EMS personnel for deviating from the standard of care.

Standards Imposed by Textbooks

In the course of a lawsuit, an attorney will often ask an EMT if he or she recognizes various textbooks as being authoritative works in the field of EMS. Since virtually all EMS textbooks follow standards established by the National Highway Transportation Safety Administration (NHTSA), these textbooks are often recognized as contributing to the standard of care that is followed by EMTs. Local protocols or state standards may differ from material presented in textbooks. When such differences occur, you are bound to follow local protocols.

Figure 3-11 Many standards of care are imposed on you as an EMT. If you deviate from these standards, legal action may be taken against you. Learn the standards of care for your level and organization.

▶ Standards Imposed by States

Medical Practices Act

In some states, EMS personnel are exempt from the licensure requirements of the Medical Practices Act because an EMT is regarded as a nonmedical professional. The practice of medicine is defined as the diagnosis and treatment of disease or illness. EMTs and others in the prehospital care chain assess the need for life support and begin care. Some states, however, have adopted legislation that establishes the scope of practice for EMS providers. Therefore, as an EMT you must be aware of the standards established by legislation in your state so you can be sure to provide care that is consistent with those standards.

Certification and Licensure

Some states provide certification, licensure, or credentialing of people who perform emergency medical care. **Certification** is the process by which an individual, institution, or program is evaluated and recognized as meeting certain predetermined standards to ensure safe and ethical patient care. **Licensure** is the process by which a competent authority, usually the state, grants permission to practice a job, trade, or profession. **Credentialing** is an established process to determine the qualifications necessary to be allowed to practice a particular profession, or to function as an organization. The credentialing process for EMTs can vary by state. An EMS provider's credentials typically follow his or her name, eg, *John Smith, NREMT*.

Once certified, you are obliged to conform to the standards that are generally recognized nationally by various registry groups and provide an important link in nationwide EMS. You must ensure that your certification or licensure remains current and that your skill levels are kept up to date.

Duty to Act

Duty to act is an individual's responsibility to provide patient care. Responsibility comes from either statute or function. A bystander is under no obligation to assist a stranger in distress and therefore has no duty to act. There may be a duty to act in certain instances, including the following:

- You are charged with emergency medical response.
- Your service or department's policy states that you must assist in any emergency.

Once your ambulance responds to a call or treatment is begun, you have a legal duty to act. In most cases, if you are off duty and come upon a crash, you are not legally obligated to stop and assist patients. There may be some circumstances where this is not true, and you should be familiar with the laws and policies that apply in your service area. If you choose to intervene while off duty, you must continue to provide competent care until an equal or higher medical authority assumes care of the patient.

Negligence

Negligence is the failure to provide the same care that a person with similar training would provide in the same or a similar situation. It is deviation from the accepted standard of care that may result in further injury to the patient. Determination of negligence is based on the following four factors:

1. **Duty.** The EMT has an obligation to provide care and to do so in a manner that is consistent with the standard of care established by training and local protocols.
2. **Breach of duty.** There is a breach of duty when the EMT does not act within an expected and reasonable standard of care.
3. **Damages.** There are damages when a patient is physically or psychologically harmed in some noticeable way.
4. **Causation.** There must be a reasonable cause-and-effect relationship between the breach of duty and the damages suffered by the patient. An example is dropping the patient during lifting, causing a fracture of the patient's leg. If an EMT has a duty and abuses it, thereby causing harm to another individual, the EMT, the agency, and/or the medical director may be sued for negligence. This is often referred to as **proximate causation**.

All four elements must be present for the legal doctrine of negligence to apply and for a plaintiff to prevail in a lawsuit against an EMS system or provider. It is also possible for an EMT or an EMS system to be held liable even when the plaintiff is unable to clearly demonstrate how an injury occurred, under the theory of **res ipsa loquitor**. An EMT could be held liable under this theory if it can be shown that an injury occurred, that the cause of the injury was in the control of the EMT, and that such injuries generally do not occur unless there is negligence. For example, you and your partner are called to the home of a man with diabetes who has lapsed into unconsciousness. You find the patient lying on a couch with no visible signs of trauma. While loading the patient into the ambulance, your partner slips and the stretcher drops, causing the patient to sustain a facial laceration. The patient later files a lawsuit against you for negligence. Because the patient was unconscious, he is unable to describe exactly how he sustained a facial laceration. Under the theory of res ipsa loquitor, the patient may prevail in his lawsuit by showing that he was under your care, that he suffered an injury, and that his injury would not have occurred unless there was negligence.

In rare cases, the plaintiff may be able to establish liability by using the theory of **negligence per se**. This is a theory that may be used when the conduct of the person being sued is alleged to have occurred in clear violation of a statute. For example, if you were to perform an advanced life support skill, such as the intravenous administration of a cardiac medication, the plaintiff might allege that this was negligence per se. In that case, the plaintiff would not have to establish the circumstances surrounding your conduct. There would be no need to show that the medication was inappropriate for the patient because you clearly exceeded your scope of practice.

All forms of negligence come under the general category known as **torts**. Torts are simply defined as civil wrongs. They are not within the jurisdiction of US criminal courts. Examples of other tort actions are lawsuits for defamation of character and invasion of privacy.

Abandonment

Abandonment is the unilateral termination of care by the EMT without the patient's consent and without making any provisions for continuing care by a medical professional who is competent to provide care for the patient. Once care is started, you have assumed a duty that must not stop until an equally competent EMS provider assumes responsibility. Failure to perform that duty is a serious legal and ethical matter that exposes the patient to harm and can result in civil action against you.

For example, suppose you arrive at the scene of a single-car crash and begin care of two injured patients. A passerby tells you of a two-car crash farther down the road in which five people are injured. You turn over care of the two injured patients from the first crash to the passerby, who is not a trained emergency care provider, and leave to go to the second crash. Abandonment may have occurred because you did not turn care of the patients over to a person who is trained and competent to provide emergency care that meets the needs of the two patients. Consider the following general questions when you are faced with making a decision such as this one:

- What problems may develop from your actions?
- How might the patient's condition worsen if you leave?
- Does the patient need care?
- Are you neglecting your duty to your patient?
- Is the person assuming care capable of providing the level of care needed by the patient?
- Are you abandoning the patient if you leave the scene?
- Are you violating a standard of care?
- Are you acting prudently?

Surprisingly, abandonment may also take place in the emergency department (ED) where you drop off your patient. A part of your obligation as an EMT is to provide hospital personnel with a report of your assessment findings, the care you provided, and any changes in patient status that occurred during transport to the hospital. The failure to do so could result in a delay in treatment or a misdiagnosis. In such a case, a claim for abandonment might be filed against the EMT who failed to provide the report. It is always a good idea for you to obtain a signature on your PCR from the person accepting transfer of care at the hospital. This will help protect you from accusations of abandonment.

Assault and Battery and Kidnapping

Assault is defined as unlawfully placing a person in fear of immediate bodily harm. Threatening to restrain a patient who does not want to be transported could be considered assault. **Battery** is defined as unlawfully touching a person; this includes providing emergency care without consent. Assault and battery can be either civil or criminal in nature. Civil lawsuits for battery are common in health care. To sustain a criminal case of assault or battery, it is generally necessary to prove the intent to cause harm. The element of intent is rarely present in the case of an EMS provider; therefore, criminal cases of assault and/or battery are rare. **Kidnapping** is the seizing, confining, abducting, or carrying away of a person by force. In theory, this might include a situation where a patient is transported against his or her will. In reality, criminal charges of kidnapping are almost unheard of in EMS because the EMT is almost always acting in a good faith effort to provide care to the patient. It is far more likely that an EMT could be the target of a civil lawsuit for **false imprisonment**. This is defined as the unauthorized confinement of a person that lasts for an appreciable period of time. Consider a patient who rescinds consent during transport and demands to be let out of the ambulance. If you refuse, you may be accused of false imprisonment.

Serious legal problems may arise in situations in which a patient has not given consent for treatment. Battery could be considered if you apply a splint to a suspected fracture of the lower leg, or use an EpiPen on a patient without the patient's consent. Under such circumstances, a patient might file a lawsuit for assault, battery, false imprisonment, or all three. Criminal charges are possible but far less likely. To protect yourself from these charges, make sure that you obtain expressed consent or that the situation allows for implied consent. Consult your medical director or service attorney if you have questions or doubt about a specific situation.

Words of Wisdom

The best way to ensure you make good ethical decisions is to make the welfare of your patient your top priority.

Defamation

As an EMT, you should also be aware of the laws involving defamation. **Defamation** is the communication of false information that damages the reputation of a person. Defamation that is in writing is referred to as **libel**, and defamation that is spoken is known as **slander**. A legal claim for defamation could arise out of a false statement on a run report, inappropriate comments made on social media or during "station house" conversations, or sharing "war stories" with friends, relatives, or neighbors. To avoid liability for such a claim and to protect the confidentiality of patients, you must only communicate information about your patients to authorized people and you should be sure that the information contained in your run reports and other documentation is accurate and relevant. There is no reason to post information about your patient on social media. You should never comment on your patient's personal information when it is not relevant to your assessment or treatment of the patient.

Good Samaritan Laws and Immunity

All states have adopted **Good Samaritan laws**, which are based on the common law principle that when you reasonably help another person, you should not be liable for errors and omissions that are made in giving good faith emergency care. However, Good Samaritan laws do not necessarily protect you from a lawsuit. Good Samaritan provisions vary significantly from state to state. Good Samaritan statutes in some jurisdictions provide immunity from a lawsuit while others provide an affirmative defense if you are sued for rendering care. In most cases, they do not prohibit the filing of a lawsuit, nor do they pertain to acts that could be considered wanton, gross, or willful negligence. To be protected by the provisions of a Good Samaritan law, several conditions must generally be met:

1. You acted in good faith in rendering care.
2. You rendered care without expectation of compensation.
3. You acted within the scope of your training.
4. You did not act in a grossly negligent manner.

Gross negligence is defined as conduct that constitutes a willful or reckless disregard for a duty or standard of care.

Another group of laws grants immunity from liability to official EMS providers, such as EMTs, in some circumstances. These laws, which vary from state to state, do not provide immunity when injury or damage is caused by gross negligence or willful misconduct. In most cases, immunity statutes apply to EMS systems that are considered governmental agencies.

Most states have also adopted specific laws granting special privileges to EMS personnel, authorizing them to perform certain medical procedures. Many states also grant partial immunity to EMTs and physicians and nurses who give emergency instructions to EMS personnel via radio or other forms of communication. Consult your medical director or state EMS agency for more information about the laws in your area.

YOU are the Provider — PART 5

While reassessing the patient, he admits to using cocaine. You complete your reassessment and then call in your radio report to the receiving facility. The patient's blood pressure has improved and he tells you that his headache is not as bad as it was before.

Recording Time: 16 Minutes	
Level of consciousness	Conscious and alert
Respirations	18 breaths/min; regular and unlabored
Pulse	90 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	166/94 mm Hg
Spo_2	99%

You deliver the patient to the emergency department and give your oral report to the receiving nurse. After completing your patient care report (PCR), you and your partner return to service.

9. Should you report the patient's use of illegal substances to law enforcement personnel? Why or why not?
10. Why is it a good idea to have the receiving nurse sign your PCR acknowledging the transfer of care?

Records and Reports

Because EMS providers are in a position to observe and gather information about diseases, injuries, and emergency events, an obligation to compile such information and report it to certain agencies may be imposed. Even if there is no such requirement, you should compile a complete and accurate record of all incidents in which you come into contact with sick or injured patients. A complete and accurate record of an emergency medical incident is an important safeguard against legal complications. The absence of a record, or a substantially incomplete record, increases the likelihood that you may have to testify on memory alone. This can prove to be wholly inadequate and embarrassing in the face of aggressive cross-examination.

You should consider the following two rules of thumb regarding reports and records:

- If an action or procedure is not recorded on the written report, it was not performed.
- An incomplete or untidy report is evidence of incomplete or inexpert emergency medical care.

You can avoid both of these potentially dangerous presumptions by compiling and maintaining accurate reports and records of all events and patients. PCRs also help the EMS system evaluate individual and service provider performance. These reports are an integral part of most quality assurance programs. Data extraction from PCRs is also used to conduct prehospital emergency care research, which may improve patient outcomes.

The National EMS Information System (NEMSIS) is a tool for the EMS profession. NEMSIS provides the ability to collect, store, and share standardized EMS data throughout the United States. This incredibly useful database can be used to improve the speed and accuracy of data collection. NEMSIS could, for example, provide early warning of a disease outbreak.

Special Mandatory Reporting Requirements

Abuse of Children, Older People, and Others

All states have enacted laws to protect abused children, and some have added other protected groups such as the older population and "at-risk" adults. Most states have a reporting obligation for certain people, ranging from physicians to any person. You must be aware of the requirements of the law in your state. Such statutes frequently grant immunity from liability for libel, slander, or defamation of character to the individual who is obligated to report, even if the reports are subsequently shown to be unfounded, as long as the reports are made in good faith.

Injury During the Commission of a Felony

Many states have laws requiring the reporting of any injury that is likely to have occurred during the commission of a crime, such as gunshot wounds, knife wounds, or poisonings. Again, you must be familiar with the legal requirements of your state.

Drug-Related Injuries

In some instances, drug-related injuries must be reported. These requirements may affect how you approach documenting the care of a patient. However, it should be stressed that the US Supreme Court has held that drug addiction, in contrast to drug possession or sale, is an illness and not a crime. An injury as a result of a drug overdose, therefore, may not be within the definition of an injury resulting from a crime.

Some states, by statute, specifically establish confidentiality and excuse certain specified people from reporting drug cases, either to a government agency or to a minor's parents, if, in the opinion of those people, withholding reporting is necessary for the proper treatment of the patient. Once again, you must be familiar with the legal requirements of your state.

Childbirth

Many states require that anyone who attends at a live birth in any place other than a licensed medical facility report the birth. As before, you must be familiar with state requirements.

Other Reporting Requirements

Other reporting requirements may include attempted suicides, dog bites, certain communicable diseases, assaults, domestic violence, and sexual assault or rape.

Special Populations

Elder abuse is as prominent as child abuse in our society. Do not forget to be observant and report any suspicious signs or symptoms to the proper authorities.

Most EMS agencies require that all exposures to infectious diseases be reported. You may be asked to transport certain patients in restraints, which may also need to be reported. Each of these situations can present significant legal problems. You should learn your local protocols regarding these situations.

Not only do the events that need to be reported vary significantly from state to state but so do the methods and procedures by which such reporting must take place. For example, although all states require that suspected child abuse be reported, some states require that the report be filed with law enforcement, others with a designated child protection agency, and yet others with the ED. There are often time-sensitive provisions associated with reporting statutes. As has been noted earlier, it is important that you become familiar with reporting requirements of your state. Failure to report may result in disciplinary action, suspension of your privileges to practice as an EMT, a fine, or even criminal prosecution.

Scene of a Crime

If there is evidence at an emergency scene that a crime may have been committed, you must notify the dispatcher immediately so that law enforcement authorities can respond. Such circumstances should not stop you from providing lifesaving emergency medical care to the patient; however, your safety is a priority, so you must ensure that the scene is safe to enter. At times, you may have to transport the patient to the hospital before law enforcement arrives. While emergency medical care is being provided, you must be careful not to disturb the scene of the crime any more than absolutely necessary. Notes and drawings should be made of the position of the patient and of the presence and position of any weapon or other objects that may be valuable to the investigating officers. If possible, do not cut through holes in clothing that were caused by weapons or gunshot wounds. Avoid walking through blood and try to avoid leaving footprints in the dirt or grass at or near a crime scene. When a sexual assault is suspected, try to persuade the victim not to shower or clean himself or herself. You should confer periodically with local authorities and be aware of their wishes regarding actions you should take at the scene of the crime. It is best if these guidelines can be established by protocol.

The Deceased

In most states, EMTs do not have the authority to pronounce a patient dead. If there is any chance that life exists or that the patient can be resuscitated, you must make every effort to save the patient at the scene and during transport. However, at times death is obvious. If a victim is clearly dead and the scene of the emergency may be where a crime was committed, do not move the body or disturb the scene.

Ethical Responsibilities

In addition to legal duties, you have certain ethical responsibilities as a health care provider. These responsibilities are to yourself, your patients, your coworkers, and the public. **Ethics** is the philosophy of right and wrong, of moral duties, and of ideal professional behavior. It is often referred to as the study of morality. **Morality** is a code of conduct that can be defined by society, religion, or a person, affecting character and conscience. An entire field of ethics known as **bioethics** has evolved over the past several decades that addresses issues that arise in the practice of health care. Many such issues have drawn national attention, such as those dealing with the termination of life support, rationing of medical resources, and physician-assisted suicide. Ethical issues are present in nearly every EMS incident. As an EMT, you will be expected to conduct yourself in a manner that is consistent with the standards of your profession and to keep the best interests of your patients at the forefront of your conduct and decision making. The manner in which principles of ethics are incorporated into professional conduct is known as **applied ethics**.

You will encounter ethical dilemmas in the course of your employment that can be challenging to resolve. Examples might include the following:

- Your partner arrives at work smelling of alcohol.
- You are called to the scene of a belligerent driver who has seriously injured several children after causing a crash while drag racing.
- You are dispatched to a 9-1-1 call for chest pain. Your partner recognizes the address and tells you not to use the lights and siren since this is a “frequent flyer” who constantly calls 9-1-1 to get attention.
- You respond to the home of an older woman in cardiac arrest. One relative hands you DNR paperwork and states the patient didn’t want to be resuscitated. Another relative demands that you do everything possible to save the patient.
- One of your coworkers is unable to attend a training session and asks you to sign him in, stating, “You know I would do it for you.”

The manner in which you respond to each of these circumstances requires you to evaluate and apply your own ethical standards as well as those of your profession. Obviously, these choices can be difficult at times, particularly in those cases where your own personal standards of right and wrong do not necessarily agree with the standards of your profession. You know you should report that your partner may be intoxicated while on duty, even if he is a good friend. You might also want to honor the patient's DNR wishes, but medical control may order you to initiate care based on the family's request.

Your behavior both on and off the job will be a reflection of your personal ethical standards. News stories that depict EMS personnel engaging in any immature or illegal activities serve to lessen the public's confidence in the services EMTs provide. Illegal drug use or selling drugs, inappropriate use of emergency vehicles, inappropriate visitors entertained at the station, and use of alcohol on duty can impact negatively on the EMT and EMS in general and should be strictly forbidden.

You also may not stand by silently and watch as other EMS providers engage in misbehavior if you care about your patients, your coworkers, and the EMS system as a whole. Misconduct should be promptly reported to the appropriate chain of command. Similarly, you are obligated to report medical errors you make or witness to the medical director or another appropriate person as soon as possible.

As any group of professionals should, EMS providers should establish their own ethical standards and police the ethical behavior of their members. How can you make sure that you are acting ethically, especially with all the decisions you have to make in the field? First, you should consider all options available to you and the consequence of each option. Have decisions been made in the past regarding a similar situation; can an existing policy or rule be applied? How will the consequences of your decision provide the greatest benefit in view of all the alternatives? Involve online medical control in your decision making **Table 3-2**.

You must meet your legal and ethical responsibilities while caring for your patients' physical and emotional needs. Patient needs will vary depending on the situation, and you must be prepared to offer whatever physical and emotional support is necessary. In most cases that you will encounter as an EMT, there will be a rule, a law, or a policy that will guide your decision making and your actions. As a professional, you are bound to follow all such policies, rules, and laws even in those rare circumstances where your own personal sense of ethics might lead you to a different result. In short, your professional ethics trump personal morals while on duty.

Table 3-2 Ethical Decision Making Checklist

	Yes	No
Is the decision in the best interests of the patient?	❑	❑
Is the decision based on logic and reason rather than emotion?	❑	❑
Does the decision protect the patient's rights?	❑	❑
Would you agree to the same decision if you were the patient?	❑	❑
Would you make the same decision again in similar circumstances?	❑	❑
Can you defend this decision to others?	❑	❑

One unquestionable responsibility you have is honest reporting. Remember, absolute honesty in reporting is essential. You must provide a complete account of the events and the details of all patient care and professional duties.

The EMT in Court

As an EMT, there are a number of different circumstances that might cause you to end up in court, either as a witness or a defendant in a civil lawsuit or as a witness or defendant in a criminal case. Regardless of the circumstances, being in court is often stressful. As a witness in a civil case, you may be called to testify about the condition of the plaintiff when you arrived at the scene of a crash and about the treatment that you provided. In a criminal case, you may be asked to describe a crime scene, the injuries that you found when you examined a crime victim, or to testify concerning any admissions or statements made to you by a criminal defendant.

Whenever you are subpoenaed to testify in any court proceeding, you should immediately notify the director of your service and legal counsel. As a witness you should remain neutral during your testimony. You are simply there to provide the facts as you observed them and not to take sides. In all likelihood, many of the questions that you will be asked will be based on the documentation you wrote at the time of the incident. Be sure to review your run report prior to your court appearance **Figure 3-12**.

As a defendant in either a civil or criminal proceeding, your involvement will obviously be far more significant and the outcome will have far greater personal consequences. In either case, you will definitely require the assistance of an attorney. In a civil lawsuit, where you are being sued in your capacity as an employee or volunteer of an EMS system, your service or its insurance company generally will provide you with legal counsel.

A civil lawsuit begins with the service of a summons and complaint. The complaint will set forth the details of the plaintiff's case and will provide the theory on which the plaintiff is relying to recover a judgment against you and your service. If served with a summons, you must bring this to the attention of the head of your service immediately, because the complaint must be responded to within a set period of time that is usually within 20 to 30 days. The response to the complaint is called an answer and it will generally deny the claims set forth in the complaint and set forth one or more defenses on behalf of you and your service. A defense is essentially a reason why the plaintiff should not recover a judgment against you. Depending on the nature of the case filed against you, the type of EMS system that you work for, and the state where you work, there may be different possible defenses available to you. These may include the defenses of statute of limitations, immunity, or contributory negligence.

The **statute of limitations** is the time within which a case must be commenced. For example, in many states, a claim for negligence must be commenced within 3 years. A case commenced beyond the 3-year period would be barred by the statute of limitations. In such a case, your attorney would include the defense of statute of limitations in the answer that is filed in response to the complaint.

Figure 3-12 Court discussions will be based on your documentation. Make sure your documentation is neat, thorough, and accurate.

Another possible defense is that of governmental immunity. **Governmental immunity** generally applies only to EMS systems that are operated by municipalities or other governmental entities. If your service is covered by immunity, it may mean that you cannot be sued at all or it may limit the amount of the monetary judgment that the plaintiff may recover. State laws vary significantly on both the statute of limitations and immunity, and you should understand the laws that apply in your state.

Contributory negligence is a legal defense that may be raised when the defendant feels that the conduct of the plaintiff somehow contributed to any injuries or damages that were sustained by the plaintiff. For example, you are treating a patient with chest pain and you feel that the administration of aspirin is indicated. You ask the patient if he is allergic to aspirin and he says no. Shortly after you administer the aspirin, the signs and symptoms of a severe allergic reaction develop in the patient. Later in the hospital, the doctor advises you that the patient's medical chart history indicates that the patient has an allergy to aspirin. The patient states that he forgot he was allergic to aspirin. In this case, the defense of contributory negligence might be raised since it was the patient's forgetfulness and his denial of an aspirin allergy that contributed to his allergic reaction.

The next phase of the case is known as **discovery**, and it is an opportunity for both sides to obtain information that will enable the attorneys to have a better understanding of the case and assist in negotiating a possible settlement or in preparing for trial. Discovery may include interrogatories, depositions, requests for production of documents, and physical examinations. **Interrogatories** are written questions that each side sends to the other, and **depositions** are oral questions asked of parties and witnesses under oath. On completion of the discovery phase, the parties may try to negotiate a possible settlement. Most cases are settled and do not go to trial. If a settlement is not able to be negotiated, the case will be set for trial. It is not uncommon for a case to take several years to get to trial.

At trial, each side will have an opportunity to present evidence that includes testimony of witnesses and documents such as medical reports and your run report. Witnesses may include experts such as physicians. Once both sides have concluded presenting evidence, a judge or jury will render a decision or verdict. If a judgment is rendered against you or your service, the plaintiff may be awarded compensatory or punitive damages:

1. **Compensatory damages**. These damages are intended to compensate the plaintiff for the injuries he or she sustained such as medical bills, damages to personal property, lost earnings, and physical or emotional pain and suffering.
2. **Punitive damages**. Punitive damages are not commonly awarded in negligence cases and are reserved for those cases where the defendant has acted intentionally or with a reckless disregard for the safety of the public.

In most cases, if a judgment is rendered against you, your service or its insurance carrier will pay the judgment.

There is also the possibility that you could be arrested and charged with a criminal offense arising out of your employment as an EMS provider. Although these are rare occurrences, there have been EMTs who have been charged with crimes including theft of patient property, assault or sexual assault on a patient, operating a vehicle while under the influence of drugs or alcohol, or various drug-related offenses. Obviously, any arrest is considered very serious because a conviction could lead to imprisonment, the imposition of fines, and possible loss of the ability to practice as an EMT. Any EMT charged with a criminal offense should secure the services of a highly experienced criminal attorney immediately.

YOU are the Provider — SUMMARY

1. Why is it essential that you obtain consent to treat the patient once you arrive?

Consent is required from every conscious adult before care can be started. The adult patient who is conscious, rational, and capable of making informed decisions has a legal right to refuse care. The patient does not forfeit this right simply because you disagree or because it may not be the best medical decision. The law allows the patient to make choices that may seem medically unsound and might even endanger his or her own life. Failing to honor a competent adult patient's right to refuse care or transport may be grounds for both criminal and civil action against you.

2. Should you assess the patient's competency or decision making capacity once you arrive?

Your role is to assess the patient's decision making capacity. Although the terms *competence* and *decision making capacity* are often thought of interchangeably, there is a distinction. Competence is typically determined by a court of law, whereas decision making capacity refers to whether a patient is capable of making a rational decision. Assessing a patient's decision making capacity can often be complicated in the prehospital setting, and you may require the assistance of medical control to make the best decision.

3. Are you legally authorized to treat this patient? Why or why not?

At this point, you have not obtained consent from the patient to begin treating him; in fact, you haven't even introduced yourself. Under most circumstances, you may not begin treatment of a mentally competent adult until he or she has given you permission, or consent, to do so. If the patient has decision making capacity—that is, he or she is conscious, alert, not under the influence of drugs or alcohol, and of legal age (18 years in most states)—you cannot legally provide care, even if the patient is obviously sick or injured. Providing care without the patient's consent may be grounds for both criminal and civil action, such as assault and battery.

4. How does informed consent differ from implied consent?

A patient's consent must be informed, which means you have explained the nature of the treatment being offered, including the potential risks, benefits, and alternatives to treatment, as well as any potential consequences of refusing treatment, and the patient has given consent.

Implied consent is based on the legal assumption that a critically ill or injured patient, who is physically unable to give consent (ie, unconscious, under the influence of drugs or alcohol), would consent to EMS treatment and transport if he or she were physically able to do so. Consent to treat is also implied when caring for a minor whose parents or caregivers are unable to be located; a minor cannot legally consent to or refuse medical care.

5. What should you do when a patient refuses treatment and/or transport?

When a patient refuses treatment and/or transport, it is not unreasonable to ask why he or she does not wish to be treated. Many people refuse treatment because of financial concerns or the fact that they are scared. In this case, you should explain that his high blood pressure and severe headache could indicate bleeding in the brain or some other potentially life-threatening condition and that only a physician can diagnose his problem. Do not be afraid to advise the patient that his refusal could ultimately result in death; this is not a scare tactic, it is the truth and the patient has a right to hear it.

If, despite your best efforts to obtain consent to treat, a mentally competent adult still refuses, there is little else you can legally do. You should, however, inform medical control of the situation. In some cases, the physician may wish to speak directly to the patient.

6. What questions should you ask yourself to help determine whether you can transport this patient against his will?

When a patient refuses treatment, you must assess his or her decision-making capacity. Is the patient's mental condition impaired? Is the patient under the influence of drugs or alcohol? Is the patient of legal age? Is the patient a danger to himself/herself or others? These are but a few of the questions that must be answered.

In this case, there is no evidence that has been uncovered thus far that the patient's decision making capacity is impaired, and although he needs medical attention for his headache and blood pressure, you cannot legally force him to accept it, nor can you transport him against his will.

The best course of action is to ensure that the patient is aware of the potential consequences of his refusal—namely, death—and contact medical control to apprise him or her of the situation.

7. Does HIPAA affect the medical care you provide to your patients? What information are you allowed to discuss with family members, bystanders, the media, and others?

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) has many aims; however, the section of the act that most directly affects EMS relates to patient privacy. *Confidential patient information* includes patient history, assessment findings, treatment, etc. HIPAA provides guidance on why types of information are protected, the responsibility of health care providers regarding that protection, and penalties for breaching that protection. Confidential information can be shared under conditions, such as for continuity of care and for billing purposes. *You should not allow HIPAA to affect the medical care that you provide to a patient*.

You must be very careful about what you discuss with family members, bystanders, the media, etc. You must protect the patient's confidential information. There may be times when this is difficult, especially with concerned family members. When in doubt about what to share, simply provide reassurance that everyone is doing his or her best for the patient.

8. How do you respond to the clerk's question in a professional manner without violating HIPAA regulations?

This is a great opportunity to praise a conscientious bystander who did the right thing. Thank the clerk, but do not provide him with any confidential patient information. For example, "You did the right thing during a stressful situation and we appreciate it. We are required to protect the patient's privacy, but I want to reassure you we will take excellent care of the patient from here."

9. Should you report the patient's use of illegal substances to law enforcement personnel? Why or why not?

The patient's use of cocaine is pertinent medical information that may have an impact on the care he receives at the hospital; therefore, it should be included in your patient care report and your oral report to the receiving facility. However, the US Supreme Court has held that drug use or addiction (in contrast to possession or sale) is an illness and not a crime. Therefore, you are not legally required to report the patient's admitted use of these substances to law enforcement personnel. If you are in doubt, consult with your EMS medical director. More important, you must be familiar with the reporting requirements of the state in which you function as an EMT.

10. Why is it a good idea to have the receiving nurse sign your PCR acknowledging the transfer of care?

Sign-off is important for several reasons. It ensures that an equal or higher medical authority has accepted care of the patient from you. It also provides a record of who accepted care of the patient in the event there are any questions later. Failure to appropriately transfer care at the receiving hospital may be considered abandonment. Your documentation should show that you have met this obligation.

EMS Patient Care Report (PCR)

Date: 4-19-17	**Incident No.:** 040109	**Nature of Call:** Headache		**Location:** 1175 N. Main St.	
Dispatched: 1720	**En Route:** 1721	**At Scene:** 1731	**Transport:** 1739	**At Hospital:** 1748	**In Service:** 1801

Patient Information

Age: 32 **Sex:** M **Weight (in kg [lb]):** 91 kg (200 lb)	**Allergies:** None **Medications:** Prinivil **Past Medical History:** Hypertension **Chief Complaint:** Severe headache

Vital Signs

Time: 1735	**BP:** 200/110	**Pulse:** 110	**Respirations:** 24	**Spo_2:** 98%
Time: 1741	**BP:** 194/108	**Pulse:** 104	**Respirations:** 22	**Spo_2:** 99%
Time: 1747	**BP:** 166/94	**Pulse:** 90	**Respirations:** 18	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Dimmed lights, position of comfort

Narrative

9-1-1 dispatch for a man with a severe headache. On arrival at the scene, found the patient, a 32-year-old man, sitting on the sidewalk outside convenience store, grabbing his head in pain. He was conscious and alert; his airway was patent, and his breathing was adequate. Patient states that his headache began a few hours earlier and that he has not taken his prescribed antihypertensive medication. No trauma was involved in this incident. Past medical history significant for hypertension. He denies loss of consciousness, nausea, or any other symptoms. Patient was initially hesitant to consent to EMS treatment and transport. However, after the potential complications of his refusal were explained to him, he agreed to EMS treatment and transport. Obtained vital signs and performed further assessment, which was unremarkable. Placed patient onto stretcher, loaded him into the ambulance, dimmed the lights, and placed him in a position of comfort. Began transport to the hospital and monitored his condition en route. Patient admitted to using cocaine, but he did not feel this was contributing to his condition. Patient remained conscious and alert during transport and stated that his headache was improving. Reassessment of his vital signs revealed that his blood pressure had improved. Delivered patient to emergency department staff and gave oral report to charge nurse.**End of report**

Prep Kit

Ready for Review

- Under most circumstances, consent is required from every conscious adult before care can be started. The foundation of consent is decision making capacity.
- You should never withhold lifesaving care unless a valid do not resuscitate (DNR) order is present.
- Because a minor might not have the wisdom, maturity, or judgment to give consent, the law requires that a parent or legal guardian give consent for treatment or transport.
- Adults who are conscious and alert and who appear to have decision making capacity have the right to refuse treatment or withdraw from treatment at any time, even if doing so may result in serious injury or death.
- You should include all information pertaining to patient refusals in your patient care report (PCR).
- Communication between you and the patient is considered confidential and generally cannot be disclosed without permission from the patient or a court order.
- Advance directives, living wills, or health care directives are most commonly used when a patient becomes comatose. Physician Orders for Life-Sustaining Treatment and Medical Orders for Life-Sustaining Treatment forms explicitly describe acceptable interventions for the patient in the form of medical orders.
- There are both definitive and presumptive signs of death. In many states, death is defined as the absence of circulatory and respiratory function.
- Consent to organ donation is evidenced by either a donor card or a driver's license indicating that the individual wishes to be a donor.
- Standard of care is established in many ways, among them local customs, statutes, ordinances, protocols, textbooks, administrative regulations, and case law. The scope of practice outlines the care you are able to provide for the patient.
- Once your ambulance responds to a call or treatment is begun, you have a legal duty to act. In most cases, if you are off duty and come upon a crash, you are not legally obligated to stop and assist patients.
- Determination of negligence is based on the following four factors: duty, breach of duty, damages, and causation. All four elements must be present for the legal doctrine of negligence to apply and for a plaintiff to prevail in a lawsuit against an EMS system or provider.
- Abandonment is the termination of care without the patient's consent and without making provisions for the transfer of care to a medical professional with skills at the same level or at a higher level than your own skills. Abandonment is legally and ethically a very serious act. Always try to obtain a signature on your PCR from the person accepting transfer of care.
- Assault is defined as unlawfully placing a person in fear of immediate bodily harm. Battery is unlawfully touching a person; this includes providing emergency care without consent. To protect yourself from these charges, be sure to obtain expressed consent whenever possible.
- To avoid liability for defamation, you must only communicate information about your patients to authorized people and you should be sure that the information contained in your run reports and other documentation is accurate and relevant.
- Good Samaritan laws are based on the common law principle that when you reasonably help another person, you should not be liable for errors and omissions that are made in giving good faith emergency care. Whereas some laws provide Good Samaritan protection for anyone who stops to render aid, others only provide protection for those with medical training.
- Records and reports are important; make sure that you compile a complete and accurate record of each incident. The courts consider an action or procedure that was not recorded on the written report as not having been performed, and an incomplete or untidy report is considered evidence of incomplete or inexpert medical care.
- You should know what the special reporting requirements are involving abuse of children, older adults, and others; injuries related to crimes; drug-related injuries; and childbirth.
- You must meet your legal and ethical responsibilities while caring for your patients' physical and emotional needs.
- As an EMT, there are a number of different circumstances that might cause you to end up in court, either as a witness or a defendant in a civil lawsuit or as a witness or defendant in a criminal case.

Vital Vocabulary

abandonment Unilateral termination of care by the EMT without the patient's consent and without making provisions for transferring care to another medical professional with the skills and training necessary to meet the needs of the patient.

advance directive Written documentation that specifies medical treatment for a competent patient should the patient become unable to make decisions; also called a living will or health care directive.

applied ethics The manner in which principles of ethics are incorporated into professional conduct.

assault Unlawfully placing a patient in fear of bodily harm.

battery Unlawfully touching a patient or providing emergency care without consent.

bioethics The study of ethics related to issues that arise in health care.

breach of confidentiality Disclosure of information without proper authorization.

certification A process in which a person, an institution, or a program is evaluated and recognized as meeting certain predetermined standards to provide safe and ethical patient care.

compensatory damages Damages awarded in a civil lawsuit that are intended to restore the plaintiff to the same condition that he or she was in prior to the incident.

competent Able to make rational decisions about personal well-being.

consent Permission to render care.

contributory negligence A legal defense that may be raised when the defendant feels that the conduct of the plaintiff somehow contributed to any injuries or damages that were sustained by the plaintiff.

credentialing An established process to determine the qualifications necessary to be allowed to practice a particular profession, or to function as an organization.

decision-making capacity Ability to understand and process information and make a choice regarding appropriate medical care.

defamation The communication of false information about a person that is damaging to that person's reputation or standing in the community.

dependent lividity Blood settling to the lowest point of the body, causing discoloration of the skin; a definitive sign of death.

depositions Oral questions asked of parties and witnesses under oath.

discovery The phase of a civil lawsuit where the plaintiff and defense obtain information from each other that will enable the attorneys to have a better understanding of the case and which will assist in negotiating a possible settlement or in preparing for trial. Discovery includes depositions, interrogatories, and demands for production of records.

do not resuscitate (DNR) orders Written documentation by a physician giving permission to medical personnel not to attempt resuscitation in the event of cardiac arrest.

durable power of attorney for health care A type of advance directive executed by a competent adult that appoints another individual to make medical treatment decisions on his or her behalf, in the event that the person making the appointment loses decision-making capacity.

duty to act A medicolegal term relating to certain personnel who either by statute or by function have a responsibility to provide care.

emancipated minors A person who is under the legal age in a given state but, because of other circumstances, is legally considered an adult.

emergency A serious situation, such as injury or illness that threatens the life or welfare of a person or group of people and requires immediate intervention.

emergency doctrine The principle of law that permits a health care provider to treat a patient in an emergency situation when the patient is incapable of granting consent because of an altered level of consciousness, disability, the effects of drugs or alcohol, or the patient's age.

emergency medical care Immediate care or treatment.

ethics The philosophy of right and wrong, of moral duties, and of ideal professional behavior.

expressed consent A type of consent in which a patient gives verbal or nonverbal authorization for provision of care or transport.

false imprisonment The confinement of a person without legal authority or the person's consent.

forcible restraint The act of physically preventing an individual from initiating any physical action.

Good Samaritan laws Statutory provisions enacted by many states to protect citizens from liability for errors and omissions in giving good faith emergency medical care, unless there is wanton, gross, or willful negligence.

governmental immunity Legal doctrine that can protect an EMS provider from being sued or which may limit the amount of the monetary judgment that the plaintiff may recover; generally applies only to EMS systems that are operated by municipalities or other governmental entities.

gross negligence Conduct that constitutes a willful or reckless disregard for a duty or standard of care.

health care directive A written document that specifies medical treatment for a competent patient, should he or she become unable to make decisions. Also known as an advance directive or a living will.

health care proxies A type of advance directive executed by a competent adult that appoints another individual to make medical treatment decisions on his or her behalf in the event that the person making the appointment loses decision making capacity. Also known as a durable power of attorney for health care.

implied consent Type of consent in which a patient who is unable to give consent is given treatment under the legal assumption that he or she would want treatment.

informed consent Permission for treatment given by a competent patient after the potential risks, benefits, and alternatives to treatment have been explained.

in loco parentis Refers to the legal responsibility of a person or organization to take on some of the functions and responsibilities of a parent.

interrogatories Written questions that the defense and plaintiff send to one another.

kidnapping The seizing, confining, abducting, or carrying away of a person by force, including transporting a competent adult for medical treatment without his or her consent.

libel False and damaging information about a person that is communicated in writing.

licensure The process whereby a competent authority, usually the state, allows people to perform a regulated act.

medicolegal A term relating to medical jurisprudence (law) or forensic medicine.

morality A code of conduct that can be defined by society, religion, or a person, affecting character, conduct, and conscience.

negligence Failure to provide the same care that a person with similar training would provide.

negligence per se A theory that may be used when the conduct of the person being sued is alleged to have occurred in clear violation of a statute.

patient autonomy The right of a patient to make informed choices regarding his or her health care.

protected health information (PHI) Any information about health status, provision of health care, or payment for health care that can be linked to an individual. This is interpreted rather broadly and includes any part of a patient's medical record or payment history.

proximate causation When a person who has a duty abuses it, and causes harm to another individual, the EMT, the agency, and/or the medical director may be sued for negligence.

punitive damages Damages that are sometimes awarded in a civil lawsuit when the conduct of the defendant was intentional or constituted a reckless disregard for the safety of the public.

putrefaction Decomposition of body tissues; a definitive sign of death.

res ipsa loquitor When the EMT or an EMS system is held liable even when the plaintiff is unable to clearly demonstrate how an injury occurred.

rigor mortis Stiffening of the body muscles; a definitive sign of death.

scope of practice Most commonly defined by state law; outlines the care that the EMT is able to provide for the patient.

slander False and damaging information about a person that is communicated by the spoken word.

standard of care Written, accepted levels of emergency care expected by reason of training and profession; written by legal or professional organizations so that patients are not exposed to unreasonable risk or harm.

statute of limitations The time within which a case must be commenced.

tort A wrongful act that gives rise to a civil lawsuit.

Assessment *in Action*

You are dispatched to a home where you find a 65-year-old man reporting chest pain. The patient is alert and oriented. Assessment of his vital signs shows a pulse rate of 110 beats/min and irregular, a blood pressure of 140/90 mm Hg, and a respiratory rate of 22 breaths/ min. He describes the pain as crushing. He has an extensive cardiac history and is taking numerous medications. The patient states he does not want to go to the hospital and that his friend was overreacting by calling EMS. Your partner hands the patient a refusal form and states "Sign here; it says if you die, it's not our fault." In the ambulance, you tell your partner, "We should have tried to convince him to go to the hospital." Your partner replies, "Don't worry, he signed a refusal. We can't be held liable."

1. Once your ambulance is dispatched to an emergency, you have an obligation to respond. This is known as:

   A. scope of practice.
   B. duty to act.
   C. breach of duty.
   D. mandatory reporting.

2. Upon arrival at the scene, your partner began assessing vital signs without talking to the patient. This demonstrates:

   A. effective interpersonal communication.
   B. patient advocacy.
   C. failure to obtain consent.
   D. breach of duty.

3. Suppose your partner had introduced himself and asked permission to examine the patient. If the patient nodded and extended his arm, this would be considered:

A. mature consent.
B. implied consent.
C. informed consent.
D. expressed consent.

4. What is the best way to care for your patient once he tells you he does not want to go to the hospital?

A. Let him know how important it is that he accept transport to the hospital.
B. Ask him to sign a refusal form, releasing you from liability.
C. Order him to go to the hospital against his wishes.
D. Encourage him to call 9-1-1 again if his condition worsens.

5. While caring for this patient, you hear a neighbor cry for help; a child is drowning just around the corner. You and your partner leave, telling the patient you must respond to this incident and will send another ambulance for him as soon as possible. This decision is an example of:

A. triage.
B. abandonment.
C. patient advocacy.
D. duty to act.

6. On another call that day, your patient consented to treatment and transport after you told her she could be experiencing a serious medical emergency. This is an example of:

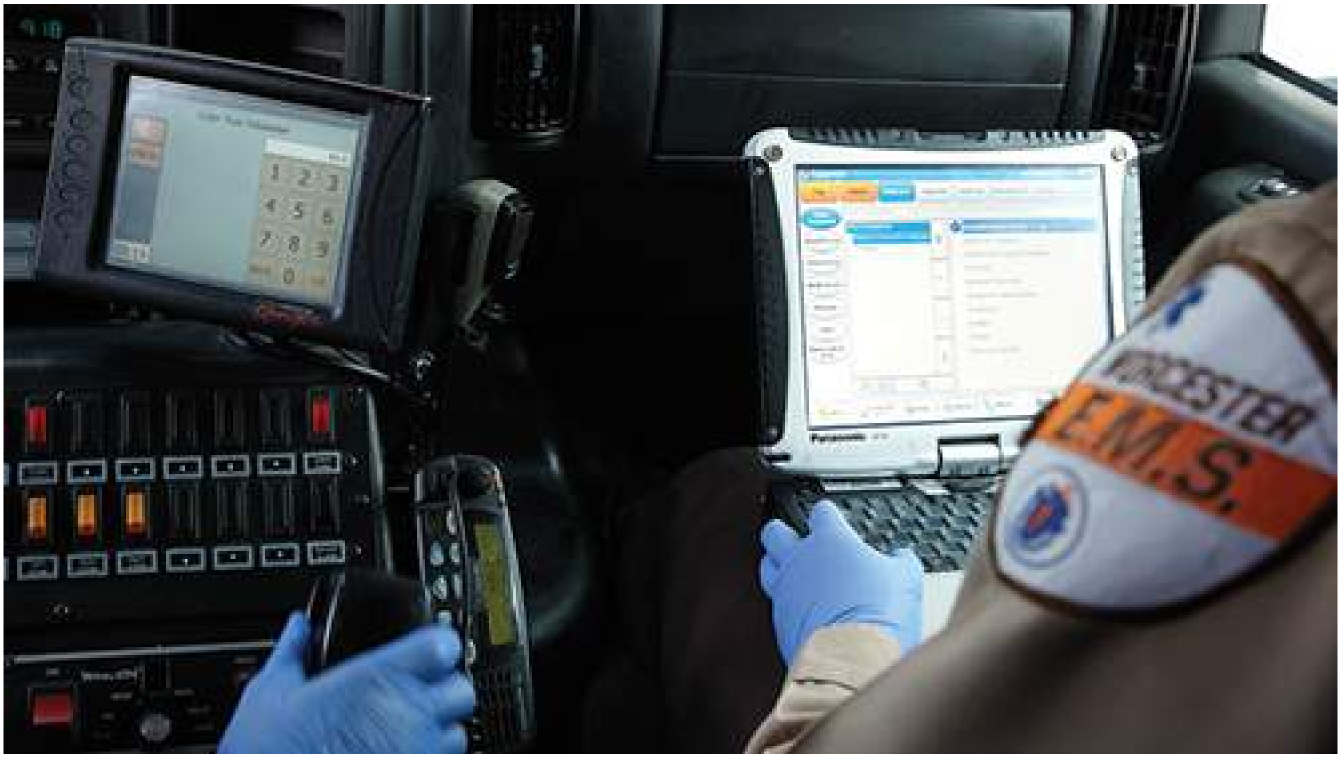
A. scope of practice.
B. implied consent.
C. serving in the patient's best interest.
D. an EMS field impression.

7. What ethical challenges were you presented with during this call?

8. If a patient says he has used heroin recently, who should you tell about this?

CHAPTER 4

Communications and Documentation



National EMS Education Standard Competencies

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal, and ethical issues to the provision of emergency care.

Therapeutic Communication

Principles of communicating with patients in a manner that achieves a positive relationship

› Interviewing techniques (pp 116–120)
› Adjusting communication strategies for age, stage of development, patients with special needs, and differing cultures (pp 114–115, 120–124)
› Verbal defusing strategies (pp 115–117)
› Family presence issues (pp 119–120)

EMS System Communication

Communication needed to
› Call for resources (pp 140–141)
› Transfer care of the patient (pp 124–127, 142–143)
› Interact within the team structure (pp 140–142)
› EMS communication system (pp 135–139)
› Communication with other health care professionals (pp 124–125, 142–145)
› Team communication and dynamics (pp 124–125, 142–145)

Documentation

› Recording patient findings (pp 126–135)
› Principles of medical documentation and report writing (pp 126–135)

Medical Terminology

Uses foundational anatomical and medical terms and abbreviations in written and oral communication with colleagues and other health care professionals.

Knowledge Objectives

1. Describe the factors and strategies to consider for therapeutic communication with patients. (pp 113–125)
2. Discuss the techniques of effective verbal communication. (pp 116–125)
3. Explain the skills that should be used to communicate with family members, bystanders, people from other agencies, and hospital personnel. (pp 116–125)
4. Discuss special considerations in communicating with older people, children, patients who are hard of hearing, visually impaired patients, and non–English-speaking patients. (pp 120–124)
5. Describe the use of written communications and documentation. (pp 126–134)
6. State the purpose of a patient care report (PCR) and the information required to complete it. (pp 126–132)
7. Explain the legal implications of the PCR. (pp 130–131)
8. Describe how to document refusal of care, including the legal implications. (pp 132–135)
9. Discuss state and/or local special reporting requirements, such as for gunshot wounds, dog bites, and abuse. (p 135)
10. Describe the basic principles of the various types of communications equipment used in EMS. (pp 135–139)
11. Describe the use of radio communications, including the proper methods of initiating and terminating a radio call. (pp 139–145)
12. List the correct radio procedures in the following phases of a typical call: initial receipt of call, en route to call, on scene, arrival at hospital (or point of transfer), and return to service. (pp 139–142)
13. List the proper sequence of information to communicate in radio delivery of a patient report. (pp 142–143)

Skills Objectives

1. Demonstrate the techniques of successful cross-cultural communication. (pp 114–115)
2. Demonstrate completion of a PCR. (pp 126–135)
3. Demonstrate how to make a simulated, concise radio transmission with dispatch. (pp 139–143)

Introduction

Communication is the transmission of information to another person—whether it is verbal or nonverbal (through body language). Effective communication is an essential component of prehospital care and is necessary to achieve a positive relationship with patients and coworkers.

Verbal communication skills are vitally important for EMTs. Your verbal skills will enable you to gather information from the patient and bystanders. These skills will also make it possible for you to effectively coordinate with the variety of responders who are often present at the scene. Excellent verbal communication is also an integral part of transferring the patient's care to the nurses and physicians at the hospital.

Documentation is the written or electronically recorded portion of your patient care interaction that becomes part of the patient's permanent medical record. It serves many purposes, including demonstrating that the care delivered was appropriate and within the scope and practice of the providers involved. Documentation also provides an opportunity to communicate the patient's story to others who may participate in the patient's care in the future. Adequate reporting and accurate records ensure the continuity of patient care. Complete patient records also guarantee proper transfer of responsibility, comply with the requirements of health departments and law enforcement agencies, and fulfill your organization's administrative needs. Reporting and record-keeping duties are an essential aspect of patient care, although they are performed only after the patient's condition has been stabilized. Documentation in the field drives both funding and research for EMS. Seat belts are a prime example. Studies gathered from record keeping in the early 1970s showed that patients have a significantly higher survival rate if seat belts are used during motor vehicle crashes. Armed with this information, laws were passed to enforce seat belt usage, and huge amounts of money were spent on educating the public.

Radio and telephone communications link you and your team with other members of the EMS, fire, and law enforcement communities. This link helps the entire team to work together more effectively and provides an important layer of safety and protection for each member of the team. You must know what your system can and cannot do, and you must be able to use your system efficiently and effectively.

This chapter describes the factors and strategies that you need to be an effective communicator, discusses a variety of effective methods of verbal communication, and provides guidelines for appropriate written documentation of patient care. The chapter concludes by identifying the kinds of communication equipment that are used, along with standard radio operating procedures and protocols. The roles of the Federal Communications Commission in EMS are also described.

Therapeutic Communication

How do we communicate? This simple question can be surprisingly complex as there are a number of things to consider during communication Table 4-1. Therapeutic communication uses various communication techniques and strategies, both verbal and nonverbal, to encourage patients to express how they are feeling and to achieve a positive relationship with the patient. This section will discuss the factors and strategies that are necessary for therapeutic communication.

People communicate in a variety of ways, such as through eye contact, body position, and facial expressions. Factors such as culture and age need to be taken into consideration during communication. Patients with special needs may require you to consider alternative forms of communication. For example, if your patient is deaf and you cannot communicate using sign language, you may need to communicate by having the patient write down his feelings.

YOU are the Provider — PART 1

At 0610 hours, your BLS unit is dispatched to 514 E. Bandera Street for a "sick person." You and your partner proceed to the scene, which is approximately 10 minutes away. En route, the dispatcher contacts you and states that she still has the caller on the phone.

1. What information should you ask the dispatcher to obtain from the caller?
2. Why is effective communication between the responding EMS unit and the dispatcher so important?

Table 4-1 Factors and Strategies to Consider During Communication

Age	Eye contact
Body language	Facial expression
Clothing	Gender
Culture	Posture
Education	Voice tempo
Environment	Volume

Words of Wisdom

The Shannon–Weaver communication model was developed to assist in the mathematical theory of communication for Bell Telephone Labs in the late 1940s **Figure 4-1**. Shannon and Weaver were trying to figure out the math involved in sending information through telephone lines. After its creation, it quickly became apparent that this model had application in areas other than math. Social scientists adopted this model and it remains a valuable tool in understanding the variables involved in human communication. In the communication model, the sender must take a thought, encode it into a message, and send the message to the receiver. The receiver then decodes the message and sends feedback to the sender.

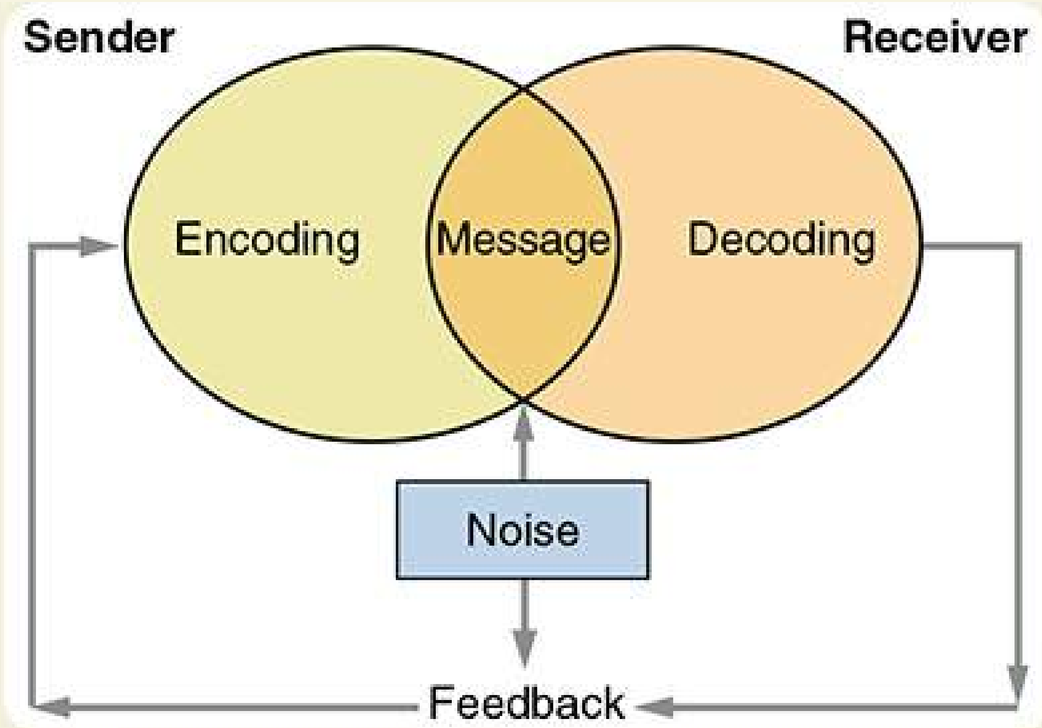


Figure 4-1 Shannon–Weaver communication model.

Age, Culture, and Personal Experience

The thoughts of people are greatly influenced by their personal experiences. For example, an older person who often experiences significant pain may view pain as more of an inconvenience than a problem. A child who has limited experience with pain would likely react much differently. People from various cultures are taught to handle illness, injury, and pain differently. Some cultures encourage people to express their emotions; others see it as a sign of weakness. These social and personal pressures will shape how people communicate.

Patients may talk, make gestures, or write a note to express how they are feeling. “I am so sorry to bother you, but my chest hurts a little.” “Hey! What took you so long? My chest is killing me! Are you going to help me or what?” Both of these messages talk about pain, but they also have much more information within them.

The tone, pace, and volume of the language will tell you about the mood of the person communicating. These clues also provide some insight into the perceived importance of the message. For example, the patient who is yelling at you may be angry, scared, or both. Take note not only of the words being spoken, but how they are said.

You need to recognize that these concepts of body language and eye contact are often greatly affected by culture. In some cultures, direct eye contact is viewed as impolite, while in other cultures, it is impolite to look away while speaking. For example, in the United States and most European countries, direct eye contact conveys honesty and respect. Conversely, in Latin-American, Asian, and African cultures, direct eye contact conveys confrontation.

People tend to translate the messages they receive using their own world view. **Ethnocentrism** occurs when you consider your own cultural values as more important when you are interacting with people of a different culture. If you are North American, for example, you might think that a patient is hiding something, afraid, or untrustworthy if the patient looks away from you while you are talking. These conclusions may be true if the two people communicating are from the same culture. All aspects of communication—eye contact, social distances, body language, and even touching—have a cultural foundation. In Thailand, for example, the touching of the head is reserved for those who are very intimate. This cultural belief can present a problem for you if the patient's head is bleeding.

Cultural imposition takes this idea to an extreme. Some health care providers may consciously or subconsciously force their cultural values onto their patient because they believe their values are better. For example, consider a child who is brought to the emergency department (ED) with red marks on his back from a traditional Asian healing practice called coining—rubbing hot coins on the child's back as a treatment for medical illness. The parents explain to the physician that the coining helped for a short time, but now the child seems to be getting sicker. The physician responds angrily to the parents, accusing them of potential abuse and insisting that their practices are harmful (although they are not). This accusation reflects cultural imposition.

Nonverbal Communication

Facial Expressions, Body Language, and Eye Contact

Eye contact and body language are powerful communication tools. Consider how dogs interact. When two dogs meet for the first time, they look at each other. The position of the head, shoulders, tail, and back all help to communicate to the other dog. Before they get any closer, the dogs need to understand their new relationship. Who is dominant? Will you hurt me? These questions must be answered quickly.

People communicate using a similar technique. The body language we consciously or subconsciously choose provides more information than words alone. Consider the images in Figure 4-2. Without any words, the mood of each of these people should be clear.

Patients can become hostile toward EMS providers. When you are treating a potentially hostile patient, it is important that you understand and be aware of your own body language. People tend to react to anger with anger. If you are dealing with an angry patient, you must stay calm and try to defuse the situation before it escalates. Consider the following steps:

1. **Assess the safety of the scene.** Decide whether you need to call law enforcement. Make sure that you have sufficient backup to ensure the safety of the patient and your crew.
2. **Do not assume an aggressive posture.** Be aware that if you cross your arms, clench your fists, or place your hands on your hips, it sends a message (whether intentional or not) that you are impatient, uninterested, or asserting a position of authority. Instead, stand with your palms facing out; this communicates openness and acceptance and allows for quick movement, if necessary.
3. **Make good eye contact, but do not stare.**
4. **Speak calmly, confidently, and slowly.** With your backup clearly visible, advise the patient what needs to be done, or provide the patient with limited, acceptable choices. "Sir, I need you to sit on the ambulance cot now. Either you will sit on the cot or we will help you to the cot."
5. ***Never* threaten the patient, either verbally or physically.** Personal safety should be your primary concern when caring for any patient, but this is especially true with patients who display hostile behavior.

Figure 4-2 The effectiveness of body language. **A.** Happy. **B.** Angry. **C.** Sad.

Remember, it is important for you to be attentive to facial expressions, body language, and eye contact—your own and your patient's. These physical cues will help you and your patient to truly understand the message being sent. Additional techniques you can use to calm a patient and establish a therapeutic rapport will be discussed later in this chapter.

Words of Wisdom

EMTs must always be dressed professionally. The first impression you make may be influenced by your appearance. Caring for your uniform may improve that impression and enhance your ability to establish trust and rapport with your patients. You are sending the message that you care without speaking a word.

Physical Factors

Various physical factors affect communication, which are referred to as noise. **Noise** is anything that dampens or obscures the true meaning of the message. Literal noise, or sounds in the environment, can make it difficult to understand the patient or for the patient to understand you. Lighting, distance, or physical obstacles are other factors that may affect your communication.

Cultural norms often dictate the amount of space, or proximity, between people when communicating Table 4-2. The degree to which people feel comfortable depends on with whom they are communicating. As a person gets closer, a greater sense of trust must be established. When you finally enter someone's intimate space, there must be a high sense of trust.

Understanding how communication works and the importance of effective communication is important when gathering information from the patient. Your communication skills will be put to the test when you communicate with patients and/or families in emergency situations. Remember that someone who is sick or injured is scared and might not understand what you are doing or saying. Therefore, your gestures, body movements, and attitude toward the patient are critically important in gaining the trust of both patient and family.

Verbal Communication

As an EMT, you must master many communication skills, including those associated with radio operations and written communications. Skilled verbal communication with the patient and family, bystanders, and the rest of the health care team are an essential part of high-quality patient care and transport. You must be able to listen effectively to fully understand the nature of the scene and the patient's problem. You must also be able to organize your thoughts to quickly and accurately verbalize instructions to the patient, bystanders, and other health care professionals.

One of the most fundamental aspects of what EMTs do is to ask patients questions. There are two types of questions: **open-ended questions** are ones in which a patient needs to provide some level of detail to give an answer, whereas **closed-ended questions** can be answered in very short or single-word responses. When first approaching your patient, you should use open-ended questions. "Good day. My name is Chuck and I am an EMT. What seems to be bothering you today?" Open-ended questions allow a free flow of conversation. They let the patient direct you to what is bothering him or her.

Closed-ended questions are important to use when patients are unable to provide long or complete answers to questions. Perhaps the patient is having severe breathing problems, or maybe the patient is a child who is scared and doesn't know what to say. In situations for which thoughtful answers are not possible, closed-ended questions are appropriate and are particularly useful when assessing a patient's condition. "Are you having trouble breathing? Do you take medications for your heart?"

Table 4-2 Guidelines for Personal Space in the United States

Space	Distance	Description
Intimate	Less than 18 in.	Whispering, touching; must be invited
Personal	18 in. to 4 ft	Conversations with close friends or family
Social	4 ft to 10 ft	Conversations with acquaintances
Public	10 ft to 25 ft	Interacting with strangers

With closed-ended questions, however, it is possible for you to miss important issues if pertinent questions are not asked. Imagine how many ways a person can be sick or injured. Now imagine trying to come up with a single yes/no question for each sickness or injury. Closed-ended questions typically provide limited information, and you should consider the answers to these questions as only a starting point toward understanding the patient's condition.

Before beginning your interview with the patient, determine which provider will lead the interview. This will ensure that you and your partner do not ask questions at the same time or ask repetitive questions. When you are asking questions of the patient, be conscious of how many questions you are asking. "How are you doing today? Have you been feeling ill?" This common approach actually asks the patient two kinds of questions, one open-ended and one closed-ended. Often the patient will respond with a simple, "yes." To avoid this situation, it is best to ask a single question, wait for an answer, and then proceed to another question.

There are many powerful communication tools you can use when trying to obtain information from patients. Sometimes patients will hide information, either consciously or unconsciously, due to fear or confusion. The techniques in Table 4-3 provide you with techniques that will assist you in gathering patient information. They can be helpful to use not only with patients who are willing to share, but with those who are resistant to sharing information.

Table 4-3 Therapeutic Communication Techniques

Communication Technique	Definition	Example
Facilitation	Encourage the patient to talk more or provide more information.	EMT: "Can you tell me more about that? I am listening to you."
Silence	Do not speak.	Give the patient space and time to think and respond.
Reflection	Restating a patient's statement made to you to confirm your understanding.	Patient: "I am so depressed that I could die." EMT: "I understand that you are feeling sad."
Empathy	Be sensitive to the patient's feelings and thoughts.	Use eye contact and touching to reinforce communication; adjust tone of voice and pace to allow for open communication
Clarification	Ask the patient to explain what he or she meant by an answer.	Patient: "I just feel sick." EMT: "Can you please tell me what is feeling sick? Can you help me to understand what is going on?"
Confrontation	Make the patient who is in denial or in a mental state of shock focus on urgent and life-critical issues.	Patient: "I am having pain in my chest, my back has been hurting me, I feel nauseated, and I ran out of my blood pressure medication." EMT: "Please tell me about your chest pain. We will talk about your other concerns in a moment."
Interpretation	Restate the patient's complaint to confirm your understanding.	EMT: "If I understand correctly, you have been feeling pain for the past 3 days, and it has gotten worse today." Patient: "That's right."
Explanation	Provide factual information to support a conversation.	Patient: "I do not understand what is happening." EMT: "We have checked your blood sugar and blood pressure and both appear to be normal."
Summary	Provide the patient with an overview of the conversation and the steps you will take.	EMT: "We will be taking you to the emergency department to care for your chest pain. I will be giving you some medication that should make you feel better."

When you interview the patient, consider using touch as a means to communicate caring and compassion. Touch is a powerful tool; therefore, keep in mind that it should be used consciously and sparingly Figure 4-3. Many people will be uncomfortable with a stranger touching them suddenly. If you are going to touch the patient, approach slowly and touch the patient's shoulder or arm respectfully. You can consider holding the patient's hand. This allows you to touch the patient, showing you care about what he or she is telling you, and also allows you to remain at a slight distance.

Avoid touching the patient's torso, chest, or face simply as a means of communication, because these areas are often viewed as intimate. Also, to touch these areas, you will need to get closer to the patient, potentially invading the patient's intimate space. Table 4-4 provides other tips on what to avoid when communicating with patients.

Figure 4-3 Using touch conveys a sense of caring and compassion.

Table 4-4 Interview Techniques to Avoid

Improper Technique	Example	Rationale
Provide false hope or reassurance.	EMT: "It will be okay." "This is nothing to worry about."	You do not know that everything will be okay.
Give unsolicited advice.	EMT: "Well, if I were you, I wouldn't have called the ambulance at all."	This demeans the patient and makes you seem arrogant, rather than helpful.
Ask leading or biased questions.	EMT: "Are you telling me that this cut is the only reason you called the ambulance?"	Your patient deserves respectful communication. It is inappropriate for you to suggest to the patient that an ambulance was not needed, even if that is what you believe.
Talk too much.	The EMT talks to the patient without really listening to the patient, simply going through the motions.	When the patient provides you information, you need to consider the information and guide the conversation toward a goal.
Interrupt the patient.	Patient: "Well, I was having trouble breathing last month and . . ." EMT: "Can we move on to how you are feeling now?"	You may seem bored or annoyed that the patient is taking up your time.
Use "why" questions.	EMT: "Why did you call the ambulance today?"	"Why" questions often appear to accuse the listener. You may seem annoyed that the patient called 9-1-1.
Use authoritative language.	EMT: "Tell me what is wrong with you." "Just give me the details."	This language does not encourage open communication.
Speak in professional jargon.	EMT: "I think we need to take you to the ED stat. We will give you ASA and NTG en route. Any questions?"	This type of communication confuses the patient. Most patients do not understand medical jargon.

Safety Tips

You are constantly communicating, both consciously and unconsciously. As a health care professional, you need to ensure that your body language reflects your words. Remember, people call 9-1-1 when they are in crisis. Part of being a good EMT is being able to project calm and control into a chaotic environment. You may not feel calm, but a good EMT will "never let them see you sweat."

The presence of family, friends, and bystanders during your interview of the patient can be valuable. Sometimes, however, well-meaning family members will speak for the patient, and, at times, you may need to ask the family member to allow the patient to answer. Ultimately, you will need to assess the situation and determine whether the additional people are helping you care for the patient or hindering your efforts. Do not be afraid to ask others to step outside or step aside for a moment while you talk with the patient. It is generally best to keep families together, but in cases where a family member is not helpful, consider giving him or her a task to do, such as gathering medications or clothing. This task can transform the person from a hindrance into a valuable aide. Take into account how the patient will feel without his or her loved ones nearby. Separating them may make the patient more anxious.

These ten Golden Rules will help you to calm and reassure your patient and provide a therapeutic rapport:

1. **Make and keep eye contact with your patient at all times.** Give the patient your undivided attention. This will let the patient know that he or she is your top priority. Look the patient straight in the eye to establish a **rapport**. Establishing a rapport is building a trusting relationship with your patient. This will make caring for the patient much easier.

2. **Provide your name and use the patient's proper name.** Introduce yourself and your partner. If your department provides you with a name tag, wear it. Ask the patient what he or she wishes to be called. Avoid using terms such as "honey" or "dear." Use a patient's first name only if the patient is a child or the patient asks you to use his or her first name. Rather, use a courtesy title, such as "Mr. Peters," "Mrs. Smith," or "Ms. Butler." If you do not know the patient's name, refer to him or her as "sir" or "ma'am."
3. **Tell the patient the truth.** Even if you have to say something very unpleasant, telling the truth is better than lying. Lying will destroy the patient's trust in you and decrease your own confidence. You might not always tell the patient everything, but if the patient or a family member asks a specific question, you should answer truthfully. A direct question deserves a direct answer. If you do not know the answer to a patient's question, say so. For example, a patient may ask, "Am I having a heart attack?" To which you would answer, "I don't know, but we will certainly get more information at the hospital. Right now, I am caring for you just like I would care for someone who is having a heart attack."
4. **Use language that the patient can understand.** Do not talk up or down to the patient in any way. Avoid technical medical terms that the patient might not understand. For example, ask the patient whether he or she has a history of "heart problems." This will usually result in more accurate information than if you ask about "previous episodes of myocardial infarction" or a "history of cardiomyopathy."
5. **Be careful what you say about the patient to others.** You need to understand the relationship between the person you are talking with (such as a bystander) and the patient. Ask the patient if it is okay for you to talk with this person. While speaking to others, ensure that you leave the general area of the patient if you must have a confidential conversation. Be mindful that sharing patient information may be a HIPAA violation. Do not talk about the patient in front of him or her; to do so gives the impression that the patient has no choice in his or her medical care. This is easy to forget when the patient has impaired cognitive (thought) processes or has difficulty communicating.
6. **Be aware of your body language.** Nonverbal communication is extremely important in dealing with patients **Figure 4-4**. In stressful situations, patients may misinterpret your gestures and movements. Be particularly careful not to appear frustrated or threatening. Instead, position yourself at the same level or at a lower level than the patient when practical. Remember that you should always conduct yourself in a calm, professional manner.

Figure 4-4 Watch your body language because patients may misinterpret your gestures, movements, and stance.

7. **Always speak slowly, clearly, and distinctly.** Pay close attention to your tone of voice.
8. **If the patient is hard of hearing, face the person so that he or she can read your lips.** Try lowering or raising the tone of your voice; some people who are hard of hearing can hear certain pitches better than others. Do not shout at a person who is hard of hearing. Shouting will not make it any easier for the patient to hear you and may frighten the patient. Never assume that an older patient is hard of hearing or otherwise unable to understand you. Also, never use "baby talk" with older patients or with anyone other than infants. If you are unable to communicate with the patient, have your partner try. Another technique is to have the patient put the stethoscope in his or her ears while you speak softly into the diaphragm to help amplify the sound.
9. **Allow time for the patient to answer or respond to your questions.** Do not rush a patient unless there is immediate danger. Sick and injured people may not be thinking clearly and may need time to answer even simple questions. This is especially true when treating older patients.
10. **Act and speak in a calm, confident manner while caring for the patient.** Make sure you attend to the patient's pain and needs. Try to make the patient physically comfortable and relaxed. Find out whether the patient is more comfortable sitting or lying down. Is the patient cold or hot? Does the patient want a friend or relative nearby?

Patients literally place their lives in your hands. They deserve to know that you can provide medical care and that you are concerned about their wellbeing. These ten Golden Rules will help provide a good foundation and will make it easier to gather information when the patient wants to talk.

Sometimes, you need to gather information from a reluctant audience. Patients may be defensive about their problems and may not want to talk about them because they are embarrassed. They may direct the conversation away from the true problem. With these patients, start the conversation as usual. Introduce yourself. Be open and compassionate. If you find yourself not getting any real answers, then consider one of the techniques as seen in Table 4-3.

Communicating With Older Patients

According to the US Census Bureau in 2013, nearly 45 million people were older than 65 years. It is projected that by the year 2030, the geriatric population will number more than 70 million, resulting in an ever-increasing number of encounters with people in this category. However, a person's actual age might not be the most important factor in classifying him or her as geriatric. It is more important to determine a person's functional age. The functional age relates to the person's ability to function in daily activities, the person's mental state, health status, and activity pattern.

As an EMS provider, when you enter a scene to care for an older patient, you are being asked to take control. You have been called because a person needs help. What you say and how you say it has an impact on the patient's perception of the call. You should present yourself as competent, confident, and caring. You must take charge of the situation, but do so with compassion. You are there to listen and act on what you learn. Don't limit your assessment to the obvious problem. Oftentimes, older patients who express that they are not well, or who are overly concerned about their health or general condition, are at risk for a serious decline in their physical, emotional, or psychologic state.

Generally speaking, older people think clearly, can give you a clear medical history, and are able to answer your questions appropriately **Figure 4-5**. Do not assume that an older patient is senile or confused. Conversely, communicating with some older patients is extremely difficult, and you may encounter hostility, irritability, and, in fact, some confusion. Do not assume this to be normal behavior for an older patient. These signs may be caused by a simple lack of oxygen (hypoxia), brain injury including a cerebrovascular accident, unintentional drug overdose, infection, abnormal blood glucose, or even insufficient perfusion (circulation of blood and, therefore, nutrients to the cells). Never attribute altered mental status to old age. In addition, your older patients may have difficulty hearing or seeing you. Therefore, you need great patience and compassion when you are called on to care for such a patient. Think of the patient as someone's grandmother or grandfather—or even as yourself when you reach that age.

Words of Wisdom

Remember that not all older patients are cognitively impaired. Be careful to assess each patient's individual abilities.

Approach an older patient slowly and calmly. Allow plenty of time for the patient to respond to your questions. Watch for signs of confusion, anxiety, or impaired hearing or vision. The patient should feel confident that you are in charge and that everything possible is being done for him or her.

Figure 4-5 You need a great deal of compassion and patience when caring for older patients. Never assume that a patient is senile or confused.

Older patients often do not feel much pain. An older person who has fallen or been injured may report no pain. In addition, older patients might not be fully aware of important changes in their body systems. Therefore, be especially vigilant for objective changes—no matter how subtle—in their condition. Objective changes are those that any observer would be able to witness. Respiratory rate, heart rate, sweating, or vomiting are all objective. Subjective findings are those that only the patient can experience, such as pain or nausea. Even minor changes in breathing or mental state may signal major problems.

YOU are the Provider — PART 2

You arrive at the scene and find the patient, an 83-year-old woman, sitting on the couch in her living room. She is conscious and alert and tells you that she started having light-headedness and nausea about an hour ago. As you begin your assessment, you note that she has hearing aids in both ears.

Recording Time: 0 Minutes	
Appearance	Calm; no obvious distress
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions or foreign bodies
Breathing	Normal rate and depth; regular

Circulation	Radial pulses, strong and regular; skin is pink, warm, and dry

3. How can you maximize successful communication with a patient who is hard of hearing?
4. Should your general approach to the assessment process be any different for this patient versus a younger patient? Why or why not?

When possible, give the patient time to pack a few personal items before leaving for the hospital. Be sure to locate hearing aids, eyeglasses, or dentures before departure; it will make the patient's hospital stay far more pleasant. You should document on the patient care report (PCR) that these items accompanied the patient to the hospital and the person to whom they were given in the ED. Older patients are often worried about the safety of their home, valuable items, and pets. Take the time to share these concerns with the person assuming care of the patient at the hospital.

Communicating With Children

Everyone who is thrust into an emergency situation becomes frightened to some degree. However, fear is probably most obvious and severe in children. Children may be frightened by your uniform, the ambulance, and the number of people who have suddenly gathered around. Even a child who says little may be very much aware of all that is going on.

Familiar faces and objects will help to reduce this fright. Let a child keep a favorite toy, doll, or security blanket to give the child some sense of control and comfort. Having a family member or friend nearby is also helpful. When not impractical due to the child's condition, it is often helpful to let the parent or a guardian hold the child during your evaluation and treatment. However, you will have to make sure this person will not upset the child or prevent the child from telling you important information. Sometimes, adult family members are not helpful because they become too upset by what has happened or the child will not share important information in front of them. An overly anxious parent or relative can make things worse. Be careful about selecting the proper adult for this role.

Children can easily see through lies or deceptions, so you must always be honest with them. Make sure that you explain to the child over and over again what and why certain things are happening. If treatment is going to hurt, such as applying a splint, tell the child ahead of time.

Respect a child's modesty. Children are often embarrassed if they have to undress or be undressed in front of strangers. This anxiety often intensifies during adolescence. When a wound or site of injury has to be exposed, try to do so out of the sight of strangers, and when appropriate be sure to have a parent or guardian present. Again, it is extremely important to tell the child what you are doing and why you are doing it.

You should speak to a child in a professional, yet friendly way. When speaking to a child make sure to use an appropriate tone and vocabulary. A child should feel reassured that you are there to help in every way possible. Maintain eye contact with a child, as you would with an adult, to let the child know that you are there to help and that you can be trusted **Figure 4-6**. It is helpful to position yourself at the child's eye level so you do not appear to tower above the child.

Special Populations

A man has fallen and hurt his leg. The injury is not severe, so a vacuum splint is placed on his leg and he is moved to the ambulance. All this time, his 4-year-old daughter is watching. Suddenly she runs to the other side of the room and begins to cry. She watched the EMTs take her daddy away. What should you do?

Talk to the child. Have her come over to the ambulance cot and see that her daddy is okay. Tell her about the splint and how it will make her daddy's leg better. Let her touch her daddy and say goodbye. Let her daddy tell her that he will be home soon. Sometimes the obvious patient is not always the *only* patient.

Figure 4-6 Maintain eye contact with a child to let the child know that you are there to help and that you can be trusted.

Communicating With Patients Who Are Deaf or Hard of Hearing

Patients who are hard of hearing are usually not ashamed or embarrassed by their disability. Often, it is the people around a person who is hard of hearing who have problems coping. Remember that you must be able to communicate with patients who are hard of hearing so you can provide necessary or even lifesaving care.

Most patients who are hard of hearing have normal intelligence and can easily understand what is going on around them, provided you can successfully communicate with them. Most patients who are hard of hearing can read lips to some extent. Therefore, you should place yourself in a position so the patient can see your lips. Many patients who are hard of hearing have hearing aids to help them communicate. Be careful that hearing aids are not lost during an accident or fall. Hearing aids may also be forgotten if the patient is confused or ill. Look around for one in the immediate area, or ask the patient or the family about use of a hearing aid.

Remember the following five steps to efficiently communicate with patients who are hard of hearing:

1. **Have paper and a pen available.** This way, you can write down questions and the patient can write down answers, if necessary. Be sure to print so that your handwriting is not a communication barrier.
2. **If the patient can read lips, you should face the patient and speak slowly and distinctly.** Do not cover your mouth or mumble. If it is dark, consider shining a light on your face.
3. **Never shout.** This will not help the patient hear you and may frighten him or her.
4. **Be sure to listen carefully, ask short questions, and give short answers.** Remember that although many patients who are hard of hearing can speak distinctly, some cannot.

5. **Learn some simple phrases in sign language.** For example, knowing the signs for "sick," "hurt," and "help" may be useful if you cannot communicate in any other way Figure 4-7.

Figure 4-7 Learn simple phrases in sign language. **A.** Sick. **B.** Hurt. **C.** Help.

Communicating With Visually Impaired Patients

Like patients who are hard of hearing, visually impaired and blind patients have usually accepted and learned to deal with their disability. Of course, visually impaired patients are not necessarily completely blind. Many can perceive light and dark or can see shadows or movement. Ask the patient whether he or she can see at all. Also remember, as with other patients who have disabilities, you should expect visually impaired patients to have normal intelligence.

As you begin caring for a visually impaired patient, explain everything you are doing in detail as you are doing it. Be sure to stay in physical contact with the patient as you begin your care. Place your hand lightly on the patient's shoulder or arm, and try to avoid sudden movements. If the patient can walk to the ambulance, guide him or her by placing his or her hand on your arm, taking care not to rush. Transport with the patient any mobility aids, such as a cane, to the hospital. A visually impaired person may have a guide dog. Guide dogs are easily identified by their special harnesses Figure 4-8. They are trained to not leave their masters and to not respond to strangers. A visually impaired patient who is conscious can tell you about the dog and give instructions for its care.

Figure 4-8 A guide dog is easily identified by its special harness.

Courtesy of the Guide Dog Foundation for the Blind. Photographed by Christopher Appoldt.

The following rare situations are difficult to manage. If the patient is very stable, you should consider bringing the guide dog to the hospital in the back of the ambulance with the patient because it will help to alleviate some of the stress for both the patient and the dog. If the patient is unstable, the dog is injured or unruly, or for other safety or patient care reasons it is inappropriate to transport the dog, then you should make arrangements for the care of the dog. Contact your supervisor for assistance. The exact method for managing a patient with a guide dog (or other medical care animal) will be outlined in your department's policies and procedures. Follow your local protocols.

Communicating With Non–English-Speaking Patients

Part of patient care includes obtaining a medical history from the patient. You cannot skip this step simply because the patient does not speak English. Most patients who do not speak English fluently will still know certain important words or phrases.

Your first step is to find out how much English the patient can speak. Use short, simple questions and simple words whenever possible, and avoid difficult medical terms. You can help patients better understand if you point to specific parts of the body as you ask questions. Speaking louder will not increase a patient's ability to understand you.

In many areas, particularly large urban centers, major segments of the population do not speak English. Your job will be much easier if you learn some common words and phrases in their language, especially common medical terms. Pocket cards that show the pronunciation of these terms are available. If the patient does not speak any English, use a smartphone app or website to help you translate, or find an interpreter. In an emergency, it may be necessary to have a family member or friend translate until a professional interpreter is located. Also, remember to request a translator at the hospital while providing the radio report if the patient's language is known. Hospitals must have professional foreign language interpreters in-house or on-call for this purpose.

Communicating With Other Health Care Professionals

Effective communication between the EMT and health care professionals in the receiving facility is an essential cornerstone of efficient, effective, and appropriate patient care.

Your reporting responsibilities do not end when you arrive at the hospital. In fact, they have just begun. The transfer of care officially occurs during your oral report at the hospital. Once you arrive at the hospital, a hospital staff member will take responsibility for the patient from you **Figure 4-9**. However, you may only transfer the care of your patient to someone with at least your level of training. In the hospital, this is a paramedic, nurse, or physician. Once a staff member is ready to take responsibility for the patient, you must provide that person with a formal oral report of the patient's condition.

Giving a report is a longstanding and well-documented end point in transferring the patient's care from one provider to another. Your oral report is usually given at the same time that the staff member is providing care for the patient. For example, a nurse or physician may start assessing the patient or help you to move the patient from the stretcher to an examination table. Therefore, you must report important information in a complete and precise way. The following six components must be included in the oral report:

1. **Opening information** that includes the patient's name (if you know it), chief complaint, nature of the illness, or mechanism of injury. For example: "Good morning. This is Mrs. McCarty. She is 65 years old and reports back pain. She woke up around 0300, tripped, and fell into the bathtub after using the restroom."
2. **Detailed information** that was not provided during the radio report. For example: "She denies a loss of consciousness, states that she has no history of stroke, TIAs, or cardiac compromise, but has been feeling a little light-headed when she stands."

Figure 4-9 Once you arrive at the hospital, a staff member will take responsibility for the patient from you.

3. **Any important history** that was not already provided. For example: "Mrs. McCarty lives by herself. She was unable to get out of the tub and was found by a hospice worker at 1000 this morning. We suspect hypothermia because she had a core temperature of 94 degrees."

4. **The patient's response** to treatment given en route. It is especially important to report any changes in the patient or the treatment provided since your initial radio report. For example: "Although we suspected that the patient's midback pain was a result of her leaning against the faucet of the bathtub for 7 hours, we put her in the Kendrick extrication device for both precautionary and extrication reasons. Hot packs wrapped in hand towels were used to help warm her up."
5. **Vital signs** assessed during transport and after the radio report. For example: "Her vitals include a blood pressure of 112/84 mm Hg, a pulse of 72 beats/min, respirations of 14 breaths/min, and core body temperature of 94 degrees at the time of transport. They are generally unchanged since then, except that her last temperature was 96 degrees."
6. **Other information** you may have gathered that was not important enough to report sooner. Information that was gathered during transport, patient medications you brought with you, known allergies, and any other details about the patient that were provided by family members or friends may be included. For example: "Mrs. Woods, the home hospice worker, has contacted Mrs. McCarty's family and followed us here to answer any questions."

You can use the same process described for giving an oral report if you need to transfer care during an EMS event. For example, if there are multiple patients, you may need to remain on the scene while someone else continues the assessment you began. Begin the oral report with a quick introduction, letting the other EMS provider know who you are and your level of licensure. You should then continue to transfer care just as you would inside the hospital.

You will also need to communicate routinely with many other professionals—police, social service personnel, fire personnel, and other EMS providers. Make sure your language and general demeanor are professional. Remember that federal laws protect a patient's right to privacy and that you should not give any health information about your patient to anyone other than those directly involved in the care of the patient.

As an EMT, you must be able to quickly and accurately find out what the patient needs and be able to tell others. Never forget that you are the vital link between the patient and the health care team.

Words of Wisdom

The Health Insurance Portability and Accountability Act (HIPAA) of 1996 established mandatory patient privacy rules and regulations to safeguard patient confidentiality. The act provides guidance on the types of information that are protected, the responsibility of health care providers regarding that protection, and penalties for breaching that protection.

Most personal health information is protected and should not be released without the patient's permission. These regulations apply to all forms of communication and media—paper, electronic, and verbal. To ensure that you are protecting your patient's right to confidentiality, do not give any information to anyone other than those directly involved in the care of the patient. Make sure you are aware of all policies and procedures governing your particular agency.

Written Communications and Documentation

The **patient care report (PCR)**, also known as a prehospital care report, is the legal document used to record all aspects of the care your patient received, from initial dispatch to arrival at the hospital. Either term can be used and both are acceptable. You may be able to complete the report en route to the hospital if the trip is long enough and the patient needs minimal care. Usually, you will finish the report after you have transferred care of the patient to an ED staff member. There are two types of PCRs: written and electronic (ePCRs), which will be discussed later in this chapter.

The information you collect during a call becomes part of the PCR, and that information is ultimately entered into a data pool. The National Emergency Medical Services Information System (NEMSIS) has been collecting prehospital care information for research purposes since the early 1970s. NEMSIS has identified specific data points (uniform components) needed to enable communication and comparison of EMS runs between agencies, regions, and states. The minimum data set includes both narrative components and check boxes Figures 4-10 and 4-11.

If you go to www.ems.gov, you can see the national data set and discover interesting facts about delivery of EMS within the United States.

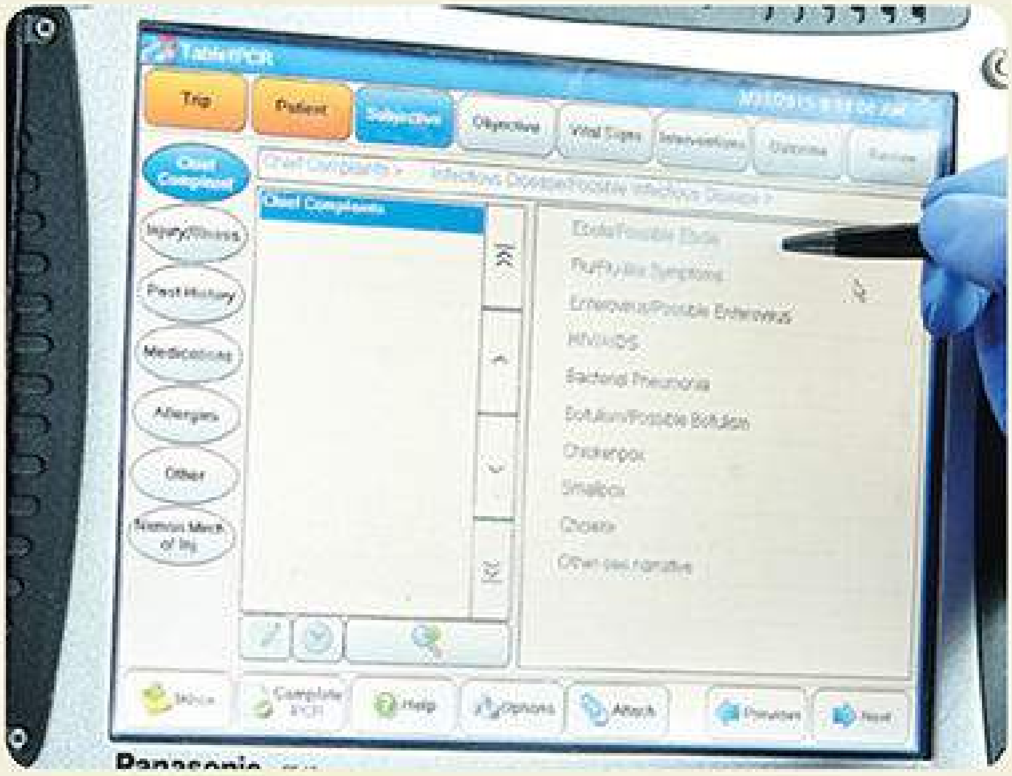


Figure 4-10 The minimum data set includes patient and administrative information, including narrative components and check boxes.

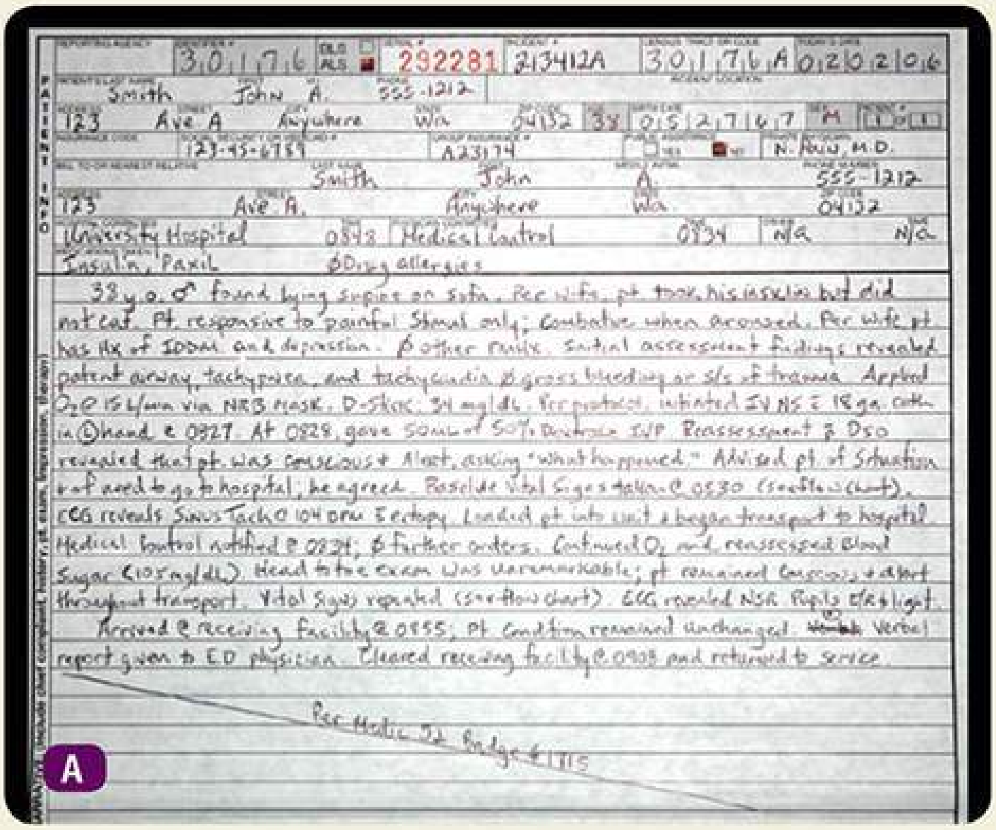
Because EMS systems track their own time, make sure that your watch is synchronized with dispatch time at the beginning of the shift, if that is procedure. Another way you can manage this information is to contact the dispatcher and have him or her provide you with the time. Either way, it is important to be able to keep close track of time. Accurate documentation will depend on it.

You will begin gathering patient information as soon as you reach the patient. Continue collecting information as you provide care until you arrive at the hospital.

Patient Care Report

As discussed, a PCR helps ensure efficient continuity of patient care. This report describes the nature of the patient's injuries or illness at the scene and the initial treatment you provide. Although this report might not be read immediately at the hospital, it may be referred to later for important information. The report serves the following six functions:

1. Continuity of care
2. Legal documentation



30176 | 292281 | 213412A | 30176A | 02/02/06

Smith | John | A. | 555-1212

123 | Ave A | Anywhere | WA | 04132 | 38 | 05/27/67 | M

123-45-6789 | A23174 | N. Awu, M.D.

Smith | John | A. | 555-1212

123 | Ave A. | Anywhere | WA | 04132

University Hospital | 0848 | Medical Control | 0834 | N/A | N/A

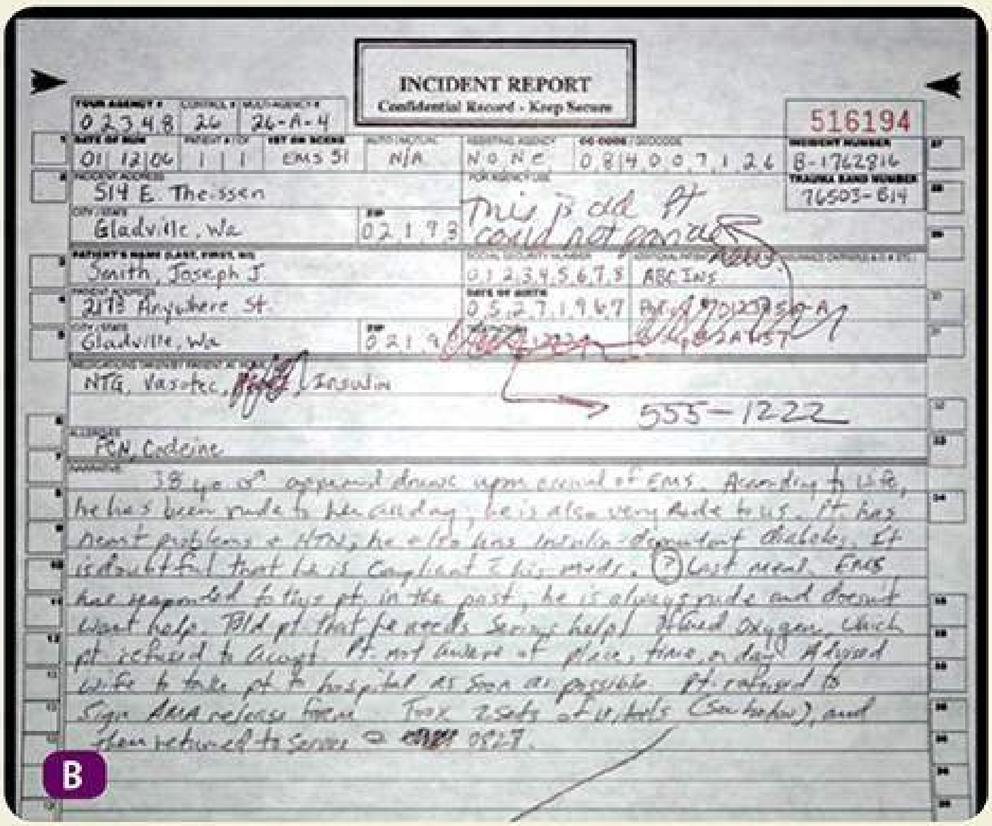
Insulin, Paxil | ∅ Drug allergies

38 y.o. ♂ found lying supine on sofa. Per wife, pt took his insulin but did not eat. Pt. responsive to painful stimuli only; combative when aroused. Per wife pt has Hx of IDDM and depression. ∅ other meds. Initial assessment findings revealed patent airway, tachypnea, and tachycardia. ∅ gross bleeding or s/s of trauma. Applied O_2 @ 15 L/min via NRB mask. D-stick: 34 mg/dL. Per protocol, initiated IV NS c̄ 18 ga. cath in Ⓛ hand @ 0827. At 0828, gave 50 mL of 50% Dextrose IVP. Reassessment p̄ D50 revealed that pt. was conscious + alert, asking "what happened." Advised pt of situation + of need to go to hospital; he agreed. Baseline vital signs taken @ 0830 (see flow chart). ECG reveals Sinus Tach @ 104 bpm c̄ ectopy. Loaded pt into unit + began transport to hospital. Medical Control notified @ 0834; ∅ further orders. Continued O_2 and reassessed blood sugar (105 mg/dL). Head to toe exam was unremarkable; pt remained conscious + alert throughout transport. Vital signs repeated (see flow chart). ECG revealed NSR. Pupils E/R + light.

Arrived @ receiving facility @ 0855; pt condition remained unchanged. ~~Verba~~ Verbal report given to ED physician. Cleared receiving facility @ 0903 and returned to service.

Per Medic 32 Badge #1715

A



INCIDENT REPORT
Confidential Record - Keep Secure

02348 | 26 | 26-A-4 | 516194

01/12/06 | 1 | 1 | EMS 51 | N/A | NONE | 0814 007 126 | B-1762816

514 E. Theissen | 76503-614

Gladville, WA | 02193

This is old pt could not ...

Smith, Joseph J | 012345678 | ABC Ins

2173 Anywhere St. | 05/27/1967

Gladville, WA

NTG, Vasotec, Insulin

555-1222

PCN, Codeine

38 y/o ♂ appeared drunk upon arrival of EMS. According to wife, he has been rude to her all day, he is also very rude to us. Pt. has heart problems + HTN, he also has insulin-dependent diabetes. It is doubtful that he is compliant c̄ his meds. ? last meal. EMS has responded to this pt. in the past, he is always rude and doesn't want help. Told pt that he needs serious help! Offered oxygen, which pt refused to accept. Pt. not aware of place, time, or day. Advised wife to take pt to hospital as soon as possible. Pt. refused to sign AMA release form. Took 2 sets of vitals (see below), and then returned to service @ 0827.

B

Figure 4-11 Filing a PCR is a critical part of your responsibilities as an EMT. **A.** Proper documentation. **B.** Improper documentation.

3. Education
4. Administrative information
5. Essential research record
6. Evaluation and continuous quality improvement

A good PCR documents any changes in the patient's condition upon arrival at the hospital. It is critical that you document everything in the clearest manner possible because the report serves multiple purposes. The information in the report will help to prove that you have provided a standard of care and, in some instances, shows you have properly handled unusual or uncommon situations. Both objective and subjective information is included in this report.

The following are examples of information collected on a PCR:

- Chief complaint
- Level of consciousness (according to the AVPU scale) or mental status
- Vital signs
- Initial assessment
- Patient demographics (age, gender, ethnic background)

Should you ever be called to provide testimony concerning patient care, you and your PCR will be used to present evidence. As with your personal appearance, your PCR will reflect a professional or a nonprofessional image. A neat, concise, well-written document—including correct spelling and grammar—will reflect good patient care. Consider the adage, "If the report looks sloppy, the patient care was also sloppy."

These reports also provide valuable administrative information, such as that used for patient billing. Information included in PCRs can be used to evaluate response times, equipment usage, and other areas of administrative responsibility. The following are examples of administrative information gathered from a PCR:

- Time the incident was reported
- Time the EMS unit was notified
- Time the EMS unit arrived at the scene
- Time the EMS unit left the scene
- Time the EMS unit arrived at the receiving facility
- Time the patient care was transferred

It is standard procedure to use military time in EMS documentation. This ensures that each time is unique; for example, 12 noon cannot be confused with 12 midnight. Military times are shown in **Table 4-5**.

Data may be obtained from the PCR to analyze causes, severity, and types of illness or injury requiring emergency medical care. These reports may also be used in an ongoing program for evaluation of the quality of patient care. All reports are periodically reviewed by your system to make sure trauma triage and/or other prehospital care criteria have been met.

Table 4-5 Military Times

Regular Time	Military Time	Regular Time	Military Time
Midnight	0000	Noon	1200
1:00 AM	0100	1:00 PM	1300
2:00 AM	0200	2:00 PM	1400
3:00 AM	0300	3:00 PM	1500
4:00 AM	0400	4:00 PM	1600
5:00 AM	0500	5:00 PM	1700
6:00 AM	0600	6:00 PM	1800
7:00 AM	0700	7:00 PM	1900
8:00 AM	0800	8:00 PM	2000
9:00 AM	0900	9:00 PM	2100
10:00 AM	1000	10:00 PM	2200
11:00 AM	1100	11:00 PM	2300

There are many requirements of a PCR Table 4-6. Often, these requirements vary from jurisdiction to jurisdiction, mainly because different agencies obtain information from them. Although no universally accepted form exists, certain uniform data points are common in all areas. The benefits of collecting such information are significant, one being that national trends can be detected. For example, roughly 15% of the nation's EMS calls involve children ages 0 to 9 years. Of those patients, 3% will have a respiratory complaint. Such information is invaluable.

Finally, PCRs are used by individual agencies to determine patterns of EMS responses. Busy times and high call volume areas can be predictive, and a thorough review of PCRs can set the stage for scheduling shifts and for system status management, including where units are placed.

Types of Forms

You will most likely use one of two types of forms. The first type is the traditional written form with check boxes and a narrative section, as shown in Figure 4-10. The second type is a computerized version, or electronic PCR (ePCR), in which you fill in information using a computer or tablet device that uploads data over a secure Internet connection Figure 4-12. EMS agencies across the country are replacing written reports with an electronic reporting system. Electronic PCRs have several advantages over the written forms. For example, ePCRs allow you to transmit patient information directly to hospital computers for review by the physician, pharmacy, and other professionals providing patient care.

If your service uses written forms, be sure to fill in the boxes completely and avoid making stray marks on the sheet. Make sure that you are familiar with the specific procedures for collecting, recording, and reporting the information in your area. Regardless of which format is used to collect information, you must complete a narrative section. For this information to be valuable, it must be correct. Therefore, you should make every effort to ensure the information is accurate.

Table 4-6 Sample Uniform Components of a Patient Care Report

- Patient's name, gender, date of birth, and address
- Dispatched as (When was the ambulance called? What was the nature of the call as reported by the dispatcher?)
- Chief complaint
- Location of the patient when first seen (including specific details, especially if the incident is a car crash or when criminal activity is suspected)
- Rescue and treatment given before your arrival
- Signs and symptoms found during your patient assessment
- Care and treatment given by you at the site and during transport
- Response to treatment
- Vital signs
- SAMPLE history
- Changes in vital signs and condition
- Additional orders received from the hospital
- Name of person receiving the patient report
- Date of the call
- Time of the call
- Location of the call
- Time of dispatch
- Time of arrival at the scene
- Time of leaving the scene
- Time of arrival at the hospital
- Patient's insurance information
- Names and/or certification numbers of the EMTs who responded to the call
- Name of the transport destination
- Type of run to the scene: emergency or routine

The narrative section of the PCR is arguably the most important portion. Here you will describe all of the facts related to the EMS call. The narrative should tell the story and present a clear, detailed picture of what you found, what you did, and how it affected the patient's condition. Be sure to include significant negative findings and important observations about the scene. Make sure that what you write is not an opinion, but fact based on findings. For example, you may write, "The patient admits to drinking today" or "The patient smelled of alcohol." These are clear descriptions that do not make any judgments about the patient's condition. However, stating "the patient was drunk" is a personal judgment that may not be able to be supported. Choose your words carefully and thoughtfully. Your job is to reproduce the important facts of the EMS call in writing.

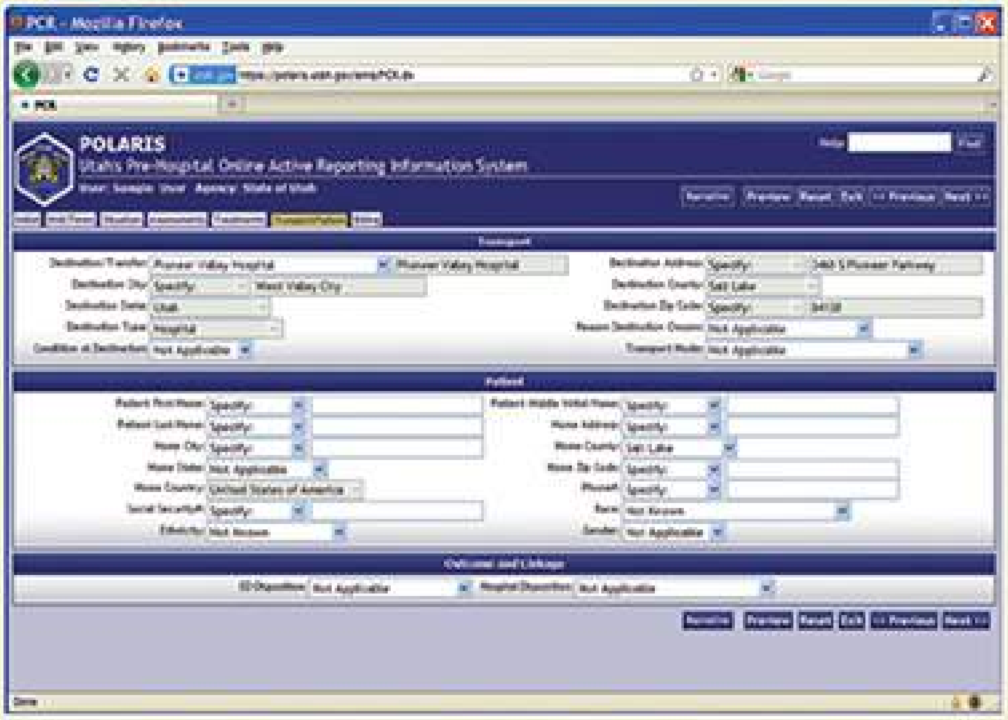


Figure 4-12 An electronic PCR (ePCR).

Courtesy of the Utah Department of Health.

The narrative section of the PCR needs to include the following information:

- Time of events
- Assessment findings
- Emergency medical care provided
- Changes in the patient after treatment
- Observations at the scene
- Final patient disposition
- Refusal of care
- Staff person who continued care

In written documentation, avoid radio codes and use only standard abbreviations, a list of which should be provided by your department. Remember, EMS personnel are not the only people who will be reading this document. Other hospital and billing personnel will need to read and understand what has been written. When information is of a sensitive nature, note the source of the information. Be sure to spell words correctly, especially medical terms. If you do not know the correct spelling of a particular word, find out how to spell it, or use another word. Also be sure to record the time with all assessment findings. Table 4-7 provides guidelines on how to write the narrative portion of your report. Whether you completed a medical or trauma assessment, the assessment-based approach follows each step of the assessment(s) as a guideline to narrative writing.

Table 4-7 How to Write a Narrative Report

Standard precautions	Were standard precautions initiated? If so, state which precautions were used and why.
Scene safety	Did you have to make your scene safe? If so, what did you do and why did you do it? Did this create a delay in patient care?
NOI/MOI	Simply state.
Number of patients	Record only when more than one patient is present; "This is patient 2 of 3."
Additional help	Did you call for help? If so, state why, at what time, and what time the help arrived. Was transport delayed?
Cervical spine	State what cervical spine precautions were initiated. You may want to include why; "Due to the significant MOI . . ."
Initial general impression	Simply record, if not already documented on the PCR.
Level of consciousness	Be sure to report LOC, any changes in LOC, and at what time changes occurred.
Chief complaint	Note and quote pertinent statements made by the patient and/or bystanders. This includes any pertinent denials; "Patient denies chest pain . . ."
Life threats	List all interventions and how the patient responded; "Assisted ventilations with O_2 (15 L/min) at 20 BPM with no change in LOC."
ABCs	Document what you found, and again, any interventions performed.
Oxygen	Record if O_2 was used, how it was applied, and how much was administered.
Primary, secondary, patient history, or reassessment	State the type of assessment used and any pertinent findings; "Secondary assessment revealed unequal pupils, crepitus to right ribs, and an apparent closed fracture of left tibia."
SAMPLE/OPQRST	Note and quote any pertinent answers.
Vital signs	Your service may want you to record vital signs in the narrative portion, as well as other places in the PCR.
Medical direction	Quote any orders given to you by medical control and who gave them.
Management of secondary injuries/treat for shock	Report all patient interventions, at what time they were completed, and how the patient responded.
Receiving facility	Document the name of the facility, the area of the facility where the patient was delivered, and the room number (if known).
Transfer of care	Record the name of the staff person who received your report and took over patient care, as well as the time.

Abbreviations: ABCs, airway, breathing, and circulation; LOC, level of consciousness; MOI, mechanism of injury; NOI, nature of illness; OPQRST, mnemonic used to facilitate the evaluation of a patient's pain: onset, provocation or palliation, quality, region/radiation, severity, and timing of pain; PCR, patient care report; SAMPLE, mnemonic used to determine signs and symptoms, allergies, medications, pertinent past history, last oral intake, and events leading up to the injury or illness.

Remember that the report form itself—and all the information in it—is considered a confidential document. Be sure you are familiar with state and local laws concerning confidentiality. All prehospital forms must be handled with care and stored in an appropriate manner once you have completed them. After you have completed a report, distribute copies to the appropriate locations, according to state and local protocol. In most instances, a copy of the report will remain at the hospital and will become part of the patient's medical record.

Depending on the requirements of the EMS system in which you work, you may not have the time to complete the full PCR while at the hospital; some EMS systems allow for a shorter, modified version of the PCR to be left at the hospital, and the full report can be completed at the station or transmitted electronically. Even in these circumstances, however, a written record should be left with the patient. In these cases, most systems will have a "drop report or transfer report" **Figure 4-13**. These single-page, abbreviated forms are used as a memory aid during an EMS call. If you are unable to remain at the hospital to complete the PCR, copy these documents and leave them with the nurse or doctor.

Reporting Errors

Everyone makes mistakes. If you leave something out of a report or record information incorrectly, do not try to cover it up. Rather, write down what did or did not happen and the steps that were taken to correct the situation. Falsifying information on the PCR may result in suspension and/or revocation of your certification or license, as well as legal implications. More important, falsifying information results in poor patient care, because other health care providers have a false impression of assessment findings or the treatment given. For example, if you did not give the patient oxygen, do not document that the patient was given oxygen.

Maryland Institute For
Emergency Medical Services Systems

Short Form Patient Information Sheet 2012

Jurisdiction: ____________ **Date:** ____________
Incident # ____________ **Time Arrived at Hospital:** ____________
Unit #: ____________
Age: ______ **DOB:** ______ **Wt:** ____ **Kg** **Gender:** ❑M ❑F
Priority: ❑1 ❑2 ❑3 ❑4 **Trauma Category:** ❑A ❑B ❑C ❑D
Patient's Name: ____________
Patient's Address: ____________
City: ____________ **State:** ____________
Point of Contact: ____________ **Phone Number:** ____________
Chief Complaint: ____________
Time of Onset: ______ **Past Medical History: (DNR/MOLST** ❑**A1** ❑**A2** ❑**B)**
Cardiac ❑ **CHF** ❑ **Hypertension** ❑ **Seizure** ❑ **Diabetes** ❑ **COPD** ❑ **Asthma** ❑
Other: ____________
Current Meds: ____________
Allergies: **Latex** ❑ **Penicillin/Ceph** ❑ **Sulfa** ❑ **Other:** ____________

Assessments

Vitals	Respiration	Skin	GCS
Time: ______	Left / Right	❑ Warm	Eyes (4): ______
B/P: ______ / ______	❑ Clear ❑	❑ Hot	Verbal (5): ______
Pulse: ______	❑ Rales ❑	❑ Cool	Motor (6): ______
Respirations: ______	❑ Labored ❑	❑ Dry	TOTAL: ______
SAO2: ______%	❑ Stridor ❑	❑ Clammy	
Capnography: ______	❑ Rhonchi ❑	❑ Diaphoretic	**Pupils**
Carbon Monoxide: ______	❑ Wheezes ❑	❑ Cyanotic	❑ PERRL
Repeat Vitals	❑ Decreased ❑		❑ Unequal
Time: ______	❑ Agonal ❑		❑ Fixed/Dilated
B/P: ______ / ______	❑ Absent ❑		
Pulse: ______			**Neuro**
Respirations: ______	**Pulse**		❑ A ❑ V
SAO2: ______%	❑ Regular ❑ Irregular		❑ P ❑ U
Capnography: ______	❑ JVD ❑ Peripheral Edema		
Carbon Monoxide: ______	Cap Refill: ______ seconds		

Assessment

Procedures

Cardiac Rhythm:	Cincinnati Stroke Scale
______	*Normal/Abnormal*
12 Lead Transmit Yes ❑ No ❑	Facial Droop Normal ❑ Abnormal ❑
Perform 12 Lead Yes ❑ No ❑	Arm Drift Normal ❑ Abnormal ❑
Glucometer:	Speech Normal ❑ Abnormal ❑
______	Last Known Well Time/Date: ______
❑IV1 ❑IV2	**Oxygen**
❑IO ❑EJ	❑ NRB Mask ❑ King Airway
Amount Infused:	❑ Nasal Cannula ❑ CPAP
______	❑ NPA/OPA ❑ NDT
CPR Performed Yes ❑ No ❑	❑ BVM ❑ Ventilator
ROSC Yes ❑ No ❑	❑ ET ❑ NT ❑ NGT
Induced Hypothermia Yes ❑ No ❑	❑ Easy Tube

Treatment:

Jurisdictional Additions:

Print Provider Name: ____________

Figure 4-13 Prehospital notepad/drop report (transfer report).

Document only the vital signs that were actually taken. A classic case of improper documentation occurs with cardiac arrest patients. Consider this scenario. Under "Vital Signs," an EMT documents: pulse 0 beats/min, respirations 0 breaths/min, and blood pressure 0/0 mm Hg. What the EMT meant to document was the application of a blood pressure cuff—inflating it and deflating it while listening for a pulse. Someone reviewing the PCR after the call may ask why the EMT took the time to check the blood pressure on a patient who didn't have a pulse, instead of performing CPR.

What if the wrong drug or the wrong dose is given to a patient? What if the patient is accidentally dropped? Unfortunately these things can and do happen. It is important that you document the event. Do not lie or cover it up. In your narrative, provide a factual account of what happened. For example: "Ordered: one sublingual nitroglycerin. Given: two sublingual nitroglycerin. Patient blood pressure checked following administration. No changes noted" or "While loading the patient into the ambulance, the patient was dropped. Patient was on the ambulance cot when it fell a total of 4 feet. Patient was not thrown off cot. Patient was assessed after being dropped and reported feeling scared and having neck pain. Hospital advised."

If you discover an error as you are writing your report, draw a single horizontal line through the error, initial it, and write the correct information next to it Figure 4-14. Do not try to erase or cover the error with correction fluid. This may be interpreted as an attempt to cover up a mistake.

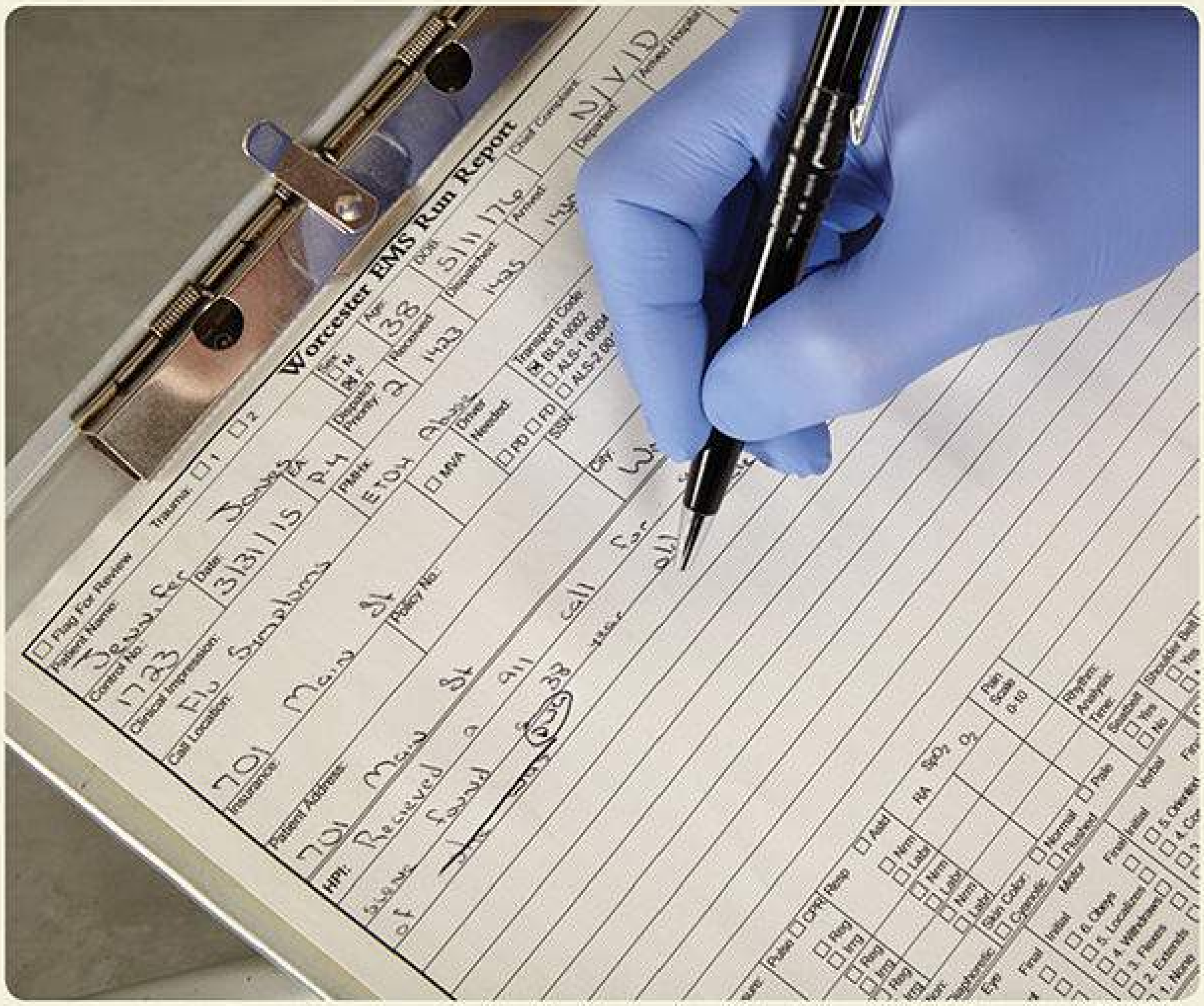


Figure 4-14 If you make a mistake in writing your report, the proper way to correct it is to draw a single horizontal line through the error, initial it, and write the correct information next to it.

If an error is discovered after you submit your report, follow the same process of error correction by drawing a single line through the error—preferably in a different color ink—initialing it, and dating it. Make sure to add a note with the correct information. If you accidentally left out information, begin the new section with the word "addendum," add the new information, and then add the date and your initials. When using a paper system, you may be able to add addendums using specific addendum forms. If you are using an electronic documentation system, refer to the system's direction as to how to make an amendment to the original document. Most electronic systems will allow for amendments but will prevent erasure in a completed document.

Words of Wisdom

In the prehospital setting, several methods of documentation are used, including the following:

CHART or CHARTE method. CHART stands for Chief complaint, History and physical examination, Assessment, Treatment (Rx), and Transport. To use CHARTE, add Exceptions. This method's strength is that it breaks the care and treatment down into smaller sections, which makes it easier to locate specific assessments or care without reading the entire report. Its weakness is that it is difficult to learn.

SOAP method. SOAP stands for Subjective, Objective, Assessment, and Patient care. This is one of the more common forms of documentation. It is simple to learn, and when it is completed, it provides a simple means for the reader to review the assessment and management.

Documenting Refusal of Care

Refusal of care is a common source of litigation in EMS; therefore, thorough documentation is crucial. As discussed in Chapter 3, *Medical, Legal, and Ethical Issues,* competent adult patients have the right to refuse treatment and, in fact, must specifically provide permission for treatment to be initiated. If you are not able to persuade the patient to proceed with treatment, document any patient assessment findings, emergency medical care given, your efforts to obtain consent, and the patient's response to your efforts. Have the patient sign a refusal form **Figure 4-15**. You should also have a family member, police officer, or bystander sign the form as a witness. If the patient refuses to sign the refusal form, have a family member, police officer, or bystander sign the form verifying that the patient refused to sign. Inform online medical control when patients refuse care.

Even if a patient refuses care, you must complete the PCR. You will need to document the advice you gave as to the risks associated with refusal of care. Report clinical information, such as the LOC, showing the competency of the person refusing care. Note pertinent patient comments and any medical advice given to the patient by the physician or medical control through phone or radio. Also include a description of the care that you wished to provide for the patient. There are many local variations of requirements for patient refusals. **Table 4-8** provides a reasonable list of items that should be included within the PCR of a patient refusal.

YOU are the Provider — PART 3

As your partner takes the patient's vital signs, you ask the patient further questions regarding her chief complaint. She denies any other complaints or past medical history and tells you that she only takes vitamins. Her blood glucose level is assessed and found to be 112 mg/dL.

Recording Time: 5 Minutes	
Respirations	20 breaths/min; regular and unlabored
Pulse	68 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	122/62 mm Hg
Oxygen saturation (Spo_2)	98% (on room air)

5. What techniques can facilitate the process of interviewing an older patient?

Patient Initiated Refusal of EMS

Patient Name: Doe, John	Primary Care Giver: John Smith, NREMT-P	
Agency: BALTIMORE COUNTY FIRE DEPARTMENT	Incident#: 1122141	eMEDS#: 00314105399
Unit #: Medic 14	Inc Date Entered: 11/22/2016	Inc Time Entered: 1824 hrs

I (or my guardian) have been informed regarding the state of my present physical condition to the extent I allowed an examination, and I (or my guardian) hereby refuse to accept such medical care and/or transportation as recommended by representatives of the EMS System above.

I (or my guardian) do hereby for myself, my heirs, executors, and administrators and assigns forever release and fully discharge said EMS system, its officers, employees, medical consultants, hospitals, borrowed servants or agents from any and all conceivable liability that might arise from this refusal of care and/or transportation, and I (and my guardian) therefore agree to hold them completely harmless. I (or my guardian) have been informed that a refusal of care and/or transportation for an evaluation may cause me to suffer PAIN, DISABILITY, LOSS of FUNCTION, WORSENING of my CONDITION, or even DEATH as a result of my illness/injury. As a competent adult, I (or my guardian) fully understand all of the above, and am/is capable of determining a rational decision on my own behalf.

Providers: When encountering a patient who is attempting to refuse EMS treatment or transport, access his or her condition, and record whether the patient screening reveals any lack of medical decision-making capability (1-3,4a or b) or high risk criteria (5-8).

1) Medical Capacity: Was the patient disoriented to person? If yes, transport	☐ Yes ☑ No
2) Medical Capacity: Was the patient disoriented to place? If yes, transport	☐ Yes ☑ No
3) Medical Capacity: Was the patient disoriented to time? If yes, transport	☐ Yes ☑ No
4) Medical Capacity: Was the patient disoriented to situation? If yes, transport	☐ Yes ☑ No
5) Medical Capacity: Did the patient show altered level of consciousness? If yes, transport	☐ Yes ☑ No
6) Medical Capacity: Alcohol or drug ingestion by history or exam with slurred speech? If yes, transport	☐ Yes ☑ No
7) Medical Capacity: Alcohol or drug ingestion by history or exam with unsteady gait? If yes, transport	☐ Yes ☑ No
8) Medical Capacity: Patient does not understand the nature of illness and potential for bad outcome? If yes, transport	☐ Yes ☑ No
9) At Risk Criteria (Abnormal vital signs): For adults. Pulse greater than 120 or less than 60? If yes, consult	☐ Yes ☑ No
10) At Risk Criteria (Abnormal vital signs): For adults. Systolic BP less than 90? If yes, consult	☐ Yes ☑ No
11) At Risk Criteria (Abnormal vital signs): For adults. Respirations greater than 30 or less than 10? If yes, consult	☐ Yes ☑ No
12) At Risk Criteria (Abnormal vital signs): For minor/pediatric patients. Age inappropriate HR? If yes, consult	☐ Yes ☑ No
13) At Risk Criteria (Abnormal vital signs): For minor/pediatric patients. Age inappropriate RR? If yes, consult	☐ Yes ☑ No
14) At Risk Criteria (Abnormal vital signs): For minor/pediatric patients. Age inappropriate BP? If yes, consult	☐ Yes ☑ No
15) At Risk Criteria: Serious chief complaint (chest pain, SOB, syncope)? If yes, consult	☐ Yes ☑ No
16) At Risk Criteria: Head injury with history of loss of consciousness? If yes, consult	☐ Yes ☑ No
17) At Risk Criteria: Significant MOI or high suspicion of injury? If yes, consult	☐ Yes ☑ No

18) At Risk Criteria: For minor/pediatric patients. ALTE, significant past medical history, or suspected intentional injury? If yes, consult	☐ Yes ☑ No
19) At Risk Criteria: Provider impression is that the patient requires hospital evaluation? If yes, consult	☐ Yes ☑ No
20) Providers: Did you perform an assessment (including exam) on this patient? If yes to # 20, skip to # 22	☐ Yes ☑ No
21) Providers: If unable to examine, did you attempt vital signs?	☐ Yes ☑ No
22) Providers: Did you attempt to convince the patient or guardian to accept transport?	☐ Yes ☑ No
23) Providers: Did you contact medical direction for patient still refusing service?	☐ Yes ☑ No
24) Patient: The patient or his or her representative refuses EMS examination.	☐ Yes ☑ No
25) Patient: The patient or his or her representative refuses EMS treatment.	☐ Yes ☑ No
26) Patient: The patient or his or her representative refuses EMS transport.	☐ Yes ☑ No

Patient Signature: **Printed Name:**

Patient Phone: **Date:** 18:24 11/24/2016

Patient Address:

Initial Disposition

Patient Refused Exam ☑	Patient Refused Treatment ☑	Patient Refused Transport ☑
Patient Accepted Exam ☐	Patient Accepted Treatment ☐	Patient Accepted Transport ☐
Auth. Decision Maker (ADM) Refused Exam ☐	Auth. Decision Maker (ADM) Refused Treatment ☐	Auth. Decision Maker (ADM) Refused Transport ☐

Intervention

Attempt to Convince Patient ☑ Attempt to Convince Family Member/Auth. Decision Maker (ADM) ☐ Contact Medical Direction ☑ Contact Law Enforcement ☐ None of the Above Available ☐

AMA Contact Medical Direction Facility St Elsewhere Hospital

Final Disposition

Patient Refused Exam ☐	Patient Refused Treatment ☐	Patient Refused Transport ☑
Patient Accepted Exam ☑	Patient Accepted Treatment ☑	Patient Accepted Transport ☐
Auth. Decision Maker (ADM) Refused Exam ☐	Auth. Decision Maker (ADM) Refused Treatment ☐	Auth. Decision Maker (ADM) Refused Transport ☐

Provide in the patient's own words why he/she refused the above care/service:

"Patient reports that despite the damage to his vehicle, he has only a small laceration on his finger and no other symptoms. He eventually agreed to allow EMS to evaluate him and provide a bandage for a small finger laceration (index finger, right hand). He agreed to follow-up with his primary care MD later today. When offered transport to the hospital he indicated, "No. thanks. I will be fine." Discussed plan with Dr Smith at St Elsewhere ED who agreed with plan and recommended reiterating to Mr Smith the importance of close follow-up with his primary care MD for tetanus prophylaxis and consideration of laceration care to include sutures.

Inc. Date: 11/22/2016 Patient Name: Doe, John BALTIMORE COUNTY FIRE DEPARTMENT Page: 2

Incident #: 1122141 Date Printed: 11/24/2016 18:24

Figure 4-15 Even though competent adult patients have the right to refuse medical treatment, attempt to have them sign a refusal form to document their informed refusal.

Table 4-8 Components of a Thorough Patient Refusal Document

Complete assessment
Evidence the patient is able to make a rational, informed decision
Discussion with the patient as to what care/transportation EMS recommends
Discussion with the patient as to what may happen if he or she does not allow care or transportation. Typically these consequences should be listed and clear to include the possibility of severe illness/injury or death if care or transportation is refused.
Discussion with family/friend/bystanders to try to encourage the patient to allow care
Discussion with medical direction according to local protocol
Providing the patient with other alternatives: Going to see his or her family doctor, having a family member drive him or her to the hospital
Willingness of EMS to return if the patient changes his or her mind
Signatures: Have a family member, police officer, or bystander sign the form as a witness. If the patient refuses to sign the refusal form, have a family member, police officer, or bystander sign the form verifying that the patient refused to sign.
If the patient refused care or did not allow a complete assessment, document that the patient did not allow for proper assessment and document whatever assessments were completed.

Refusal of care not only includes patients who do not wish to be transported to the hospital, but also those who refuse a certain aspect of care. For example, a victim of a car crash may wish to be treated and transported but refuses to be appropriately immobilized. In these instances, you should carry out all other medical care and document the patient's refusal of spinal immobilization. Just because the patient refuses a cervical collar is no reason to deny oxygen. The same is true for the patient who wishes to use a local hospital when the injuries dictate transport to a trauma facility. Any time a patient refuses any part of the standard treatment, it needs to be documented in the PCR.

Special Reporting Situations

In some situations, you may be required to file special reports with appropriate authorities. These situations may involve gunshot wounds, dog bites, certain infectious diseases, or suspected physical or sexual abuse. Learn your local requirements for reporting these incidents. Failure to report them may have legal consequences. It is important that the report be accurate, objective, and submitted in a timely manner.

Another special reporting situation is a mass-casualty incident (MCI). The local MCI plan should have some means of temporarily recording important medical information (such as a triage tag that can be used later to complete the form). The standard for completing the form in an MCI is not the same as for a typical call. Your local plan should have specific guidelines. MCIs will be discussed in Chapter 39, *Incident Management.*

Communications Systems and Equipment

Radio and telephone communications link you and your team with other members of the EMS, fire, and law enforcement communities. This link helps the entire team to work together more effectively and provides an important layer of safety and protection for each member of the team. You must know what your system can and cannot do, and you must be able to use your system efficiently and effectively. You must be able to send precise, accurate reports about the scene, the patient's condition, and the treatment that you provide.

As an EMT, you must be familiar with two-way radio communications and have a working knowledge of the mobile and handheld portable radios that are used in your unit. You must also know when to use them and what to say when you are transmitting.

Base Station Radios

The dispatcher usually communicates with field units by transmitting through a fixed radio base station that is controlled from the dispatch center. A **base station** is any radio hardware containing a transmitter and receiver that is located in a fixed place. The base station may be used by an operator speaking into a microphone that is connected directly to the equipment. It also works remotely through telephone lines or by radio from a communications center. Base stations may include dispatch centers, fire stations, ambulance bases, or hospitals.

A two-way radio consists of two units: a transmitter and a receiver. Some base stations may have more than one transmitter and/or more than one receiver. They may also be equipped with one multi-channel transmitter and several single-channel receivers. A **channel** is an assigned frequency or frequencies used to carry voice and/or data communications. Regardless of the number of transmitters and receivers, they are commonly called *base radios* or *stations*. Base stations usually have more power (often 100 watts or more) and higher, more efficient antenna systems than mobile or portable radios. This increased broadcasting range allows the base station operator to communicate with field units and other stations at much greater distances.

The base radio must be physically close to its antenna. Therefore, the actual base station cabinet and hardware are commonly found on the roof of a tall building or at the bottom of an antenna tower. The base station operator may be miles away in a dispatch center or hospital, communicating with the base station radio by dedicated lines or special radio links. A **dedicated line**, also known as a *hotline*, is used for specific point-to-point contact. This type of phone, typically located within an ED, is not on the main switchboard. EMS personnel are able to call the number directly without being placed on hold or transferred. This type of line makes recording medical command conversations much easier.

Mobile and Portable Radios

In the ambulance, you will use both mobile and portable radios to communicate with the dispatcher and/or medical control. An ambulance will often have more than one mobile radio, each on a different frequency **Figure 4-16**. One radio may be used to communicate with the dispatcher or other public safety agencies. A second radio is often used for communicating patient information to medical control.

A mobile radio is installed in a vehicle and usually operates at lower power than a base station. Most **VHF (very high frequency)** mobile radios operate between 30 and 300 MHz. **UHF (ultra-high frequency)** mobile radios operate between 300 MHz and 3,000 MHz. Radios that operate at 800 MHz are increasingly common in EMS systems. These systems provide a great amount of system flexibility without the need for vast numbers of frequencies. What was once accomplished with 30 separate frequencies can be done with less than 10. Mobile antennas are much closer to the ground than base station antennas, so communications from the unit are typically limited to 10 to 15 miles over average terrain.

Figure 4-16 Some ambulances have more than one mobile radio to allow communications with hospitals, mutual aid jurisdictions, and other agencies.

Portable radios are hand-held devices that operate at 1 to 5 watts of power. Because the entire radio can be held in your hand, when in use, the antenna is often no taller than you. The transmission range of a portable radio is more limited than that of mobile or base station radios. Portable radios are essential in helping to coordinate EMS activities at the scene of an MCI. They are also helpful when you are away from the ambulance and need to communicate with dispatch, another unit, or medical control **Figure 4-17**.

Repeater-Based Systems

A **repeater** is a special base station radio that receives messages and signals on one frequency and then automatically retransmits them on a second frequency. Because a repeater is a base station (with a large antenna), it is able to receive lower power signals, such as those from a portable radio, from a long distance away. The signal is then rebroadcast with all the power of the base station **Figure 4-18**. EMS systems that use repeaters usually have outstanding systemwide communications and are able to get the best signal from portable radios. There are also mobile repeaters that may be found in ambulances or placed in various areas around an EMS system area.

Figure 4-17 A portable radio is essential if you need to communicate with the dispatcher or medical control when you are away from the ambulance.

At times, you may be able to communicate with a base station radio, but you will not be able to hear or transmit to another mobile unit that is also communicating with that base. Repeater base stations eliminate such problems. They allow two mobile or portable units that cannot reach each other directly to communicate through the repeater, using its greater power and antenna.

Digital Equipment

Although most people think of voice communications when they think of two-way radios, digital signals are also a part of EMS communications. With telemetry, electronic signals are converted into coded, audible signals. These signals can then be transmitted by radio or telephone to a receiver with a decoder at the hospital. The decoder converts the signals back into electronic impulses that can be displayed on a screen or printed, such as a fax message. New technology also allows for digital telemetry. For example, data from cardiac monitors can be transmitted via Bluetooth-enabled mobile devices to a monitoring center, where physicians can review the data and quickly contact patients, if needed. Rhythm strips and 12-lead ECGs are transmitted to the hospital to identify abnormal heart rhythms and critical cardiac information such as ST segment elevation myocardial infarction (or STEMI) alerts, allowing informed treatment decisions to be made during the prehospital phase. Digital signals are also used in some kinds of paging and tone alerting systems because they transmit faster than spoken words and allow more choices and flexibility.

Figure 4-18 A message is sent from the control center to the transmitter by a landline. The radio carrier wave is picked up by the repeater for rebroadcast to outlying units. Return radio traffic is picked up by the repeater and rebroadcast to the control center.

▶ Cellular/Satellite Telephones

Whereas dispatchers communicate with field units by transmitting through a fixed radio base station, it is common for EMTs to communicate with receiving facilities by **cellular telephone**. These telephones are simply low-power portable radios that communicate through a series of interconnected repeater stations called *cells* (hence the name *cellular*). Cells are linked by a sophisticated computer system and connected to the telephone network. Another option is a satphone or satellite phone. These phones use a satellite, which receives and relays the signals, instead of a cell.

Many cellular systems make equipment and air time available to EMS services at little or no cost as a public service. The public is often able to call 9-1-1 or other emergency numbers on a cellular telephone free of charge. However, this easy access may result in overloading and jamming of cellular systems in mass-casualty and disaster situations.

When using these systems, ensure that a reference of commonly called numbers is available. Local hospitals, poison control, police services, and the number to the dispatcher should be readily available. Cellular and satellite systems also have areas of bad reception. As an EMT, it is important to be aware of any areas in which your equipment will not work.

As with all repeater-based systems, a cellular or satellite telephone is useless if the equipment fails, if there is a loss of power, or if it is damaged by severe weather or other circumstances.

A **scanner** is a radio receiver that searches or "scans" across several frequencies, stops whenever it receives a radio broadcast on that frequency, and continues once the message is complete. Although cellular and satellite telephones are more private than most other forms of radio communications, keep in mind that these telephones use digital signals, which makes eavesdropping difficult but not impossible. Therefore, you must always be careful to appropriately respect patient privacy and to speak in a professional manner every time you use any form of an EMS communications system.

▶ Other Communications Equipment

Ambulances and other field units are usually equipped with an external public address system. This system may be a part of the siren or the mobile radio. The intercom between the cab and the patient compartment may also be a part of the mobile radio. These components do not involve radio wave transmission, but you must understand how they work and practice using them before you really need them.

EMS systems may use a variety of two-way radio hardware. Some systems operate VHF equipment in the **simplex** (push to talk, release to listen) mode. In this mode, radio transmissions can occur in either direction but not simultaneously in both.

When one party transmits, the other can only receive. Once one party finishes transmitting, the other party can then reply. Other systems conduct **duplex** (simultaneous talk–listen) communications on UHF frequencies and cellular telephones. In the full duplex mode, radios can simultaneously transmit and receive communications on one channel. This is sometimes called "a pair of frequencies." A third possible configuration for a communications system is **multiplex**. This design utilizes two or more frequencies, which enables more than one transmission to occur simultaneously and provides for the transmission of both audio and data signals via separate channels. This type of system is what allows paramedics to transmit a patient's electrocardiogram to the hospital from the scene or back of the ambulance. A number of VHF and UHF channels, commonly called **MED channels**, are reserved exclusively for EMS use. However, hundreds of other commercial, local government, and fire services frequencies are also used for EMS communications.

Trunking, or 800-MHz, systems take advantage of the latest technologies in communications. Instead of being assigned to one or two frequencies, in a trunking system, many frequencies are assigned to a group. As the radio conversation begins, a computer selects the next open frequency and you begin talking. When you speak a second time, you will likely be speaking on a different frequency because the computer is constantly monitoring for frequency load and reassigning transmissions to unused frequencies. These systems allow for greater traffic without greater numbers of frequencies. Therefore, you do not need to worry about being able to transmit or receive. In a trunking system, the computer will switch you to another channel without your knowledge and you will operate the radio as you normally do.

YOU are the Provider — PART 4

The patient agrees to EMS transport, is placed on the stretcher, and is loaded into the ambulance. You cover her with a blanket to keep her warm and proceed to a hospital located 15 miles away. En route, you reassess her condition.

Recording Time: 11 Minutes	
Level of consciousness	Conscious and alert
Respirations	20 breaths/min; regular and unlabored
Pulse	74 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	118/60 mm Hg
Spo_2	98% (on room air)

The patient's condition remains unchanged since your initial encounter. You contact the receiving facility and provide them with a radio report.

6. What are the components of a radio report to the hospital?
7. How does the oral report differ from the radio report?

Any large-scale emergency requires cooperative efforts from several agencies such as law enforcement, fire departments, and EMS. At times more than one jurisdiction is involved and effective communication between all of those involved becomes challenging. An **interoperable communications system** allows all of the agencies involved to share valuable information with each other in real time. This system utilizes a voice-over-Internet-protocol format to connect landlines, cell phones, and computers to create a seamless, reliable exchange of information between all parties.

Another type of communication system is a **mobile data terminal (MDT)** Figure 4-19. An MDT is a small computer terminal inside the ambulance that directly receives data from the dispatch center. MDTs allow for greatly expanded communication capabilities. Instead of asking the dispatcher to confirm whether he said 11345 Main Street or 11354 Main Street, you look at the terminal where the address is displayed. Satellite communications can track your progress to the scene and can provide important scene information, such as known violent calls to this address, the nature of those calls, and the number of times the ambulance has been called.

Your ability to effectively communicate with other units or medical control depends on how well the weaker radio can "talk back." Base and repeater station radios often have higher antennas and much greater power than mobile or portable units do. This increased power ensures that signals are generally heard and understood from a far greater distance than the signal produced from a mobile unit. Remember, when you are at the scene, you may be able to clearly hear the dispatcher or hospital on your radio, but you may not be heard or understood when you transmit.

Figure 4-19 A mobile data terminal.

Even small changes in your location can significantly affect the quality of your transmission. Also remember that the location of the antenna is critically important for clear transmission. Commercial aircraft flying at 37,000 feet can transmit and receive signals over hundreds of miles, yet their radios have only a few watts of power. The "power" comes from their antenna positioned at 37,000 feet.

The success of communications depends on the efficiency of your equipment. A damaged antenna or microphone often prevents high-quality communications. Check the condition and status of your equipment at the start of each shift, and then correct or report any problems.

Radio Communications

All radio operations in the United States, including those used in EMS systems, are regulated by the Federal Communications Commission (FCC). The FCC has jurisdiction over interstate and international telephone and telegraph services and satellite communications—all of which may involve EMS activity.

The FCC has five principal EMS-related responsibilities:

1. **Allocate specific radio frequencies for use by EMS providers.** Modern EMS communications began in 1974. At that time, the FCC assigned 10 MED channels in the 460- to 470-MHz (UHF) band to be used by EMS providers. These UHF channels were added to the several VHF frequencies that were already available for EMS systems. However, these VHF frequencies had to be shared with other "special emergencies" uses, including school buses and veterinarians.
2. **License base stations and assign appropriate radio call signs for those stations.** An FCC license is usually issued for 5 years, after which time it must be renewed. Each FCC license is granted only for a specific operating group. Often, the longitude and latitude (locations) of the antenna and the address of the base station determine the call signs.
3. **Establish licensing standards and operating specifications for radio equipment used by EMS providers.** Before it can be licensed, each piece of radio equipment must be submitted to the FCC by its manufacturer for type acceptance, based on established operating specifications and regulations.
4. **Establish limitations for transmitter power output.** The FCC regulates broadcasting power to reduce radio interference between neighboring communications systems.

5. **Monitor radio operations.** This includes making spot field checks to help ensure compliance with FCC rules and regulations.

The FCC's rules and regulations are written in technical and legal language and fill many volumes. Only a very small section (part 90, subpart C) deals with EMS communication issues. You are not responsible for reading these detailed and often confusing documents. For appropriate guidance on technical issues, contact your EMS system supervisor. In fact, many EMS systems look to radio and telephone communications experts for advice on technical issues.

Responding to the Scene

EMS communication systems may operate on several frequencies and use different frequency bands. Some EMS systems may even use different radios for various purposes. However, all EMS systems depend on the skill of the dispatcher. The dispatcher receives the first call to 9-1-1. You are part of the team that responds to calls once the dispatcher notifies your unit of an emergency.

The dispatcher has several important responsibilities during the alert and dispatch phase of EMS communications. The dispatcher must do all of the following:

- Properly screen and assign priority to each call (according to predetermined protocols)
- Select and alert the appropriate EMS response unit(s)
- Dispatch and direct EMS response unit(s) to the correct location
- Coordinate EMS response unit(s) with other public safety services until the incident is over
- Provide emergency medical instructions to the telephone caller (according to predetermined protocols) so that essential care (eg, CPR) may begin before the EMTs arrive

When the first call to 9-1-1 comes in, the dispatcher must judge its relative importance to begin the appropriate EMS response using emergency medical dispatch protocols. First, the dispatcher must find out the exact location of the patient and the nature and severity of the problem. The dispatcher asks for the caller's telephone number, the patient's name and age, and other information, as directed by local protocol. Next, the dispatcher asks for some description of the scene, such as the number of patients or special environmental hazards.

Using this information, the dispatcher will assign the appropriate EMS response unit(s) based on local protocols and the following factors:

- Dispatcher's determination of the nature and severity of the problem (Many emergency medical dispatch systems will determine this automatically based on a caller's answers to a defined series of questions.)
- Anticipated response time to the scene
- Level of training (EMR, EMT, AEMT, Paramedic) of available EMS response unit(s)
- Need for additional EMS units, fire suppression, rescue, a hazardous materials team, air medical support, or law enforcement

The dispatcher's next step is to alert the appropriate EMS response unit(s) **Figure 4-20**. Alerting these units may be done in a variety of ways. The dispatcher may use the dispatch radio system to contact units that are already in service and monitoring the channel. Dedicated lines (hotlines) between the control center and the EMS station may also be used.

The dispatcher may also page EMS personnel. Pagers are commonly used in EMS operations to alert on-duty and off-duty personnel. **Paging** involves the use of a coded tone or digital radio signal and a voice or display message that is transmitted to pagers (beepers) or desktop monitor radios. Paging signals may be sent to alert only certain personnel or may be blanket signals that will activate all the pagers in the EMS service. Pagers and monitor radios are convenient because they are usually silent until their specific paging code is received. Alerted personnel contact the dispatcher to confirm the message and receive details of their assignments.

Figure 4-20 You will be assigned to a call by the dispatcher.

Once EMS personnel have been alerted, they must be properly dispatched and sent to the incident. Every EMS system should use a standard dispatching procedure. The dispatcher should give the responding unit(s) the following information:

- Nature and severity of the injury, illness, or incident
- Exact location of the incident
- Number of patients
- Responses by other public safety agencies
- Special directions or advisories, such as adverse road or traffic conditions, severe weather reports, or potential scene hazards
- Time at which the unit or units are dispatched

Your unit must confirm with the dispatcher that you have received the information and are en route to the scene. Local protocol will dictate whether it is the job of the dispatcher or your unit to notify other public safety agencies that you are responding to an emergency. In some areas, the ED is also notified when an ambulance responds to an emergency.

You should report to the dispatcher any problems during your response. You should also inform the dispatcher when you have arrived at the scene. The arrival report to the dispatcher should include any obvious details that you see during scene size-up. For example, you might say, "Dispatcher, BLS Unit Two is on scene at 3010 Mitchell Street. It is a blue house with a long driveway." This information is particularly useful if additional units are responding to the same scene.

All radio communications during dispatch, as well as during other phases of operations, must be brief and easily understood. Speak in plain English and do not use code words in your transmissions. The use of ten-codes is specifically discouraged because they vary by jurisdiction and decrease the understandability of a transmission. Your tone and pace should be slow, relaxed and clear. You do not need to use excessively polite language. Also, avoid wordiness. An example of an excessively wordy communication is: "Good morning dispatch, this is Ambulance 6-3-1. We are responding to 381 South Main Street. Have a good day." Although this sounds pleasant (and you should try to foster a good working environment with the dispatcher), this wastes radio time. Remember, the dispatcher's job is to field hundreds of calls an hour; therefore, you need to only report important information so that he or she can focus on what to do next. Table 4-9 lists common instances for which EMS providers will need to use the radio to communicate with dispatch.

Table 4-9 Typical EMS Communications With Dispatch

Phase of EMS Call	EMS Unit Communication
Initial receipt of call	Acknowledge call Respond to the call
En route to call	Request assistance with directions, when needed Request additional resources, when needed
On scene	Report arrival at scene Check in; often a system will require EMS units to transmit every 20 minutes as a safety measure Request additional resources, when needed Report leaving scene
Arrival at hospital (or point of transfer)	Notify dispatch of arrival at point of transfer
Return to service	Notify dispatch when the unit is available for another call
Miscellaneous	Some systems require EMS units to notify dispatch anytime they are not in station

Table 4-10 lists tips to using the radio. Although these may change slightly from department to department, they provide a good foundation from which to begin.

Communicating With Medical Control and Hospitals

The principal reason for radio communication is to facilitate communication between you and medical control (and the hospital). Medical control may be located at the receiving hospital, another facility, or sometimes even in another city or state. You must, however, consult with medical control to notify the hospital of an incoming patient, request advice or receive orders, or advise the hospital of special situations.

It is important to plan and organize your radio communication before you push the transmit button. Remember, a concise, well-organized report is the best method of accurately and thoroughly describing the patient and his or her medical condition to the providers who will be receiving the patient. It also demonstrates your competence and professionalism to all who hear your report. Well-organized radio communications with the hospital will engender confidence in the receiving facility's physicians and nurses, as well as others who are listening. In addition, the patient and family will be comforted by your organization and ability to communicate clearly. A well-delivered radio report puts you in control of the information, which is correct procedure.

Hospital notification is the most common type of communication between you and the hospital. The purpose of these calls is to notify the receiving facility of the patient's chief complaint and condition Figure 4-21. On the basis of this information, the ED is able to appropriately prepare staff and equipment to receive the patient. This is primarily a one-way form of communication. You are telling the ED what to expect. You are not asking for advice or orders; you are simply notifying them.

Giving the Patient Report

The patient report should follow a standard format established by your EMS system. The report commonly includes the following nine elements:

1. Your unit identification and level of services. Example: "Columbus Fire 2-BLS."
2. The receiving hospital and your estimated time of arrival. Example: "Columbus Community Hospital, ETA 10

minutes," or "patient transport code" according to local protocols.

YOU are the Provider PART 5

With an estimated time of arrival at the hospital of 20 minutes, you reassess the patient and note that her condition has remained unchanged.

Recording Time: 16 Minutes	
Level of consciousness	Conscious and alert
Respirations	18 breaths/min; regular and unlabored
Pulse	72 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	120/60 mm Hg
Spo_2	99% (on room air)

You arrive at the hospital and give your oral report to the charge nurse. After answering the nurse's questions, you complete your patient care report and return to service.

8. What functions does the patient care report serve?

Table 4-10 Tips When Using EMS Radio Communications

Turn radio on and adjust volume.
Ensure a clear frequency before speaking.
To speak, use the "press-to-talk" button, and wait 1 second before speaking.
Hold the microphone 2 in. to 3 in. from your mouth.
Address the unit you are calling, and provide the name of your unit.
The unit you call will signal that you can begin your transmission.
Use a clear, calm, and monotone voice and speak at a reasonable pace.
Keep the transmission brief.
Use clear text.
Avoid the use of codes or agency-specific terms.
Avoid using slang or unapproved abbreviations.
Do not use useless or meaningless phrases, such as "be advised."
Limit saying "please," "thank you," and "you're welcome."
When transmitting numbers, such as an address, provide both the number and the individual digits ie, "Respond to 1381, 1-3-8-1, Main Street."
Remember that the airwaves are public and the use of scanners is popular.
Do not use names; protect the privacy of patients.
Remain objective and impartial in describing patients.
Never use profanity; always be professional.
Use the words "affirmative" and "negative" instead of "yes" or "no."
Use the standard format for transmission of information.
When you are finished transmitting, indicate this by saying "over."
Do not provide a diagnosis of the patient's problem.
Use EMS frequencies only for EMS communications.
Monitor background noise.

3. The patient’s age and gender. Example: “An 86-year-old woman.” The patient’s name should not be given over the radio because it may be overheard. This would be a violation of the patient’s privacy.
4. The patient’s chief complaint or your perception of the problem and its severity. Example: “Patient reports severe pelvic and less severe back pain.”
5. A brief history of the patient’s current problem. Example: “Patient fell into bathtub at 0300 this morning and wasn’t able to get out.” Other important history information that may pertain to the current problem should also be included, such as “The patient has diabetes and takes insulin.”

Figure 4-21 The patient report should be given in an objective, accurate, and professional manner.

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6. A brief report of physical findings. This report should include level of consciousness, the patient’s general appearance, pertinent abnormalities noted, and vital signs. Example: “The patient is alert and oriented, has pale skin color, and is cold to the touch. We noted crepitus in the pelvic girdle. Her blood pressure is 112/84, pulse is 72, and respirations 14.”
7. A brief summary of the care given and any patient response. Example: “We have immobilized her onto a backboard. She still has pulse, motor, and sensory function distally in all four extremities.”
8. A brief description of the patient’s response to the treatment provided.
9. Determine whether the receiving facility has any additional questions or orders.

Be sure you report all patient information in an objective, accurate, and professional manner. Remember that people with scanners are listening. You could be successfully sued for slander if you describe a patient in a way that injures his or her reputation.

The Role of Medical Control

The delivery of EMS involves an impressive array of assessments, stabilization, and treatments. In some cases, you may assist patients in taking medications. AEMTs and paramedics go beyond this level by initiating medication therapy based on the patient's presenting signs. For logical, ethical, and legal reasons, the delivery of such sophisticated care must be done in association with physicians. For this reason, every EMS system needs input and involvement from physicians, including your system or department medical director, providing medical direction (medical control) for your EMS system. Medical control is either off-line (indirect) or online (direct), as authorized by the medical director. Medical control guides the treatment of patients in the system through protocols, direct orders, advice, and postcall review.

Depending on how the protocols are written, you may need to call medical control for direct orders (permission) to administer certain treatments, to determine the transport destination of patients, or to be allowed to stop treatment and/or not transport a patient. In these cases, the radio or cellular phone provides a vital link between you and the expertise available through the base physician.

To maintain this link 24 hours a day, 7 days a week, medical control must be readily available on the radio at the hospital or on a mobile or portable unit when you call **Figure 4-22**. In most areas, medical control is provided by the physicians who work at the receiving hospital. However, many variations have developed across the country. For example, some EMS units receive medical direction from one hospital even though they are taking the patient to another hospital. In other areas, medical direction may come from a freestanding center or even from an individual physician. Regardless of your system's design, your link to medical control is vital to maintain the high quality of care your patient requires and deserves.

Figure 4-22 Medical control must be readily available on the radio at the hospital.

Words of Wisdom

Some EMS systems will assign roles in their units: a primary person to speak on the radio and a primary person to administer patient care. In these systems, all members of the crew must communicate very closely to make this process work. In reality, EMTs are involved in every role, but the partial division of responsibilities can be efficient and effective. This approach is most common in systems that use extensive online medical control.

Calling Medical Control

You can use the radio in your unit or a portable radio to call medical control. A cellular telephone can also be used. Regardless of the type of communication, you should use a channel that is relatively free of other radio traffic and interference and one that will be recorded. Medical command communications create medical legal requirements that such conversations should be recorded. There are a number of ways to control access on ambulance-to-hospital channels. In some EMS systems, the dispatcher monitors and assigns appropriate, clear medical control channels. Other EMS systems rely on special communications operations, such as centralized medical emergency dispatch or resource coordination centers, to monitor and allocate the medical control channels.

Because of the large number of EMS calls to medical control, your radio report must be precise and well organized and must only contain important information. In addition, because you need specific directions on patient care, the information that you provide to medical control must be accurate. Remember, the physician on the other end bases his or her instructions on the information you provide.

As discussed earlier, you should use proper medical terminology when giving your report. Never use codes when communicating with medical control unless you are directed by local protocol to do so. Most medical control systems handle many EMS agencies and will most likely not know your unit's special codes or signals.

To ensure complete understanding, once you receive an order from medical control, such as an order for a medication or the denial of a request for a particular treatment, you must repeat the order back, word for word, and then receive confirmation. This helps to eliminate confusion and the possibility of poor patient care. Orders that are unclear or seem inappropriate or incorrect should be questioned. Do not blindly follow an order that does not make sense to you. The physician may have misunderstood or may have missed part of your report. In that case, he or she may not be able to respond appropriately to the patient's needs. The role of medical control will be discussed further in Chapter 11, *Principles of Pharmacology*.

Words of Wisdom

Orders that are unclear or seem inappropriate or incorrect should be questioned. Do not blindly follow an order that does not make sense to you.

Information About Special Situations

Depending on your system's procedures, you may initiate communication with one or more hospitals to advise them of an extraordinary call or situation. For instance, a small rural hospital may be better able to respond to multiple victims of a highway crash if it is notified when the ambulance is first responding. At the other extreme, an entire hospital system must be notified of any disaster, such as a plane or train crash, as early as possible to enable activation of its staff call-in system. These special situations may also include hazardous materials situations, rescues in progress, MCIs, or any other situation that could require special preparation on the part of the hospital. In some areas, mutual aid frequencies may be designated in MCIs so that responding agencies can communicate with one another on a common frequency.

When notifying the hospital(s) of any special situations, keep the following in mind: The earlier the notification, the better. You should ask to speak to the charge nurse or physician in charge, as he or she is best able to mobilize the resources necessary to respond. Also, whenever possible, provide an estimate of the number of people who may be transported to the facility. Be sure to identify any conditions the patient(s) may have that require special needs, such as burns or hazardous materials exposure, to assist the hospital in preparation. In many cases, hospital notification is part of a larger disaster or hazardous materials plan. Follow the plan for your system.

Maintenance of Radio Equipment

Like all other EMS equipment, radio equipment must be serviced by properly trained and equipped personnel. Remember that the radio is your lifeline to other public safety agencies (who function to protect you), as well as to medical control, and it must perform under emergency conditions. Radio equipment that is operating properly should be serviced at least once a year. Any equipment that is not working properly should be immediately removed from service and sent for repair. Outdated equipment should be removed from service as new equipment becomes available.

When you are beginning your shift, it is typical to check the ambulance to ensure that it is ready to go. You cannot assume that the crew before you left the ambulance well stocked and in operational readiness. The radio is also an important component that needs to be checked to ensure that it is operating correctly and using the correct frequency.

Sometimes, radio equipment will stop working during a run. Your EMS system must have several backup plans and options for this scenario. The goal of a backup plan is to make sure you can maintain contact when the usual procedures do not work. There are quite a few options.

The simplest backup plan relies on written standing orders. **Standing orders** are written documents that have been signed by the EMS system's medical director. These orders outline specific directions, permissions, and sometimes prohibitions regarding patient care. By their very nature, standing orders do not require direct communication with medical control. When properly followed, standing orders or formal protocols have the same authority and legal status as orders given over the radio. They exist to one extent or another in every EMS system and can be applied to all levels of EMS providers. Other backup plans can involve using a cell phone and calling the ED directly. The problem with this approach is that the conversation will probably not be recorded. Medical command conversations are often recorded for the purpose of quality improvement.

YOU are the Provider — SUMMARY

1. What information should you ask the dispatcher to obtain from the caller?

A "sick person" could be anyone from a patient with the flu to a patient in cardiac arrest. For all you know, the patient could be experiencing a psychiatric crisis, in which case law enforcement should be dispatched to secure the scene before your arrival. After determining the nature of the patient's illness and gathering information that will maximize your own safety, your next priority is to determine if the patient is conscious and breathing. Try to ascertain the patient's age and gender, if possible. Although you will truly not know what you are dealing with until you arrive at the scene and assess the patient, you should capitalize on the fact that the dispatcher still has the caller on the phone. The more information you obtain prior to arrival at the scene, the better prepared you will be to care for the patient.

2. Why is effective communication between the responding EMS unit and the dispatcher so important?

Effective communication between the dispatcher and the EMS unit is important because accurate, thorough communication results in quicker and more effective care for the patient at the scene as possible. Once you respond to a scene, you will confirm with the dispatcher that you are en route. Should there be any delay in your unit's response, your communication with the dispatcher allows adjustments to the response as needed.

During an emergency call, you will communicate with the dispatcher regarding any problems. Depending on your local protocol, the dispatcher will inform other public agencies that you are responding, and coordinate efforts with them to ensure that needed resources are mobilized.

3. How can you maximize successful communication with a patient who is hard of hearing?

First, determine the degree of the patient's hearing loss; her hearing aids may allow her to hear normally. Do not assume she is totally deaf! Remember, most patients who are hard of hearing have a normal intelligence level. Provided you successfully communicate with them, they usually understand what is going on around them.

Many patients who are hard of hearing can read lips to some extent; therefore, you should position yourself where the patient can see your lips. Never shout in the ear of a patient who is hard of hearing. Listen carefully, ask short questions, and give short answers whenever possible.

If your efforts to verbally communicate with the patient are unsuccessful, write down your questions on paper and ask the patient to write down her response. Print legibly, so your handwriting is not a communication barrier.

Learn some simple phrases in sign language, such as "hurt," "sick," and "help" in case you cannot communicate in any other way.

4. Should your general approach to the assessment process be any different for this patient versus a younger patient? Why or why not?

As a result of the natural process of aging, older patients may not react to pain the same as younger patients. An older person who has fallen, for example, may not report any pain, despite the presence of an obvious injury.

Assess the patient just as you would a younger patient; however, you may need to allow extra time for her to answer your questions. As with any patient, she should feel confident that everything possible is being done for her.

5. What techniques can facilitate the process of interviewing an older patient?

Many of the same techniques used to interview younger patients can be used effectively to interview older patients. When interviewing an older patient, however, patience is even more important. Identify yourself; do not assume that an older person—or any person for that matter—knows who you are. Remain aware of how you present yourself; frustration and impatience can be conveyed through body language.

When communicating with an older patient, look directly at her and speak slowly and distinctly. Do not increase the volume of your voice based on the assumption that the patient is hard of hearing. After asking the patient a question, allow her ample time to answer it and then *actively listen* to her response. As with any patient, show respect. Refer to her as Mrs. or Miss, unless she asks to be addressed otherwise.

Do not talk about the patient in front of her; doing so gives the impression that she has no choice in her medical care. Again, this may only escalate her fear of losing independence.

6. What are the components of a radio report to the hospital?

The purpose of the radio report is to inform the receiving facility that you are transporting to its location and to provide an overview of the patient's condition so it can adequately prepare to receive the patient. Your radio report to the receiving hospital should be concise—brief in length, yet comprehensive in scope.

Identify your EMS system and unit number and then advise the nurse or physician that you are prepared to give a radio report. After he or she confirms that he or she can hear you, begin your radio report with the patient's age, gender, chief complaint, and level of consciousness. Next, provide a brief elaboration of the patient's chief complaint (eg, the history of present illness), your assessment findings, SAMPLE history, initial vital signs, and the most recent set of vital signs. Summarize any treatment that you provided and the patient's response, if any, to your treatment. Finally, give the hospital your estimated time of arrival and transport mode.

7. How does the oral report differ from the radio report?

Patient care transfer occurs during your oral report, not your radio report. Once a hospital staff member is ready to take responsibility for the patient, you should provide that person with a formal oral report of the patient's condition.

Unlike your radio report, which should be brief and concise, your oral report should be more comprehensive. In many cases, your oral report is given at the same time the nurse or physician is providing care for the patient, such as assessing the patient or helping you move the patient from the stretcher to the hospital bed. Therefore, you must report important information in a complete, precise manner. The following components should be included in your oral report:

- The patient's name and the chief complaint, nature of illness, or mechanism of injury
- Detailed information, such as pertinent negatives and findings of a more detailed physical exam
- Any medical history not already given
- The patient's response to treatment given en route. It is especially important to report any changes in the patient's condition or the treatment provided after your radio report.
- The vital signs assessed during transport and after your radio report
- Any other information that you obtained en route and after your radio report; for example, a list of medications that the patient is currently taking, or any known allergies to medications or food.

8. What functions does the patient care report (PCR) serve?

In addition to your radio and oral reports, you should also complete a formal PCR before you leave the hospital or shortly thereafter depending on your local jurisdictional protocol. There are two types of PCRs: written and electronic. A copy of the report, whether written or transmitted electronically, must be left at the hospital.

The PCR describes the nature of the patient's injuries or illness at the scene, the treatment you provided initially and en route, vital signs, and the patient's condition on arrival at the hospital. The PCR serves the following functions:

- Continuity of care

- Legal documentation
- Education
- Administrative information (ie, billing)
- Essential research information
- Evaluation and continuous quality improvement

The information in the PCR confirms that you provided proper patient care. In some cases, it also shows that you properly handled unusual or uncommon situations. You should include both objective (what you find) and subjective (what the patient tells you) information in the PCR. A well-written, neat, and concise PCR—including correct spelling and grammar—reflects good patient care. If the report looks sloppy, the care you provided may be assumed to have been the same.

EMS Patient Care Report (PCR)

Date: 4-16-16	**Incident No.:** 030109	**Nature of Call:** Sick person		**Location:** 514 E. Bandera St.	
Dispatched: 0610	**En Route:** 0610	**At Scene:** 0616	**Transport:** 0627	**At Hospital:** 0650	**In Service:** 0705

Patient Information

Age: 83 **Sex:** F **Weight (in kg [lb]):** 50 kg (110 lb)	**Allergies:** None **Medications:** Vitamins **Past Medical History:** None **Chief Complaint:** Light-headedness and nausea

Vital Signs

Time: 0621	**BP:** 122/62	**Pulse:** 68	**Respirations:** 20	**Spo_2:** 98%
Time: 0627	**BP:** 118/60	**Pulse:** 74	**Respirations:** 20	**Spo_2:** 98%
Time: 0632	**BP:** 120/60	**Pulse:** 72	**Respirations:** 18	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Blood glucose assessment, blanket for warmth

Narrative

Dispatched for a "sick person." Arrived on scene to find the patient, an 83-year-old woman, sitting on the couch in her living room. She was conscious and alert; her airway was patent and her breathing was adequate. The patient reported light-headedness and nausea that had started approximately one hour earlier. Patient denied chest pain, shortness of breath, abdominal pain, headache, or significant medical problems. Only medications are vitamins; no prescribed medications or known drug allergies. Assessment did not reveal any gross abnormalities. Her blood glucose level was assessed and noted to be 112 mg/dL. Obtained vital signs and prepared patient for transport. Applied blanket because the patient stated that she was cold. Began transport and monitored patient's mental status and vital signs en route. Her condition remained unchanged. The patient wears hearing aids in both ears but was easy to communicate with. Arrived at the hospital and transferred patient care without incident. Oral report was given to staff nurse. Returned to service at 0655.**End of report**

Prep Kit

Ready for Review

- The Shannon–Weaver model of communication is a valuable tool in understanding the variables involved in human communication.
- There are many verbal and nonverbal factors and strategies that are necessary for therapeutic communication.

- Excellent communication skills are crucial in relaying pertinent information to the hospital before arrival.
- It is important to remember that people who are sick or injured may not understand what you are doing or saying. Therefore, your body language and attitude are very important in gaining the trust of both the patient and family. You must also take special care of people such as children, older adults, patients who are hard of hearing, patients who are visually impaired, and non–English-speaking patients.
- As an EMT, you must have excellent verbal communication skills. You should be able to interact with the patient and any family members, friends, or bystanders.
- You must aim to complete a patient care report before you leave the hospital. This is a vital part of providing emergency medical care and ensuring the continuity of patient care. This information guarantees the proper transfer of responsibility, complies with the requirements of health departments and law enforcement agencies, and fulfills your agency's administrative needs.
- Radio and telephone communications link you and other members of the EMS, fire, and law enforcement communities. This enables your entire team to work together more effectively.
- Understand and be able to use different forms of communication. Be familiar with two-way radio communications and have a working knowledge of mobile and hand-held portable radios. You must know when to use them and what type of information you can transmit.
- Know what your communication system can and cannot handle. You must be able to communicate effectively by sending precise, accurate reports about the scene, the patient's condition, and the treatment that you provide.
- Remember, the lines of communication are not always exclusive; therefore, speak in a professional manner at all times and protect patient privacy.
- Your reporting and record-keeping duties are essential, but they should never come before the care of a patient.

Vital Vocabulary

base station Any radio hardware containing a transmitter and receiver that is located in a fixed place.

cellular telephone A low-power portable radio that communicates through an interconnected series of repeater stations called "cells."

channel An assigned frequency or frequencies that are used to carry voice and/or data communications.

closed-ended questions Questions that can be answered in short or single word responses.

communication The transmission of information to another person—verbally or through body language.

cultural imposition When one person imposes his or her beliefs, values, and practices on another because he or she believe his or her ideals are superior.

dedicated line A special telephone line that is used for specific point-to-point communications; also known as a *hotline*.

documentation The recorded portion of the EMT's patient interaction, either written or electronic. This becomes part of the patient's permanent medical record.

duplex The ability to transmit and receive simultaneously.

ethnocentrism When a person considers his or her own cultural values as more important when interacting with people of a different culture.

Federal Communications Commission (FCC) The federal agency that has jurisdiction over interstate and international telephone and telegraph services and satellite communications, all of which may involve EMS activity.

interoperable communications system A communication system that uses voice-over-Internet-protocol (VoIP) technology to allow multiple agencies to communicate and transmit data.

MED channels VHF and UHF channels that the Federal Communications Commission has designated exclusively for EMS use.

mobile data terminal (MDT) A small computer terminal inside the ambulance that directly receives data from the dispatch center.

multiplex The ability to transmit audio and data signals through the use of more than one communications channel.

noise Anything that dampens or obscures the true meaning of a message.

open-ended questions Questions for which the patient must provide detail to give an answer.

paging The use of a radio signal and a voice or digital message that is transmitted to pagers ("beepers") or desktop monitor radios.

patient care report (PCR) The legal document used to record all patient care activities. This report has direct patient care functions but also administrative and quality control functions. PCRs are also known as *prehospital care reports*.

rapport A trusting relationship that you build with your patient.

repeater A special base station radio that receives messages and signals on one frequency and then automatically retransmits them on a second frequency.

scanner A radio receiver that searches or "scans" across several frequencies until the message is completed; the process is then repeated.

simplex Single-frequency radio; transmissions can occur in either direction but not simultaneously in both; when one party transmits, the other can only receive, and the party that is transmitting is unable to receive.

standing orders Written documents, signed by the EMS system's medical director, that outline specific directions, permissions, and sometimes prohibitions regarding patient care; also called *protocols*.

telemetry A process in which electronic signals are converted into coded, audible signals; these signals can then be transmitted by radio or telephone to a receiver with a decoder at the hospital.

therapeutic communication Verbal and nonverbal communication techniques that encourage patients to express their feelings and to achieve a positive relationship.

trunking Telecommunication systems that allow a computer to maximize utilization of a group of frequencies.

UHF (ultra-high frequency) Radio frequencies between 300 and 3,000 MHz.

VHF (very high frequency) Radio frequencies between 30 and 300 MHz; the VHF spectrum is further divided into "high" and "low" bands.

Assessment *in Action*

You are dispatched at 0130 hours to an apartment complex for a gunshot wound. While you are en route, dispatch informs you that law enforcement has arrived and secured the scene. Upon arrival, you observe a law enforcement officer kneeling next to a teenager while two other officers interview witnesses. The patient is a 17-year-old boy with a single gunshot wound to the left upper leg. He is screaming in pain and states, "I can't believe he did this to me! I didn't know she was his sister!" You locate the wound and control the bleeding with direct pressure. Assessment of his vital signs shows a pulse rate of 96 beats/min; a respiratory rate of 22 breaths/min; blood pressure of 104/76 mm Hg; an Spo_2 of 98% on room air; and his skin is pink, warm, and dry.

1. Encouraging this patient to provide more information about his injury is an example of which therapeutic communication technique?

   A. Facilitation
   B. Clarification
   C. Reflection
   D. Interpretation

2. Which of the following actions should you avoid while interviewing this patient?

   A. Being empathetic
   B. Asking leading or biased questions
   C. Clarifying information
   D. Giving the patient time to answer the question

3. If this patient refuses to be transported to the hospital, you should:

   A. contact medical control.
   B. ask law enforcement to take him into custody.
   C. immediately stop patient care and leave.
   D. find another person to continue medical care.

4. As you radio the hospital to give a report on your patient, remember to:

   A. provide as much detail as possible.
   B. use code words to protect the patient's identity.
   C. speak as quickly as possible.
   D. remain objective and impartial.

5. What information should you include in your report to the hospital?

   A. Your estimated time of arrival
   B. The patient's full name and date of birth
   C. The address of the location you are coming from
   D. Your personal opinion of the patient's condition

6. As you write your narrative for this call, it is important to include:

   A. your personal opinions.
   B. many abbreviations.
   C. physical assessment findings.
   D. the address of your location.

7. After you submit the electronic PCR for this call, you realize that you accidentally documented the wrong vital signs. You should:

   A. leave the record as it is and seek legal advice.
   B. notify your agency's information technology department.
   C. follow your agency's directions for making an amendment.
   D. say nothing and hope that the error goes unnoticed.

8. Your partner takes several photos of the patient and the scene to post online to share with friends. This could be a violation of:

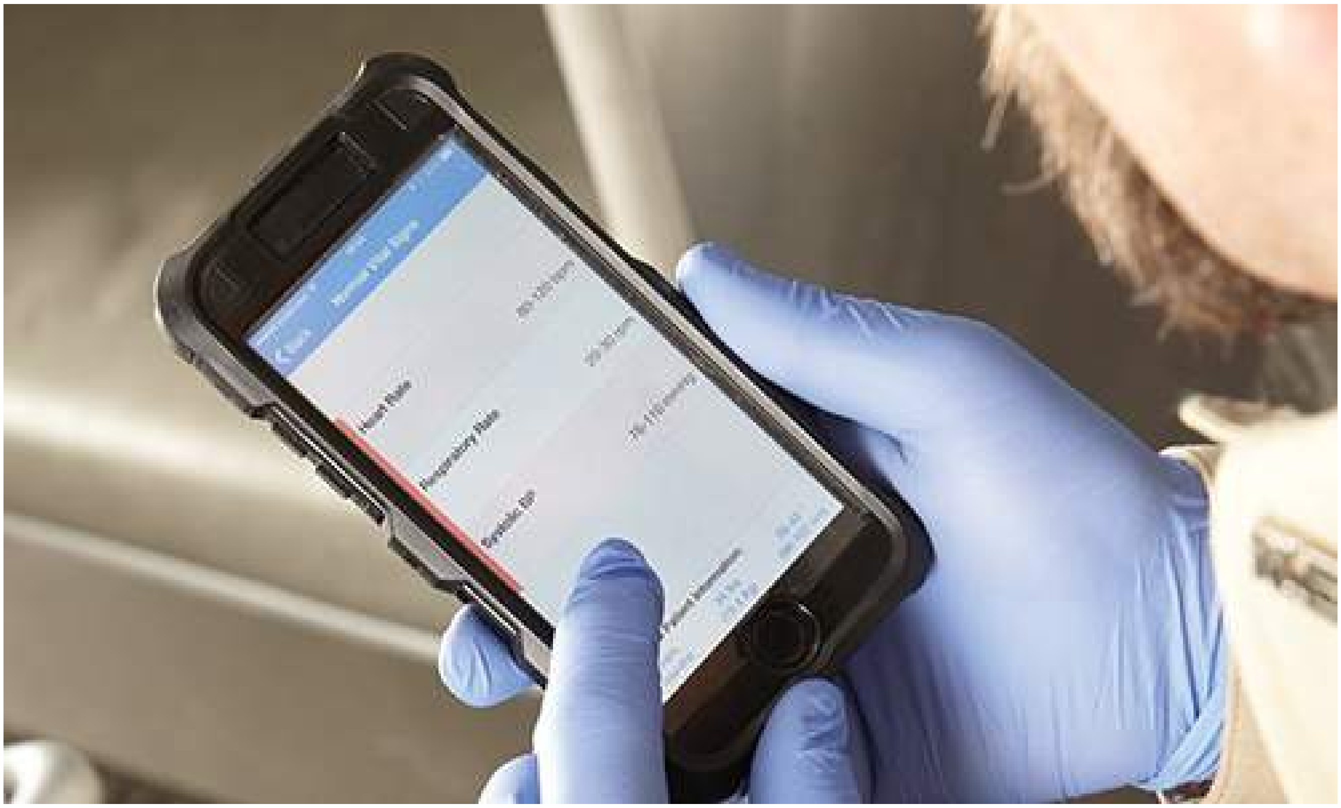
   A. Internet laws.
   B. patient care report protocol.
   C. NEMSIS.
   D. HIPAA.

9. Describe some of the administrative information that can be found on a PCR.

10. Describe the importance of the administrative information.

CHAPTER 5

Medical Terminology



National EMS Education Standard Competencies

Medical Terminology

Uses foundational anatomical and medical terms and abbreviations in written and oral communication with colleagues and other health care professionals.

Knowledge Objectives

1. Explain the purpose of medical terminology. (p 153)
2. Identify the four components that comprise a medical term. (p 153)
3. Describe the following directional terms: anterior (ventral), posterior (dorsal), right, left, superior, inferior, proximal, distal, medial, lateral, superficial, and deep. (pp 158–161)
4. Describe the prone, supine, Fowler, and semi-Fowler positions of the body. (p 161)
5. Break down the meaning of a medical term based on the components of the term. (p 162)
6. Identify error-prone medical abbreviations, acronyms, and symbols. (p 162)
7. Interpret selected medical abbreviations, acronyms, and symbols. (p 163)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

As an EMT, it is essential that you have a strong working knowledge of medical terminology. Understanding key terms, acronyms, symbols, and abbreviations is important for effective communication and documentation. Understanding how terms are formed and the definitions for the various parts of a medical term will help you determine the meaning of an unknown term by breaking the word apart. Once you understand medical jargon, you will be able to communicate effectively with other members of the EMS, health care, and public safety teams.

Anatomy of a Medical Term

Medical terms are made of distinct parts that perform specific functions. Changing or deleting any of those parts can significantly change the function (or meaning) of a word. Components that comprise medical terms include the:

- **Word root** – the foundation of the word
- **Prefix** – what occurs before the root word
- **Suffix** – what occurs after the root word
- **Combining vowels** – vowels that join one or more word roots to other components of a term

How the parts of a term are combined determines its meaning. Accurate spelling, especially when some words are pronounced almost the same way, is essential in medical terminology. For example, the suffix *-phasia* means speaking, whereas *-phagia* means eating or swallowing. The prefix *dys-* means difficult or painful. Combining those two parts, *dysphasia* means difficulty speaking, while *dysphagia* means difficulty eating or swallowing. These are very different terms and the two words, although spelled differently, sound almost identical. Likewise, the terms *ilium* and *ileum* are pronounced exactly the same, but refer to different anatomic parts. The ilium is the largest bone of the pelvis, and the ileum is the last part of the small intestine. Knowing anatomy and the context of how these words are used will help you correctly determine (and spell) the term in a given situation.

Word Roots

The main part or stem of a word is called a word root. Some books use the term *word root*; others use *root word*. The terms are synonymous. A word root conveys the essential meaning of the word and frequently indicates a body part. Most terms have at least one word root, and some have more than one word root. Adding a prefix or suffix to the word root creates a term. Changing the prefix or suffix will change the meaning of the term.

A frequently used medical term is CPR, which stands for cardiopulmonary resuscitation. *Cardiopulmonary* breaks down as follows: *cardio* is a word root meaning "heart," and *pulmon* is a word root meaning "lungs." By performing CPR you introduce air into the lungs and circulate blood by compressing the heart to resuscitate the patient. Some word roots may also be used as prefixes or suffixes for other terms.

Examples of some word roots are shown in **Table 5-1**.

YOU are the Provider — PART 1

It is almost the end of your shift when you get a call for a routine transfer from the nursing home to the hospital for a 79-year-old woman with constipation and abdominal pain. Upon your arrival, you are met by a nurse who informs you the patient is new to the facility. She hands you the medical record, which includes the following information:

Patient Hx: AAA; HTN; CVA in 2009; AMI in 2010; GERD; and type 1 DM.

Your patient is pale and her skin is wet. When you gently palpate her abdomen you feel a pulsing mass in the area of her umbilicus. Your partner has placed a nonrebreathing oxygen mask on the patient at 12 L/min and obtained vital signs.

1. What can you determine about the patient's medical history based on the acronyms in the record?

See the tables at the end of this chapter for more common word roots. Combining forms are discussed later in the chapter.

Prefixes

A prefix is the part of a term that appears at the beginning of a word. It generally describes location and intensity. Prefixes are frequently found in general language (ie, *auto*pilot, *sub*marine, *tri*cycle), as well as in medical and scientific terminology. Not all medical terms have prefixes.

A prefix gives the word root a specific meaning. When a medical word contains a prefix, the meaning of the word is altered. For example, *pnea* is the word root for breathing. Adding the prefix *a-* (without), *brady-* (slow), or *tachy-* (rapid) to a word creates three very different terms:

- a/pnea – without breathing
- brady/pnea – slow breathing
- tachy/pnea – rapid breathing

Some common prefixes are shown in Table 5-2.

By learning to recognize a few of the more commonly used medical prefixes, you can figure out the meaning of terms that may not be immediately familiar to you. See the tables at the end of the chapter for more common prefixes.

Suffixes

Suffixes are placed at the end of words and usually indicate a procedure, condition, disease, or part of speech.

A commonly used suffix is *-itis*, which means "inflammation." When this suffix is paired with the word root *arthro-*, meaning joint, the resulting word is arthritis, an inflammation of the joints.

Some common suffixes are listed in Table 5-3. See the tables at the end of this chapter for more common suffixes.

Table 5-1 Common Word Roots in EMS

Root	Meaning	Example	Definition of Example
cardi	heart	tachycardia	fast heart rate
hepat	liver	hepatomegaly	enlargement of the liver
nephr	kidney	nephropathy	disease of the kidney
neur	nerves	neurologist	physician who specializes in diseases of the nervous system
psych	mind	psychology	study of the mind
thorac	chest	thoracic	pertaining to the chest or thorax

Table 5-2 Common Prefixes in EMS

Prefix	Meaning	Example	Definition of Example
hyper-	over, excessive, high	hyperventilation	fast ventilations
hypo-	under, below normal	hypoperfusion	below normal blood flow to vital organs
tachy-	rapid, fast	tachycardia	fast heart rate
brady-	slow	bradypnea	slow breathing
pre-	before	prenatal	occurring before birth
post-	after, behind	postsurgical	occurring after surgery

Table 5-3 Common Suffixes in EMS

Suffix	Meaning	Example	Definition of Example
-al	pertaining to	syncopal	pertaining to syncope
-algia	pertaining to pain	arthralgia	joint pain
-ectomy	surgical removal of	appendectomy	surgical removal of the appendix
-ic	pertaining to	diaphoretic	pertaining to diaphoresis
-itis	inflammation	epiglottitis	inflammation of the epiglottis
-logy	study of	cardiology	the study of the heart
-logist	specialist	pulmonologist	specialist in diseases of the lung
-megaly	enlargement	cardiomegaly	enlargement of the heart
-meter	measuring instrument	sphygmomanometer	instrument to measure blood pressure
-oma	tumor (usually referring to cancer)	lymphoma	cancer of the lymphatic system
-pathy	disease	nephropathy	diseases of the kidneys

Combining Vowels

A combining vowel is the part of a term that connects a word root to a suffix or other word root. In most cases, the combining vowel is an *o*; however, it may also be an *i* or an *e*. A combining vowel is usually used when joining a suffix that begins with a consonant or when joining another word root. For example, take the term *gastroenterology*, the study of diseases of the stomach and small intestines:

- gastr/o + enter/o + logy
- stomach + small intestines + the study of

In this term, *gastr* and *enter* are both word roots, *-logy* is the suffix, and *o* is the combining vowel (used twice). The combining vowel helps ease the pronunciation of the term. Without the vowel, the term would be rather difficult to pronounce—*gastrenterlogy*.

Refer to the tables at the end of this chapter for combining vowels associated with common word roots. A combining vowel shown with the word root is called a combining form. Here are a few of the most common combining forms you will see:

- cardi/o (heart)
- gastr/o (stomach)
- hepat/o (liver)
- arthr/o (joint)
- oste/o (bone)
- pulmon/o (lungs)

YOU are the Provider — PART 2

ALS assistance is 15 minutes away, so after administering oxygen you prepare the patient for transport. En route to the hospital you call with a report:

"EMT 123 to Regional Medical Center. We are en route to your facility with a 79-year-old woman reporting abdominal pain that started 2 hours ago. History of abdominal aortic aneurysm, hypertension, cerebrovascular accident in 2009; acute myocardial infarction in 2010, gastroesophageal reflux disease, and type 1 diabetes. Patient's skin is pale and wet and there is a pulsing mass in the periumbilical area. BP is 80/50 mm Hg; pulse 128 BPM; respirations 24 per minute. Patient is on NRB mask at 12 L/min; Our ETA is 10 minutes."

2. How did the use of acronyms assist in delivering your report to the hospital?
3. What other acronyms or abbreviations could have been used in this report?

Word Building Rules

When building or taking apart a medical term, it is helpful to understand some basic rules. The following summarizes the rules covered thus far:

1. The prefix is always at the beginning of a term; however, not all terms will have a prefix.
2. The suffix is always at the end of the term.
3. When a suffix begins with a consonant, a combining vowel is used between the word root and suffix to make pronunciation easier.
4. When a term has more than one word root, a combining vowel must be placed between the two word roots, even if the second root begins with a vowel.

Plural Endings

To change a term from a singular to plural form, certain rules apply. In some cases, you simply add a *s* to the word (lung becomes lungs). However, for some medical terms, making the plural form is more complicated. Rules you may encounter when converting terms from singular to plural are:

1. Singular words that end in *a* change to *ae* when plural.
   - Example: vertebra becomes vertebrae.
2. Singular words that end in *is* change to *es* when plural.
   - Example: diagnosis becomes diagnoses.
3. Singular words that end in *ex* or *ix* change to *ices*.
   - Example: apex becomes apices.
4. Singular words that end in *on* or *um* change to *a*.
   - Examples: ganglion becomes ganglia, ovum becomes ova.
5. Singular words that end in *us* change to *i*
   - Example: bronchus becomes bronchi.

Special Word Parts

As already described, prefixes appear at the beginning of a word, before the word root. Prefixes used to indicate numbers, colors, and directions are described as follows. Look at the prefixes, meanings, and examples. Can you think of other terms using the same prefix with another root? Do you see how it changes the meaning?

Numbers

Several prefixes are used to indicate if a term involves a number such as half, one or two or more parts or sides. Common prefixes for numbers are listed in Table 5-4.

Colors

Several word roots are used to describe color. The most common include those listed in Table 5-5.

Positions and Directions

Prefixes can also be used to describe a position, direction, or location. The most common include those listed in Table 5-6.

Table 5-4 Common Number Prefixes

Prefix	Meaning	Example	Definition of Example
uni-	one	unilateral	one side
dipl-	two; double	diplopia	double vision
null-	none	nullipara	never given birth
primi-	first	primigravida	pregnant for the first time
multi-	many	multiparous	giving birth to more than one offspring at a time
bi-	two	bilateral	pertaining to both sides
tri-	three	trigeminy	irregular heartbeat of two normal beats followed by one premature beat
quad-	four	quadriplegic	paralysis of all four extremities
tetra-	four	tetralogy of Fallot	a congenital defect involving four anatomic abnormalities of the heart
quint-	five	quintipara	five pregnancies resulting in five live births
sexti-	six	sextuplets	six offspring of the same pregnancy
septi-	seven	septuplets	seven offspring of the same pregnancy
oct-	eight	octigravida	pregnant for the eighth time
nona-	nine	nonan	occurring on the ninth day
deca-	ten	decagram	measurement of ten grams
semi-	half; partial	semiconscious	partially conscious
hemi-	half; one sided	hemiplegia	paralysis on one side of the body
ambi-	both	ambidextrous	able to use either hand equally well
pan-	all, entire	pandemic	an epidemic over a wide area

Table 5-5 Word Roots That Describe Color

Root	Meaning	Example	Definition of Example
cyan/o	blue	cyanosis	bluish discoloration of the skin
leuk/o	white	leukocyte	white blood cells that fight infection
erythr/o	red	erythrocyte	red blood cells that contain hemoglobin to carry oxygen
cirrh/o	yellow-orange	cirrhosis	inflammation of the liver causing yellow-orange pigmentation of the liver
melan/o	black	melena	black, tarry stool typically caused by upper GI bleeding
poli/o	gray	poliomyelitis	an acute viral disease that attacks the motor neurons of the central nervous system (brain and spinal cord)
alb	white	albino	a person lacking skin pigmentation (very white hair, very pale skin, and nonpigmented iris)
chlor/o	green	chlorophyll	green pigment in leaves used in photosynthesis

Table 5-6 Prefixes That Describe Position

Prefix	Meaning	Example	Definition of Example
To/From			
ab-	away from	abduction	away from the point of reference
ad-	to, toward	adduction	toward the center
Above/Below/Around			
de-	down from, away	decay	to waste away
circum-	around, about	circumferential burn	a burn around an entire area (arm, chest, abdomen, etc)
peri-	around	pericardium	the sac around the heart
trans-	across, through, beyond	transvaginal	across or through the vagina
epi-	above, upon, on	epigastric	above or over the stomach
supra-	above, over	suprasternal notch	top of the sternum
retro-	behind	retroperitoneal	the area behind the peritoneum
sub-	under, beneath	subcutaneous	beneath the skin
infra-	below, under	infraclavicular	below the clavicle
para-	near, beside, beyond, apart from	parasternal	beside the sternum
contra-	against, opposite	contraindicated	something that is not indicated
Outside/Inside			
ecto-	out, outside	ectopic pregnancy	pregnancy where the embryo attaches outside of the uterus
endo-	within	endoscopy	examining inside someone's body (with an endoscope)
extra-	outside, in addition	extraneous	outside the organism and not belonging to it
intra-	inside, within	intrauterine	within the uterus
ipsi-	same	ipsilateral	on or affecting the same side

Common Direction, Movement, and Position Terms

Directional Terms

When discussing where an injury is located or how pain radiates in the body, you need to know the correct directional terms Figure 5-1. Table 5-7 provides the basic terms used in medicine. Notice how directional terms are paired as "opposites."

Right and Left

The terms *right* and *left* refer to the patient's right and left sides, not to your right and left sides.

Superior and Inferior

The **superior** part of the body, or any body part, is the portion nearer to the head from a specific reference point. The part nearer to the feet is the **inferior** portion. These terms are also used to describe the relationship of one structure to another. For example, the knee is superior to the foot and inferior to the pelvis.

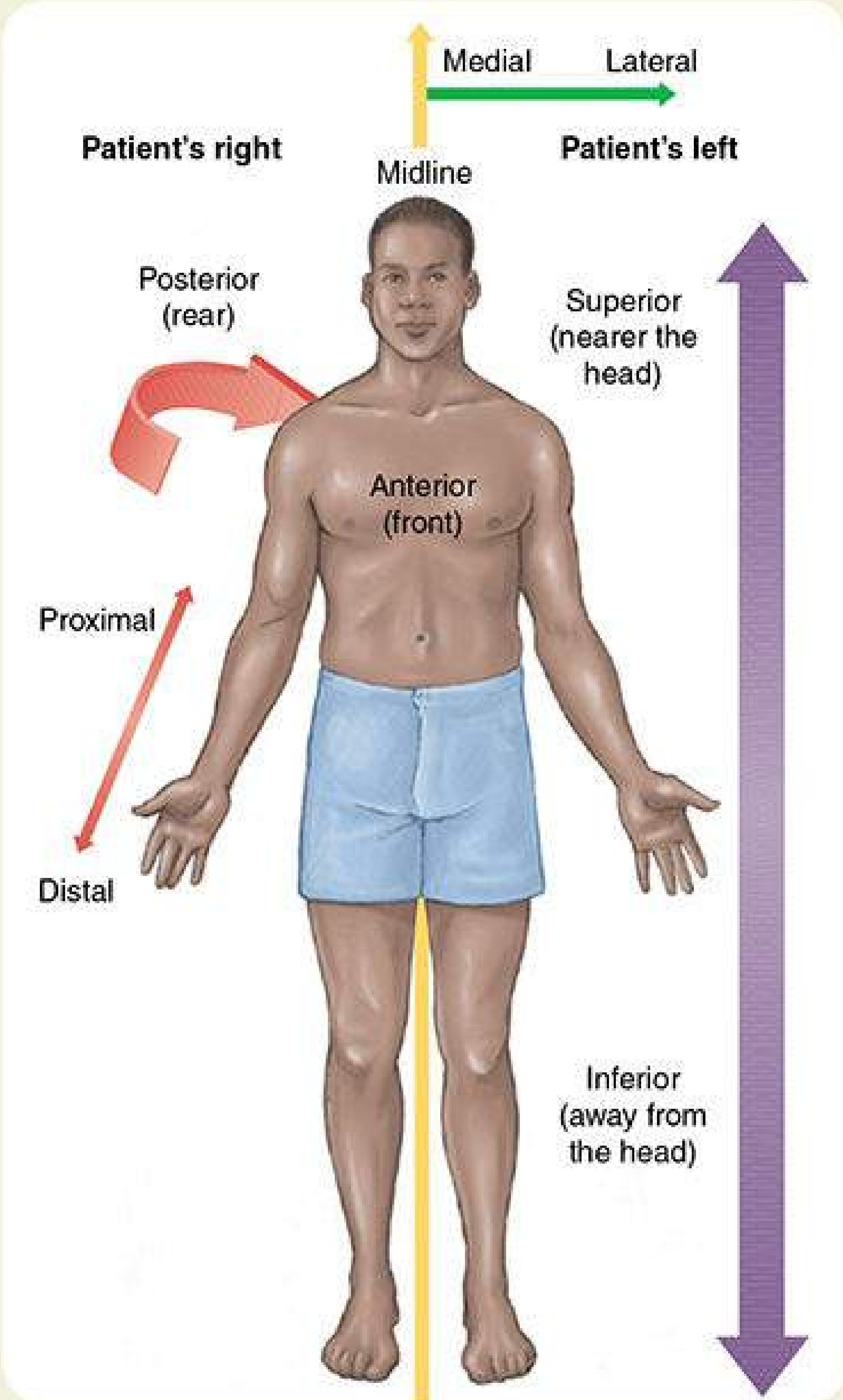


Figure 5-1 Directional terms indicate distance and direction from the midline.

Lateral and Medial

Parts of the body that lie farther from the midline are called **lateral** (outer) structures. The parts that lie closer to the midline are called **medial** (inner) structures. For example, the thigh has medial (inner) and lateral (outer) surfaces. In general terms, *lateral* means side. For example, lying on the left side is called left lateral recumbent. Something that occurs on both sides is referred to as *bilateral*. When describing the location of an injury, the terms *medial* and *lateral* help pinpoint an exact location. For example, the patient has a 2-inch (5 cm) laceration on the medial aspect of the thigh (toward the inside).

Table 5-7 Directional Terms

Common Term	Directional Term	Definition
Front and back	Anterior (ventral) Posterior (dorsal)	The front surface of the body The back surface of the body
Right and left	Right Left	The patient's right The patient's left
Top and bottom	Superior Inferior	Closest to the head Closest to the feet
Closest and farthest	Proximal Distal	Closest to the point of attachment Farthest from the point of attachment
Middle and side	Medial Lateral	Closest to the midline Farthest from the midline
In and out	Superficial Deep	Closest to the surface of the skin Farthest from the surface of the skin

Proximal and Distal

The terms *proximal* and *distal* are used to describe the relationship of any two structures on an extremity. **Proximal** describes structures that are closer to the trunk. **Distal** describes structures that are farther from the trunk or nearer to the free end of the extremity. For example, the elbow is distal to the shoulder and proximal to the wrist and hand.

Superficial and Deep

Superficial means closer to or on the skin. **Deep** means farther inside the body or tissue and away from the skin. For example, a superficial burn involves only the top layer of skin, similar to a sunburn. An abrasion is a superficial wound, similar to "scraping your knee," whereas a deep laceration involves a cut deeper into the tissue such as with a knife.

Ventral and Dorsal

Ventral refers to the belly side of the body, or the anterior surface of the body. **Dorsal** refers to the spinal side of the body, or the posterior surface of the body, including the back of the hand. These terms are used less frequently than the terms **anterior** (the front surface of the body) and **posterior** (the back surface of the body). An easy way to remember *dorsal* is to think of the dorsal fin on a dolphin, which is on its back (posterior) side.

Palmar and Plantar

The front region of the hand is referred to as the palm or **palmar** surface. The bottom of the foot is referred to as the **plantar** surface.

Apex

The **apex (plural apices)** is the tip of a structure. For example, the apex of the heart is the bottom (inferior portion) of the ventricles in the left side of the chest.

Movement Terms

The following terms relate to movement Figure 5-2:

- **Flexion** is the bending of a joint.
- **Extension** is the straightening of a joint.
- **Adduction** is motion toward the midline.
- **Abduction** is motion away from the midline.

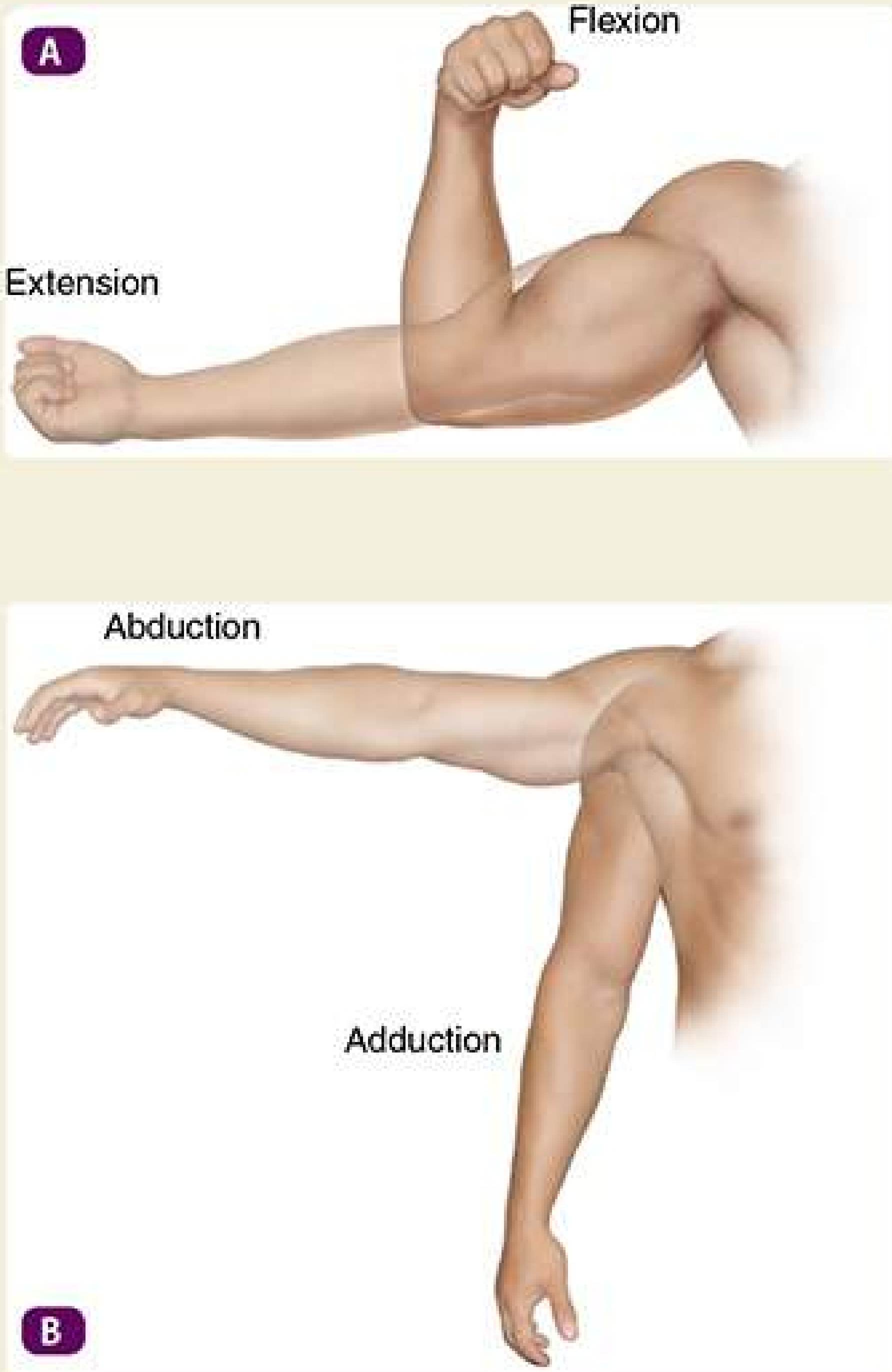


Figure 5-2 **A.** Flexion and extension at the elbow. **B.** Adduction and abduction at the shoulder.

Words of Wisdom

Using the correct anatomic terminology in your patient care report improves patient care by making the report more useful to hospital personnel and enhances your professional image as an EMT.

▶ Other Directional Terms

Many structures of the body occur bilaterally. A body part that appears on both sides of the midline is **bilateral**. For example, the eyes, ears, hands, and feet are bilateral structures, meaning there is one on each side of the midline. This is also true for structures inside the body, such as the lungs and kidneys. Something that appears on only one side of the body is said to occur *unilaterally*. For example, unilateral chest expansion means that only one lung is expanding with inhalation (such as with a pneumothorax). Pain that occurs on only one side of the body could be called unilateral pain.

As part of the assessment process, you will palpate the abdomen and report findings. Therefore, it is important that you are able to describe the exact location of areas of the abdomen. The way to describe the sections of the abdominal cavity is by **quadrants**. Imagine two lines intersecting at the umbilicus, dividing the abdomen into four equal areas **Figure 5-3**. These are referred to as the right upper quadrant, left upper quadrant, right lower quadrant, and left lower quadrant. Remember that here, too, right and left refer to the patient's right and left, not yours.

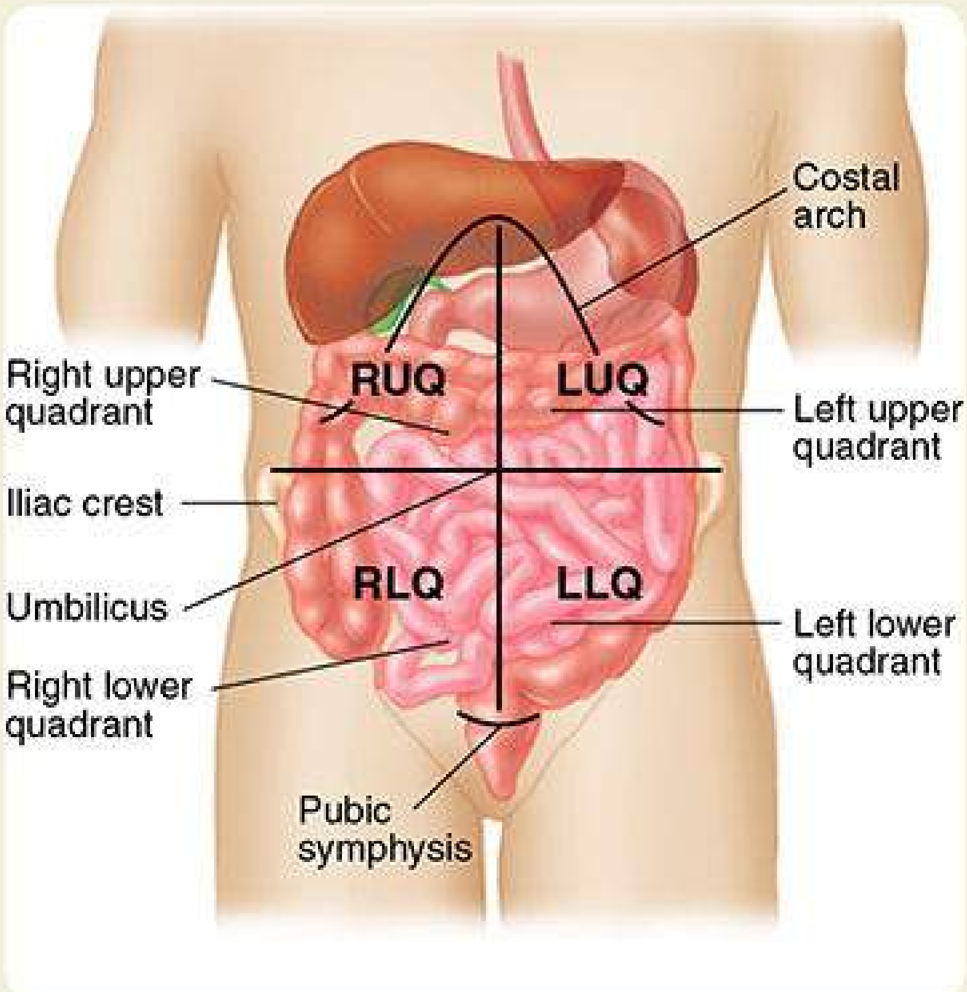


Figure 5-3 The abdomen is divided into four quadrants. RUQ indicates right upper quadrant; LUQ, left upper quadrant; RLQ, right lower quadrant; and LLQ, left lower quadrant.

It is important to learn all of these terms and concepts so you can describe the location of any injury or assessment findings. When you use these terms properly, any other medical personnel who care for the patient will know immediately where to look and what to expect.

Anatomic Positions

There are many terms used to describe the position of the patient upon your arrival or during transport to the emergency department **Figure 5-4**.

Prone and Supine

These terms describe the position of a body. The body is in the **prone** position when lying face down; the body is in the **supine** position when lying faceup.

Fowler Position

The **Fowler position** was named after a US surgeon, George R. Fowler, MD, at the end of the 19th century. Dr. Fowler placed his patients in a semireclining position with the head elevated to help them breathe easier and to control the airway. A patient who is sitting upright is therefore said to be in the Fowler position. Some refer to semi-Fowler position as sitting with the back of the stretcher at a 45-degree angle and high-Fowler position as sitting at a 90-degree angle.

Figure 5-4 **A.** Fowler position. **B.** Supine. **C.** Prone. **D.** Recovery position.

Breaking Terms Apart

Just as you use parts of terms to build new words, you can use knowledge of the meaning of parts to decipher the meaning of a term. When trying to define a term, begin with the suffix and work backward. If the term also contains a prefix, define the suffix, then the prefix, and then the word root. Here are some examples:

- nephropathy
  nephr/o/pathy
  -pathy (suffix meaning "disease")
  o (combining form)
  nephr (word root meaning "kidney")
  nephropathy = disease of the kidney
- dysuria
  dys/ur/ia
  -ia (suffix meaning "condition of")
  dys- (prefix meaning "difficult, painful, or abnormal")
  ur (word root meaning "urine")
  dysuria = painful urination (pain when urinating) or difficulty urinating
- hyperemesis
  hyper/emesis
  hyper- (prefix meaning "excessive")
  emesis (word root meaning "vomiting")
  hyperemesis = excessive vomiting
- analgesic
  an/alges/ic
  -ic (suffix meaning "pertaining to")
  an- (prefix meaning "without" or "absence of")
  alges (word root meaning "pain")
  analgesic = pertaining to no pain

Abbreviations, Acronyms, and Symbols

Medical abbreviations, acronyms, and symbols are a type of shorthand used to communicate in the medical world. They came about for the same reason that people send text messages and tweets using text shorthand—you can communicate faster using this method. It is important, however, not to trade speed for accuracy. Use only commonly understood acronyms and abbreviations to minimize misinterpretations and errors. The Joint Commission and the Institute for Safe Medication Practices are considered two authorities on abbreviations; both organizations provide do-not-use lists identifying abbreviations that lead to errors.

There is a slight difference in meaning between abbreviations and acronyms. When you shorten a word using an abbreviation, you pronounce each letter of the abbreviation separately and distinctly. For example, emergency medical technician is abbreviated to EMT (you say it E–M–T). When you use an acronym, you are shortening several words, usually using the first letter of each word to make the acronym. Acronyms are pronounced as their own word (for example, SAMPLE history is pronounced like the word *sample*), by reading the letters one by one (for example, EMS is pronounced "E-M-S"), or by a combination of the two (for example, DCAP-BTLS is pronounced "D-cap-B-T-L-S," and the acronym for Urban Search and Rescue (USAR) is pronounced ū-săr.

Misunderstanding and errors will occur if everyone involved in the emergency care of a patient does not understand the meaning of abbreviations or acronyms. For this reason, some agencies limit the use of abbreviations.

YOU are the Provider — PART 3

Within 10 minutes of arriving at the hospital, your patient is in the operating room having her ruptured abdominal aortic aneurysm repaired. You sit down to carefully document your care, and start with: "EMT123 arrived to find a 79 yo female, A&O, supine in hospital bed. CC: Periumbilical abdominal pain. Skin is pale and wet. On palpation, noted a pulsing midline abdominal mass in the epigastric region approximately 2 inches superior to the umbilicus..."

4. What do the abbreviations or acronyms in this portion of the report mean?
5. What other abbreviations, acronyms, or symbols could you have used in this portion of the report?

Abbreviations

Abbreviations take the place of words to shorten notes or documentation. When using abbreviations on patient care reports, remember to use only standard, accepted abbreviations to avoid confusion and errors. See the tables at the end of this chapter for a list of commonly used abbreviations. This list is intended to help you decipher documents written by other health care professionals. Before using any abbreviations in your own reports, be familiar with accepted use of abbreviations in your local jurisdiction or service area.

Words of Wisdom

There are many medical terms, acronyms, abbreviations, and symbols used by medical professionals. The material in this chapter provides only a small sample. You may find it helpful to invest in a phone app or pocket reference guide to assist you when you encounter unfamiliar terms.

Symbols

Like abbreviations, symbols are sometimes used as a shortcut in communication and documentation. As with abbreviations, it is important to use only the symbols that are widely understood and accepted Table 5-8.

Master Tables

Table 5-9 through Table 5-12 provide a thorough reference list of common word roots, combining forms, prefixes, suffixes, and abbreviations.

Table 5-8 Common Symbols

1°	first, first degree, primary
2°	secondary, second degree
↑	increase(d)
↓	decrease(d)
Ⓡ	right
Ⓛ	left
μ	micro
α	alpha
β	beta
~	approximately
N	normal
×2	times two
/	per
≠	not equal
>	greater than
<	less than
?	questionable, possible
Δ	change
—	negative
♀	female
♂	male

Note: The forward slash mark ("/") is included for explanatory purposes, but its use is not recommended by the Institute for Safe Medication Practices.

YOU are the Provider — PART 4

Knowing that the abbreviations related to the patient's history point to severe cardiovascular disease helps direct the assessment and subsequent field impression to abdominal aortic aneurysm. The ability to call in the report using common abbreviations helps save precious time so you can return to the care of your patient. Using medical terminology correctly to document the call increases your professionalism as an EMT.

Table 5-9 Common Word Roots and Combining Forms

Root	Meaning	Root	Meaning	Root	Meaning
abdomin/o	abdomen	bronch/i	airway, bronchus	corne/o	cornea
acou/o; acoust/o	hear	bucc/o	cheek	cost/o	rib
aden/o	gland	burs/o	pouch or sac	crani/o	cranium, skull
adip/o	fat	calc/i	calcium	crin/o	to secrete
alb/o	white	carcin/o	cancer	cubitus	elbow
alges/o	pain	cardi/o	heart	cutane/o	skin
andr/o	man, male	carp/o	wrist	cyan/o	blue
angi/o	vessel	cartil/o	cartilage, gristle	cycl/o	circle or cycle
angin/o	blood vessel	caud/o	tail	cyst/o	bladder
ankyl/o	fused, stiff	cec/o	blind intestine, cecum	cyt/o	cell
anter/o	front	cel/o	hernia, protrusion	derm(at)/o	skin
aort/o	aorta	cent/e	to puncture (a body cavity)	digit	finger or toe
append/o	appendix	cent/i	a fraction in the metric system; one hundredth or 100	dipl/o	two, double
arteri/o	artery	cephal/o	head	dips/o	thirst
arthr/o	joint	cerebr/o	brain, cerebrum	disk/o	flat shape, intervertebral disk
asthen/o	weak	cervic/o	neck	dist/o	distant, away
atel/o	incomplete	chol/e	bile	diverticul/o	diverticulum, a small blind pouch
ather/o	fat	chondr/o	cartilage	dors/o	back
atri/o	atrium	chrom/o	color	duct/o	lead, move
audi/o	to hear	chron/o	time	duoden/o	duodenum
aur/o	ear	cirrh/o	yellow-orange	ech/o	to bounce, sound
aut/o	self	cleid/o	clavicle	ede	swelling
bacteri/o	bacteria	col/o	colon	elast/o	change shape
bi	life; also two	colp/o	vagina	electr/o	electricity
bil/i	bile	condyl/o	knuckle of a joint	embol/o	a plug
blast/o	germ, bud, developing cell	cor/o	pupil	embry/o	embryo
blephar/o	eyelid			emesis	vomit
brachi/o	arm				

Root	Meaning
emmetr/o	according to measure
enchephal/o	brain
enter/o	small intestine
episi/o	vulva
erythr/o	red
esthesi	sensation or perception
febr	fever
flex	bend
foramen	opening
fract	break
gastr/o	stomach
gest	carry, produce, congestion
glyc/o	sugar, sweet
gno	know
gyn/o	woman, female
hem(at)/o	blood
hepat/o	liver
heter/o	other, different
hom/o	the same
hydr/o	water
idi/o	person, self
lact/o	milk
leuk/o	white
lingu/o	tongue
mal/o	abnormal, bad
medi/o	middle
melan/o	black, dark
men/o	month, menstruation

Root	Meaning
mening/o	membrane, usually refers to the meninges
myel/o	marrow or spinal cord
my/o	muscle
nephr/o	kidney
neur/o	nerve
ocul/o	eye
ophthalm/o	eye
oste/o	bone
ot/o	ear
ov/o	egg
palpate	to examine by touch
path/o	disease
ped/o	child or foot
percuss	to examine by striking
phag/o	eat
pharyng/o	throat
phot/o	light
pleur/o	rib, side
pneum(at)/o	lungs, air
pneumo(n)/o	lung
pod(i)	foot
pseud/o	false
psych/o	mind
pto	fall
ptyal/o	saliva
pulmon/o	lungs
pur, py	pus
pyr/o	fire, heat

Root	Meaning
quadr/o; quar	four
ren/o	kidney
rhin/o	nose
sangui(n)o	blood
scler/o	hard
sebum	a fatty secretion of the sebaceous glands
sect/o	cut
sept/o	wall, divider; also seven
serum	the clear portion of body fluids, including blood
sinus	cavity, channel, or hollow space
som(a)	body
spir/o	coil, to breathe
stern(o)-	sternum (breastbone)
stomat/o	mouth
thorac/o	chest
tom/o	cut
toxic/o	poisonous
trich/o	hair
ur/o	urine
uter/o	uterus, womb
varic/o	dilated vein
vas/o	blood vessel
viscer/o	internal organs
xen/o	foreign (material)
xer/o	dry

Table 5-10 Common Prefixes

Prefix	Meaning	Prefix	Meaning	Prefix	Meaning
a-	without, lack of	hemi-	half	pan-	all, entire
ab-	away from	hyper-	over, excessive, high	para-	near, beside, beyond, apart from
ad-	to, toward	hypo-	under, below normal	per-	through
an-	without, lack of	in-	in, into, not, without	peri-	around
ana-	up, back, again	infra-	below, under	poly-	many
ante-	before, forward	inter-	between	post-	after, behind
anti-	against, opposed to	intra-	inside, within	pre-	before
auto-	self	ipsi-	same	primi-	first
bi-	two	iso-	equal	pro-	before, in front of
brady-	slow	macro-	large	quadr(i)-	four
circum-	around, about	mal-	bad or abnormal	re-	back
contra-	against, opposite	mega-	large	retro-	backward, behind
de-	down from, away	meta-	after, change	semi-	half, partial
di-	twice, double	micro-	small	sub-	under, below
dia-	through, completely	mono-	one, single	super-	above, excessive, or more than normal
dys-	difficult, painful, abnormal	multi-	many	supra-	above, upper
ect(o)-	out, outside	neo-	new	sym-	together, joined
end(o)-	within	noct-	night	syn-	together, joined
epi-	upon, over, above	nulli-	none	tachy-	rapid, fast
eu-	easy, good, normal	olig(o)-	little, deficient	tetra-	four
ex(o)-	outside, away from	ortho-	straight or normal	trans-	across, through, beyond
extra-	outside, in addition			tri-	three
				uni-	one

Table 5-11 Common Suffixes

Suffix	Meaning	Suffix	Meaning	Suffix	Meaning
-al	pertaining to	-ia	condition of	-pnea	pertaining to breathing
-algia	pertaining to pain	-ic	pertaining to	-ptosis	drooping
-asthenia	weakness	-itis	inflammation	-rrhage	abnormal or excessive flow or discharge
-blast	immature cell	-lysis	decline, disintegration, or destruction	-rrhagia	abnormal or excessive flow or discharge
-cele	pertaining to a tumor or swelling	-megaly	enlargement of	-rrhaphy	suture of; repair of
-centesis	pertaining to puncturing an organ or body cavity, often to drain excess fluid or obtain a sample for analysis	-meter	measuring instrument	-rrhea	flow or discharge
-cyte	cell	-ology	science or study of	-scope	instrument for examination
-ectomy	surgical removal of	-oma	tumor	-scopy	examination with an instrument
-emesis	vomiting	-osis	pertaining to a disease process (*see also* -sis)	-sis	a process, action, or condition (*see also* -osis)
-emia	pertaining to the presence of a substance in the blood	-ostomy	surgical creation of an opening	-stasis	slowing or stopping of the normal flow of a fluid, such as blood
-esthesia	pertaining to sensation or perception	-pathy	disease or a system for treating disease	-taxis	order, arrangement of
-genic	causing	-phagia	pertaining to eating or swallowing	-trophic	pertaining to nutrition
-gram	record	-phasia	pertaining to speech		
-graph	a record or the instrument used to create the record	-phobia	pertaining to an irrational fear		
		-plasty	plastic surgery		
		-plegia	paralysis		

Table 5-12 Common Abbreviations*

Abbreviation	Meaning	Abbreviation	Meaning	Abbreviation	Meaning
A&P	anatomy and physiology	abd	abdomen	ACLS	advanced cardiac life support
ā	before	ABC, ABCs	airway, breathing, circulation	ADL, ADLs	activities of daily living
AAA	abdominal aortic aneurysm	ac	before meals		

Abbreviation	Meaning
ad lib	as desired
AED	automated external defibrillator
AF, A-fib	atrial fibrillation
AICD	automated implantable cardioverter defibrillator
AIDS	acquired immuno-deficiency syndrome
AK	above the knee
AKA	above the knee amputation
AMA	against medical advice
amb	ambulatory
AMI	acute myocardial infarction
ant	anterior
AO × 4, A/O × 4	alert and oriented to person, place, time, and self
AP	anteropo-sterior, front-to-back, action potential, angina pectoris, anterior pituitary, arterial pressure
ARDS	adult respiratory distress syndrome
ASA	aspirin (acetylsalicylic acid)

Abbreviation	Meaning
ASHD	arteriosclerotic or atherosclerotic heart disease
BGL	blood glucose level
bid/b.i.d./BID	twice daily
BKA	below the knee amputation
BM	bowel movement
BP, B/P	blood pressure
BPM	beats per minute
BS	blood sugar, breath sounds, bowel sounds, bachelor of science (degree)
BSA	body surface area
BVM	bag-valve mask
bx	biopsy
c̄	with
°C	degrees Celsius (centigrade)
CA	cancer, cardiac arrest, chronologic age, coronary artery, cold agglutinin
CABG	coronary artery bypass graft
CAD	coronary artery disease
CBC	complete blood cell count
CC or C/C	chief complaint
CCU	coronary care unit

Abbreviation	Meaning
C diff	*Clostridium difficile*
CHF	congestive heart failure
cm	centimeter
CNS	central nervous system
c/o	complaining of
CO	cardiac output, carbon monoxide
CO_2	carbon dioxide
COLD	chronic obstructive lung disease
COPD	chronic obstructive pulmonary disease
CP	chest pain, chemically pure, cerebral palsy
CPR	cardiopul-monary resuscitation
CRNA	certified registered nurse anesthetist
CRT	capillary refill time, cathode ray tube
CSF	cerebrospinal fluid
CVA	cerebrovascular accident
DM	diabetes mellitus
DNR	do not resuscitate
DOA	dead on arrival
DOE	dyspnea on exertion
DON	director of nursing

Abbreviation	Meaning
DPT	diphtheria and tetanus toxoids and pertussis vaccine, Doctor of Physical Therapy
DSD	dry sterile dressing
DtaP	diphtheria and tetanus toxoids and acellular pertussis vaccine
DTP	diphtheria and tetanus toxoids and pertussis vaccine
DTs	delirium tremens
DVT	deep venous thrombosis
Dx	diagnosis
ECG	electro-cardiogram
ED	emergency department, erectile dysfunction
EDC	estimated date of confinement
EEG	electroen-cephalogram
EKG	electro-cardiogram
ENT	ears, nose, and throat
EOC	Emergency Operations Center
ER	emergency room
ET, ETT	endotracheal tube, endotracheal
ETA	estimated time of arrival
ET_{CO_2}	end-tidal carbon dioxide
ETOH	ethyl alcohol
°F	degrees Fahrenheit
F_{IO_2}	fraction of inspired oxygen
FBS	fasting blood sugar
Fe	iron
FHR	fetal heart rate
FHx	family history
fl or fld	fluid
fx	fracture
GB	gallbladder
GCS	Glasgow Coma Scale
GERD	gastroesophageal reflux disease
GI	gastrointestinal
GSW	gunshot wound
gtt	drop(s)
GTT	glucose tolerance test
GU	genitourinary
gyn	gynecology
h	hour
H&P	history and physical
HA, H/A	headache
Hb, Hgb	hemoglobin
HBV	hepatitis B virus
Hct	hematocrit
HCV	hepatitis C virus
HH	hiatal hernia
HIV	human immuno-deficiency virus
H_2O	water
HPI	history of present illness
HR	heart rate
hr	hour
HTN	hypertension
Hx	history
I&O	intake and output
ICP	intracranial pressure
ICS	incident command system, intercostal space
ICU	intensive care unit
IDDM	insulin-dependent diabetes mellitus
IM	intramuscular
IMS	incident management system
IO	intraosseous
IPPB	intermittent positive-pressure breathing
IUD	intrauterine (contraceptive) device
IV	intravenous
JVD	jugular venous distention
kg	kilogram
LE	lower extremity, left eye, lupus erythematosus
LLL	left lower lobe of the lung

Abbreviation	Meaning
LLQ	left lower quadrant of the abdomen
L/M, LPM	liters per minute
LMP	last menstrual period
LOC	level of consciousness, loss of consciousness
LUL	left upper lobe of the lung
LUQ	left upper quadrant of the abdomen
LVAD	left ventricular assist device
MAE	moves all extremities
MAEW	moves all extremities well
mg	milligram
MI	myocardial infarction
MICU	mobile intensive care unit; medical intensive care unit
min	minute
mL	milliliter
mm	millimeter
mm Hg	millimeters of mercury
MOI	mechanism of injury
MRI	magnetic resonance imaging
MRSA	methicillin-resistant *Staphylococcus aureus*
MVA	motor vehicle accident
MVC	motor vehicle crash

Abbreviation	Meaning
MVP	mitral valve prolapse
NA, N/A	not applicable
NAD	no apparent distress, no appreciable disease
NC	nasal cannula
NG	nasogastric
NICU	neonatal intensive care unit
NIDDM	non–insulin-dependent diabetes mellitus
NKA	no known allergies
NKDA	no known drug allergies
NPA	naso-pharyngeal airway
NPO	nil per os (nothing by mouth)
NRB, NRBM	nonre-breathing mask
NS	normal saline
NSR	normal sinus rhythm
NTG	nitroglycerin
N/V	nausea and vomiting
N/V/D	nausea, vomiting, and diarrhea
O_2	oxygen
OB	obstetrics
OBS	organic brain syndrome
OD	overdose, right eye, optical density, outside diameter, doctor of optometry

Abbreviation	Meaning
OP	outpatient
OPA	oropharyngeal airway
OR	operating room
OS	left eye
OU	both eyes
oz	ounce
$\bar{p}$	after
pc	after meals
Pco_2	partial pressure of carbon dioxide
PDR	*Physicians' Desk Reference*
PE	pulmonary embolism, physical examination
PEARL or PERL	pupils equal and reactive to light
PEARLA	pupils equal and reactive to light and accommodation
PEARRL	pupils equal and round, regular in size, react to light
ped or peds	pediatric
PEEP	positive end-expiratory pressure
PERRL	pupils equal, round, and reactive to light
PID	pelvic inflammatory disease
PMH	past medical history
PND	paroxysmal nocturnal dyspnea
po	per os (by mouth)

Abbreviation	Meaning
PO	postoperative, post-op
PRN	pro re nata (as needed)
psi	pounds per square inch
PSVT	paroxysmal supraventricular tachycardia
pt	patient
PT	physical therapy, prothrombin time
PTA	prior to admission, plasma thromboplastin antecedent
PTT	partial thromboplastin time
PVC	premature ventricular contraction, polyvinyl chloride
PVD	peripheral vascular disease
q	every
RA	rheumatoid arthritis, right atrium
RAD	reactive airway disease, right axis deviation
RBC	red blood cell
Rh	Rhesus blood factor, rhodium
RLL	right lower lobe of the lung
RLQ	right lower quadrant of the abdomen
RN	registered nurse
R/O	rule out
ROM	range of motion, rupture of membranes
RUL	right upper lobe of the lung
RUQ	right upper quadrant of the abdomen
Rx	prescription
$\bar{s}$	without
Sao_2	oxygen saturation
SC	subcutaneous
SICU	surgical intensive care unit
SIDS	sudden infant death syndrome
SL	sublingual
SOB	shortness of breath
Spo_2	saturation of peripheral oxygen
S/S, S&S	signs and symptoms
stat	immediately
STD	sexually transmitted disease
STEMI	ST-segment elevation myocardial infarction
subcut	subcutaneous
SVT	supraventricular tachycardia
sym or Sx	symptoms
T	temperature
tab	tablet
TB	tuberculosis
TBA	to be admitted, to be announced
tech	technician, technologist
TIA	transient ischemic attack
tid/t.i.d./TID	three times a day
Tx	treatment
UA	urinalysis
UE	upper extremity
URI	upper respiratory infection
UTI	urinary tract infection
VD	venereal disease
VF/V fib	ventricular fibrillation
VRE	vancomycin-resistant enterococcus
VS	vital signs
VT/V tach	ventricular tachycardia
W/	with
WBC	white blood cell
WMD	weapon of mass destruction
WNL	within normal limits
W/O	without
wt	weight
$\bar{x}$	except
yo; y/o	year old

*Abbreviations are sometimes written with periods (for example, abd. and a.c.), and different capitalization might be used that may convey a different meaning. This table does not include all possible meanings. If you are uncertain, always ask the person using the abbreviation.

YOU are the Provider SUMMARY

1. What can you determine about the patient's medical history based on the acronyms in the record?

You can determine that the patient has a significant past medical history. The record indicates the patient has had an abdominal aortic aneurysm, hypertension, a cerebrovascular accident (stroke), acute myocardial infarction (heart attack), gastroesophageal reflux disease, and type 1 diabetes.

2. How did the use of acronyms assist in delivering your report to the hospital?

When providing a verbal report to the hospital, it is important to be as succinct as possible. Using abbreviations will help you deliver the most information in the minimum amount of time. For this report, stating the BP is 80/50, rather than "the blood pressure is...," the pulse is 128 BPM rather than beats per minute, and using ETA rather than estimated time of arrival, all help to shorten the time for providing a verbal report. Time in an emergency can be critical, so providing a quick report of essential information is sometimes valuable.

3. What other acronyms or abbreviations could have been used in this report?

You can use acronyms when reporting most of the past medical history. Appropriate acronyms for this report include *AAA, CVA, AMI,* and *GERD*. Abbreviations are useful in written and verbal reports. Also, *LPM* could be used in place of *L/min* when documenting oxygen flow.

4. What do the abbreviations or acronyms in this portion of the report mean?

The abbreviations in this report include *EMT* for Emergency Medical Technician, *A&O* meaning "alert and oriented," and *CC* meaning chief complaint. The abbreviation yo is used for years old.

5. What other abbreviations, acronyms, or symbols could you have used in this portion of the report?

The acronym *AAA*, for abdominal aortic aneurysm, could be used. Acceptable abbreviations include *abd* for abdomen and *min* for minute. An appropriate use of a symbol in this report is ♀, meaning female.

EMS Patient Care Report (PCR)

Date: 6-10-17	**Incident No.:** 060109	**Nature of Call:** Constipation and abdominal pain		**Location:** Friends Acre Nursing Home, 322 Azalea Trail	
Dispatched: 1740	**En Route:** 1741	**At Scene:** 1747	**Transport:** 1759	**At Hospital:** 1809	**In Service:** 1817

Patient Information

Age: 79 **Sex:** F **Weight (in kg [lb]):** 84 kg (185 lb)	**Allergies:** Sulfa, Codeine, Contrast dye **Medications:** Lopressor, ASA, Coumadin, Pepcid AC, NovoLog insulin **Past Medical History:** AAA, HTN, CVA in 2009, AMI in 2010, GERD, type 1 diabetes **Chief Complaint:** Abdominal pain

Vital Signs

Time: 1749	**BP:** 80/50	**Pulse:** 128	**Respirations:** 24	**Spo_2:** 98%
Time: 1758	**BP:** 86/54	**Pulse:** 112	**Respirations:** 24	**Spo_2:** 97%
Time: 1808	**BP:** 100/60	**Pulse:** 108	**Respirations:** 20	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ 12 **L/min via (circle one):** **NC** **NRM** **BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Position of comfort

Narrative

Dispatched for a female patient c/o constipation and abdominal pain. On arrival at the scene, found the patient, a 79-year-old female, lying on her side in bed with her knees drawn up into her abdomen. She was conscious and alert; her airway was patent, and breathing adequate. Skin was pale and wet. Patient states the pain (8 on a 0-to-10 scale) began suddenly approximately 20 minutes ago. Her medical history is significant for AAA, HTN, CVA in 2009, AMI in 2010, GERD, and type 1 diabetes. Applied oxygen at 12 L/min via nonrebreathing mask and obtained vital signs. Further assessment of patient's abdomen revealed an anterior, periumbilical pulsating mass; it was point tender to palpation of the RUQ. Patient denies chest pain, shortness of breath, nausea or vomiting, and any other symptoms. She further denies radiating and referred pain. Patient was placed onto the stretcher in a position of comfort, loaded into the ambulance, and transported to the hospital. En route, continued to monitor patient's condition, which remained unchanged. Vital signs reassessed and noted above. Shortly before arrival at the hospital, reassessment of the patient revealed that her vital signs remained stable and that her pain had decreased in severity. Transferred care of patient to receiving hospital without incident and gave verbal report to charge nurse. Departed the hospital and returned to service.**End of report**

Prep Kit

Ready for Review

- Knowledge of medical terminology is essential for health care team members to effectively communicate and document calls.
- Understanding how terms are formed, and the definitions for the various parts of a medical term, will help you determine the meaning of an unknown term.
- Parts that can make up a word include the word root, prefix, suffix, and combining vowels. Not every part is included in every word. Each part can significantly change the meaning of a word.
- The word root is the stem of the word and conveys the core meaning. It frequently indicates a body part. Most terms have at least one word root.
- A prefix and/or suffix can be added to the word root to create a term. Changing the prefix or suffix will change the meaning of the term.
- A prefix is the part of a term that appears at the beginning of a word. It generally describes location and intensity.
- A suffix is placed at the end of a word to change the original meaning. In medical terminology, a suffix usually indicates a procedure, condition, disease, or part of speech.
- A combining vowel is the part of a term that connects a word root to a suffix or other word root to make it easier to pronounce.
- To make some terms plural, an s is added to the term. Other terms use other plural forms.
- Prefixes can also indicate numbers, colors, or direction.
- Directional terms indicate distance and direction from the midline. These include right, left, superior, inferior, lateral, medial, proximal, distal, superficial, deep, ventral, dorsal, palmar, plantar, and apex.
- Terms related to movement include flexion, extension, adduction, and abduction.
- Anatomic position refers to the position of the body; for example, the position the patient is in when you arrive on scene. Anatomic positions include prone, supine, and Fowler.
- Abbreviations, acronyms, and symbols are used as shorthand to communicate and document in a concise manner. To avoid potentially dangerous misinterpretation of your documentation, be sure to use only abbreviations that are commonly understood; avoid using abbreviations that are not recommended.

Vital Vocabulary

abduction Motion of a limb away from the midline.

adduction Motion of a limb toward the midline.

anterior The front surface of the body; the side facing you in the standard anatomic position.

apex (plural apices) The pointed extremity of a conical structure.

bilateral A body part or condition that appears on both sides of the midline.

combining vowel The vowel used to combine two word roots or a word root and suffix.

deep Farther inside the body and away from the skin.

distal Further from the trunk or nearer to the free end of the extremity.

dorsal The posterior surface of the body, including the back of the hand.

extension The straightening of a joint.

flexion The bending of a joint.

Fowler position An inclined position in which the head of the bed is raised.

inferior Below a body part or nearer to the feet.

lateral Parts of the body that lie farther from the midline; also called outer structures.

medial Parts of the body that lie closer to the midline; also called inner structures.

palmar The forward facing part of the hand in the anatomic position.

plantar The bottom surface of the foot.

posterior The back surface of the body; the side away from you in the standard anatomic position.

prefix Part of a term that appears before a word root, changing the meaning of the term.

prone Lying face down.

proximal Closer to the trunk.

quadrants Describes the sections of the abdominal cavity, in which two imaginary lines intersect at the umbilicus, dividing the abdomen into four equal areas.

suffix The part of a term that comes after the root word, at the end of the term.

superficial Closer to or on the skin.

superior Above a body part or nearer to the head.

supine Lying face up.

ventral The anterior surface of the body.

word root The main part of a term that contains the primary meaning.

Assessment *in Action*

You are dispatched to a motor vehicle crash involving a motorcycle. Upon your arrival, you find a 17-year-old male patient lying face down on the ground. The patient's breath smells of alcohol. He reports a headache and weakness on one side. He also reports seeing double. Upon examination, you find a 2-inch (5 cm) laceration above the left upper quadrant of his abdomen and a gunshot wound to his right leg, above the thigh. The patient is coughing up blood. His blood pressure is 100/60 mm Hg. His heart rate was 90 beats/min. His pupils are equal, round, and reactive to light and accommodation. His breath sounds are clear and equal on both sides. He has no known allergies and a history of hypertension. You treat the patient by placing him on oxygen at 12 L/min via a nonrebreathing mask. You begin transport of the patient on his left side with an estimated time of arrival of 10 minutes.

1. What is the term for the position in which you found the patient?

   A. Recumbent
   B. Fowler
   C. Prone
   D. Supine

2. As you document this call, you note the patient is in pain. What is the root word for *pain*?

   A. alges
   B. angi
   C. asthen
   D. centesis

3. You note the patient reports weakness. What is the root word for *weakness*?

   A. alges
   B. angi
   C. asthen
   D. centesis

4. The patient reports weakness on one side. What is the term for *on one side*?

   A. Bilateral
   B. Hemilateral
   C. Lateral
   D. Unilateral

5. The patient does not appear to have any allergies. What is the acronym for this?

   A. NA
   B. ANK
   C. NKA
   D. ANN

6. The patient is seeing double. What medical term means *double vision*?

   A. Bioccular
   B. Bioptic
   C. Dioccular
   D. Diplopia

7. The patient is coughing up blood. What is the medical term for *coughing up blood*?

   A. Hemogastritis
   B. Hematuria
   C. Hematemesis
   D. Hemoptysis

8. The patient has a history for hypertension. What is the abbreviation for hypertension?

   A. HPT
   B. HTN
   C. ATN
   D. AHTN

9. Rewrite the scenario above using abbreviations and symbols whereever possible.

10. What is the danger of using abbreviations?

CHAPTER
6

The Human Body

Courtesy of SynDaver Labs.

National EMS Education Standard Competencies

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal and ethical issues to the provision of emergency care.

Anatomy and Physiology

Applies fundamental knowledge of the anatomy and function of all human systems to the practice of EMS.

Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Knowledge Objectives

1. Identify the body's topographic anatomy, including the anatomic position and the planes of the body. (pp 179–180)
2. Identify the anatomy and physiology of the skeletal system. (pp 180–181)
3. Describe the anatomy and physiology of the musculoskeletal system. (pp 186–187)
4. Discuss the anatomy and physiology of the respiratory system. (pp 187–196)
5. Discuss the anatomy and physiology of the circulatory system. (pp 196–208)
6. Discuss the anatomy and physiology of the nervous system. (pp 208–212)
7. Describe the anatomy and the physiology of the integumentary system. (pp 212–214)
8. Explain the anatomy and physiology of the digestive system. (pp 214–218)
9. Describe the anatomy and physiology of the lymphatic system. (p 218)
10. Discuss the anatomy and physiology of the endocrine system. (pp 218–220)
11. Describe the anatomy and physiology of the urinary system. (pp 220–221)
12. Discuss the anatomy and physiology of the genital system. (pp 221–223)
13. Describe the life support chain, aerobic metabolism, and anaerobic metabolism. (pp 223–224)
14. Define pathophysiology. (p 224)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

A working knowledge of human anatomy is important for you as an EMT. By using the proper medical terms, you will be able to communicate correct information to other medical professionals with the least possible confusion. At the same time, you need to be able to communicate with laypeople who may not understand medical terms. Balancing these two approaches is one of the most challenging aspects of your job. A basic understanding of human anatomy, physiology, and pathophysiology is essential so that you can meet these challenges.

This chapter begins with a discussion of topographic anatomy, or the landmarks on the surface of the body. The various parts of the body, or its anatomy, are then described. This information will provide you with the correct medical terms you will use in the field. Physiology, or the functions of the body or any of its parts, is also covered. Finally, pathophysiology is discussed, which describes how normal physiologic processes are affected by disease.

Topographic Anatomy

The surface of the body has many definite visible features that serve as guides or landmarks to the structures that lie beneath them. You must be able to identify the superficial landmarks of the body—its **topographic anatomy**—to perform an accurate assessment. But how do you know that everyone is looking at the body in the same orientation?

To accomplish this, the terms that are used to describe the topographic anatomy are applied to the body when it is in the **anatomic position**. This is a position of reference in which the patient stands facing you, arms at the side, with the palms of the hands forward. The anatomic position is used as a common starting point so that health care providers refer to the body in the same way. Directional terms are always from the patient's perspective. For example, you are looking at a person who reports pain in the left arm. Which left do you use—your left or the patient's left? To be consistent, use the patient's left as the reference point.

The Planes of the Body

The anatomic planes are imaginary straight lines that divide the body **Figure 6-1**. There are three main axes of the body depending on how it is divided. The frontal or **coronal plane** divides the body into a front and back portion. The **transverse (axial) plane** divides the body into a top and bottom portion. The **sagittal (lateral) plane** divides the body into left and right (but not necessarily equal) portions.

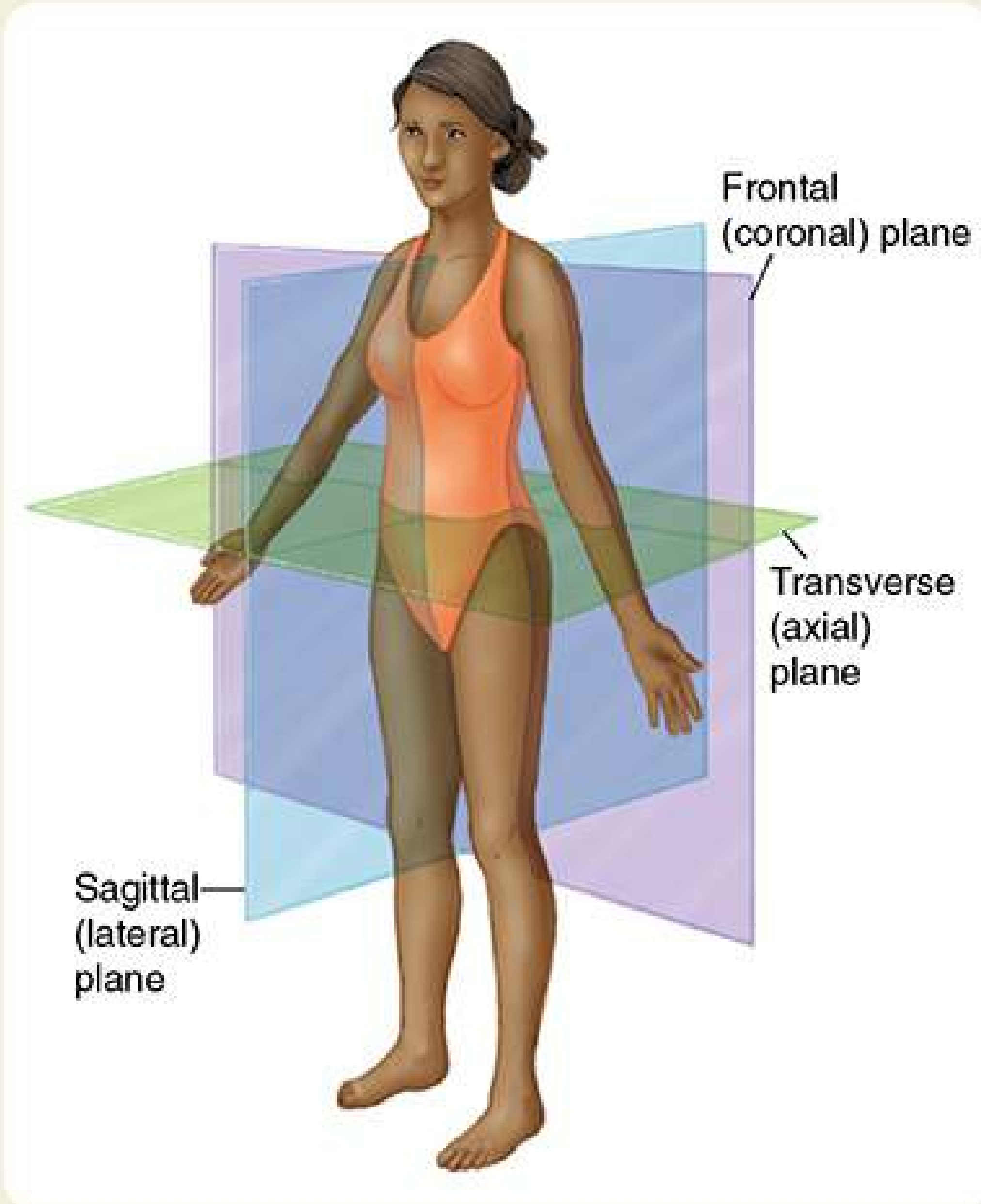


Figure 6-1 Planes of the body.

YOU are the Provider — PART 1

At 1740 hours, you are dispatched to 322 Azalea Trail for a 60-year-old man with severe abdominal pain. The weather is overcast, the traffic is heavy, and your response time to the scene is approximately 6 minutes.

1. How will knowledge of anatomy and physiology help you provide appropriate patient care?

Table 6-1 Planes of the Body	
Plane of the Body	**Description**
Coronal (frontal)	Front and back
Transverse (axial)	Top and bottom
Sagittal (lateral)	Left and right
Midsagittal (midline)	Left and right (equal halves)

The **midsagittal plane (midline)** is a type of sagittal plane where the body is divided into equal left and right halves. Your nose and navel are found along this imaginary line. These planes help you to identify the location of internal structures and understand the relationships between and among the organs Table 6-1.

The Skeletal System: Anatomy

The **skeleton** gives the body its recognizable human form and protects the vital internal organs. The 206 bones of the skeleton constitute the major structure of the skeletal system and provide a framework for the attachment of muscles. The skeleton is designed to allow motion of the body. Bones come into contact with one another at joints where, with the help of muscles, the body is able to bend and move. **Ligaments** are fibrous tissues that connect bones to each other. **Tendons** are ropelike structures that connect muscles to bones. Finally, **cartilage** is the smooth connective tissue that covers the ends of bones at mobile joints Table 6-2.

The skeletal system is divided into two main portions: the axial skeleton and the appendicular skeleton. The **axial skeleton** forms the foundation to which the arms and legs are attached. The axial skeleton is composed of the skull, facial bones, **thoracic cage**, and vertebral column. The arms and legs, their connection points, and the pelvis make up the **appendicular skeleton** Figure 6-2. The brain lies within the skull. The heart, lungs, and great vessels are enclosed in the **thorax**, which is part of the torso. Much of the liver and spleen are protected by the lower ribs. The spinal cord is contained within and protected by a bony spinal canal formed by the vertebrae.

Table 6-2 Support Structures Within the Skeletal System

Name	Function
Ligament	Connects bone to bone
Tendon	Connects muscle to bone
Cartilage	Cushion between bones

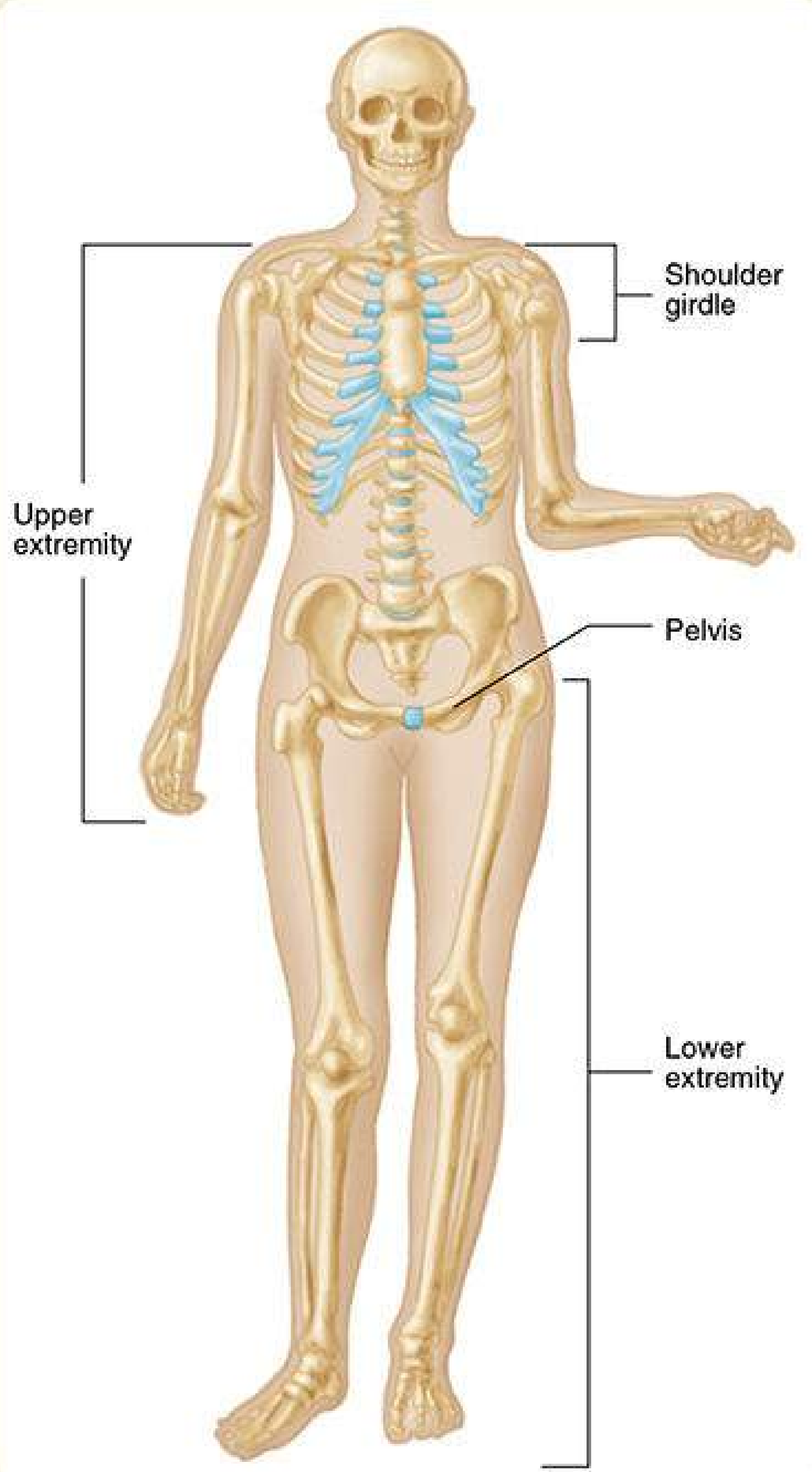


Figure 6-2 The 206 bones of the skeleton give the body its form, protect the vital organs, and allow the body to move. The axial skeleton runs in a straight line from the head to the pelvis. The appendicular skeleton is made up of the arms and legs and the pelvis.

The Axial Skeleton

The Skull

The head is a great place to start this discussion since it is at the top of the body. The skull is composed of two groups of bones: the cranium and the facial bones. The **cranium** is composed of a number of thick bones that fuse together to form a shell above the eyes and ears that holds and protects the brain **Figure 6-3**. The brain connects to the spinal cord through a large opening at the base of the skull called the **foramen magnum** (Latin for "great opening").

Four major bones make up the cranium. The most posterior portion of the cranium is the **occiput**. On each side of the cranium, the lateral portions are the temples or **temporal bones**. Between the temporal regions and the occiput lie the **parietal bones**. The forehead is the **frontal bone**. If you have ever felt an infant's head, you may have noticed the soft spots on top of the head. These gaps are where the separate bones have yet to fuse together. This allows the infant's head to be molded without breaking during the birthing process.

The face is composed of 14 bones. The upper, non-moveable jawbones are the **maxillae**, the cheek bones are the **zygomas**, and the **mandible** is the lower, moveable portion of the jaw. The **orbit** (eye socket) is made up of two facial bones: the maxilla and the zygoma. The orbit also includes the frontal bone of the cranium. Together, these bones form a solid, bony rim that protrudes around the eye to protect it. If you look at the face from the side, you can see that the eyeball sits back in the orbit. Finally, one-third of the nose is made up of very short bones that form the bridge of the nose; the rest of the nose is made of flexible cartilage.

The Spinal Column

The spinal column is the central supporting structure of the body and is composed of 33 bones, each called a vertebra (plural: vertebrae). The **vertebrae** are named according to the section of the spine in which they are located and are numbered from top to bottom **Figure 6-4**. From the top down, the spine is divided into five sections:

- **Cervical spine**. The first seven vertebrae (C1 through C7) in the neck form the cervical spine. The skull rests on and attaches to both the first cervical vertebra (the atlas) and the second cervical vertebra (the axis). The vertebrae fit together but move separately, allowing the head to turn in multiple directions.
- **Thoracic spine**. The next 12 vertebrae make up the thoracic spine. One pair of ribs is attached to each of the thoracic vertebrae.
- **Lumbar spine**. The next five vertebrae form the lumbar spine.

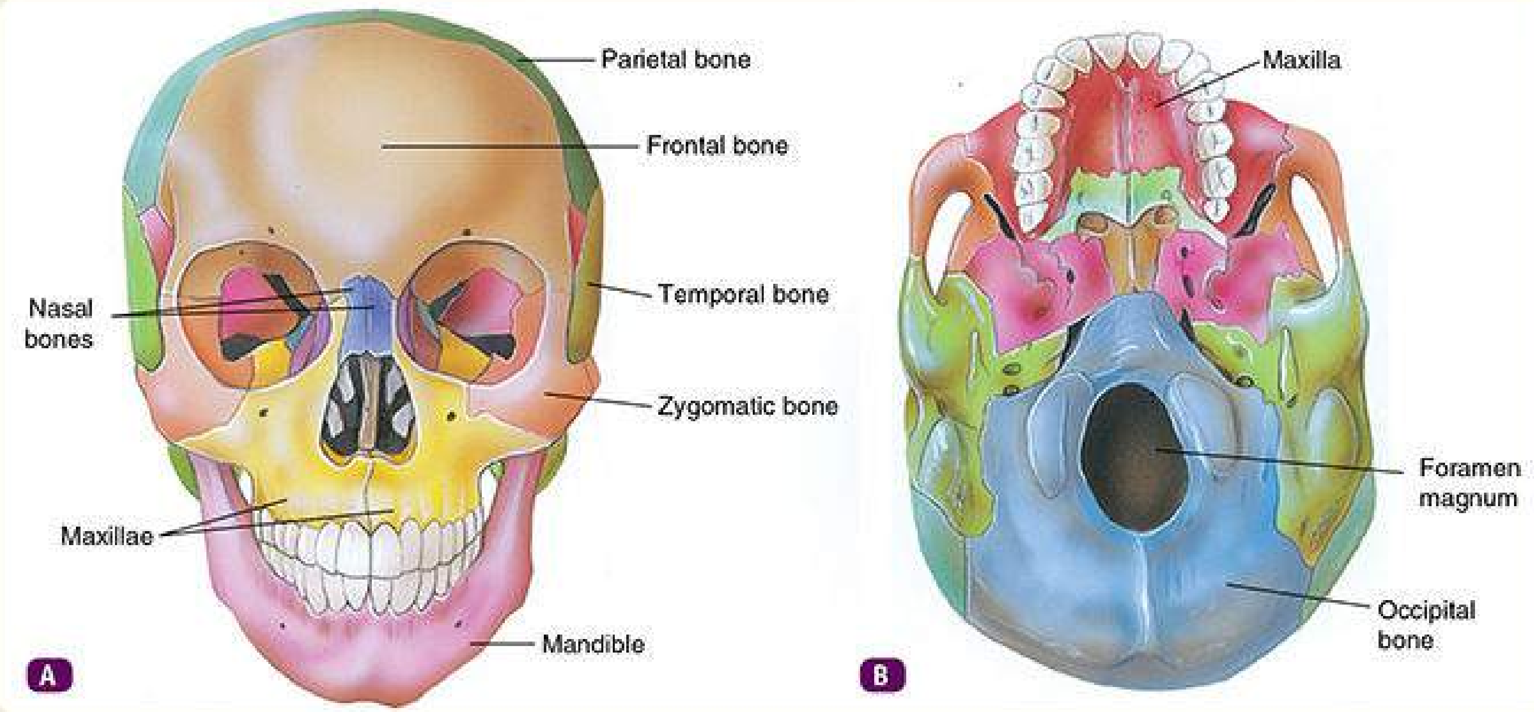


Figure 6-3 The skull. **A.** Anterior view. **B.** Inferior view.

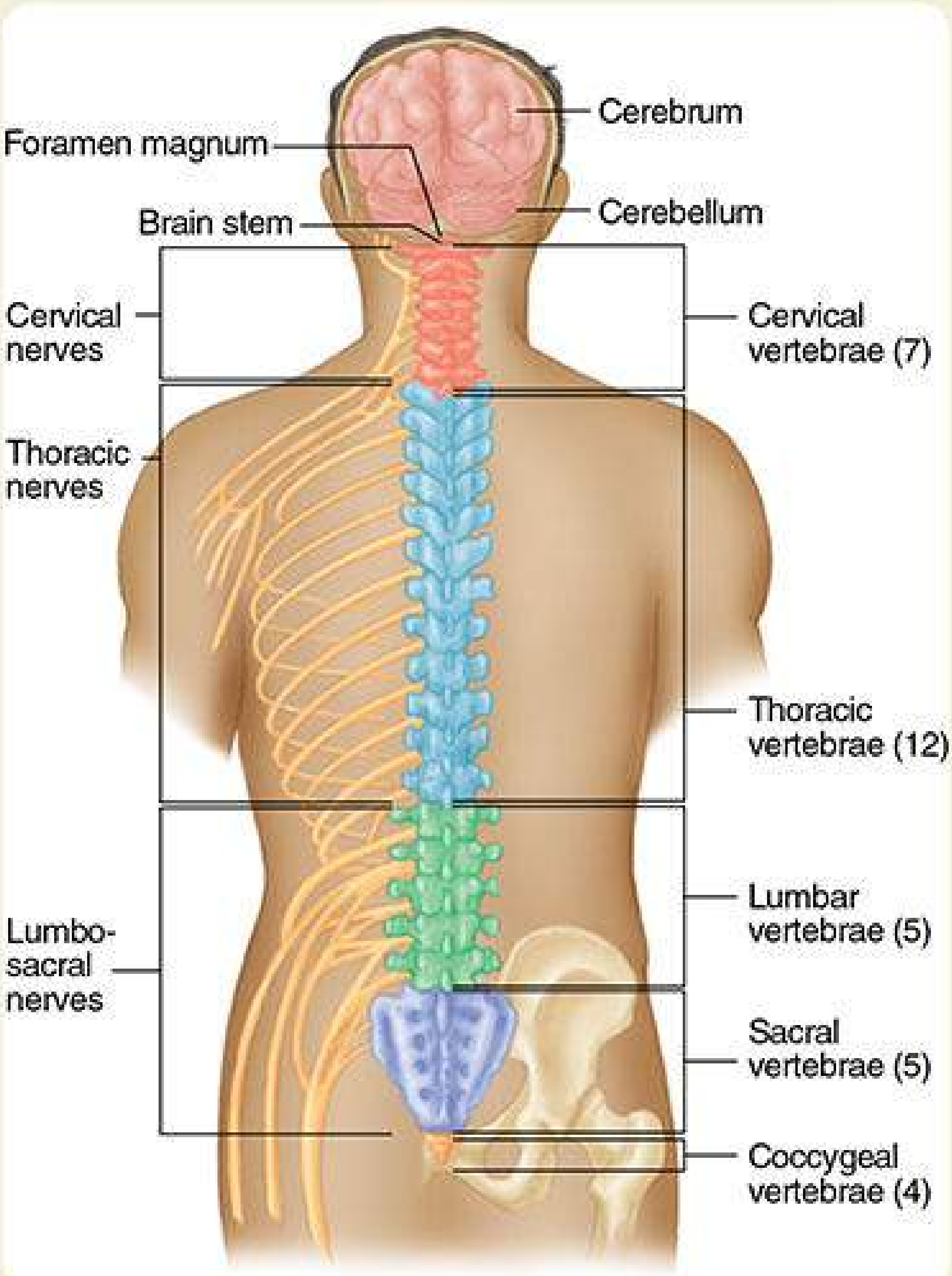


Figure 6-4 The spinal column is composed of 33 bones divided into five sections.

- **Sacrum**. The five sacral vertebrae are fused together to form one bone called the sacrum. The sacrum is joined to the iliac bones of the pelvis with strong ligaments at the sacroiliac joints to form the pelvis.
- **Coccyx**. The last four vertebrae, also fused together, form the coccyx, or tail bone.

The vertebrae are connected by ligaments, and between each vertebra is a cushion called the intervertebral disk. These ligaments and disks allow some motion so the trunk can bend forward (flex) and back (extend), and they allow for rotation and lateral movement. However, they also limit motion of the vertebrae to protect the spinal cord against injury. An injury to the spine may damage part of the spinal cord and its nerves. Therefore, you must use extreme caution in caring for patients with any spinal injury to prevent further injury to the spinal cord.

The Thorax

The thorax (chest) contains the heart, lungs, esophagus, and great vessels (the aorta and two venae cavae). It is formed by the 12 thoracic vertebrae (T1 through T12) and their 12 pairs of ribs.

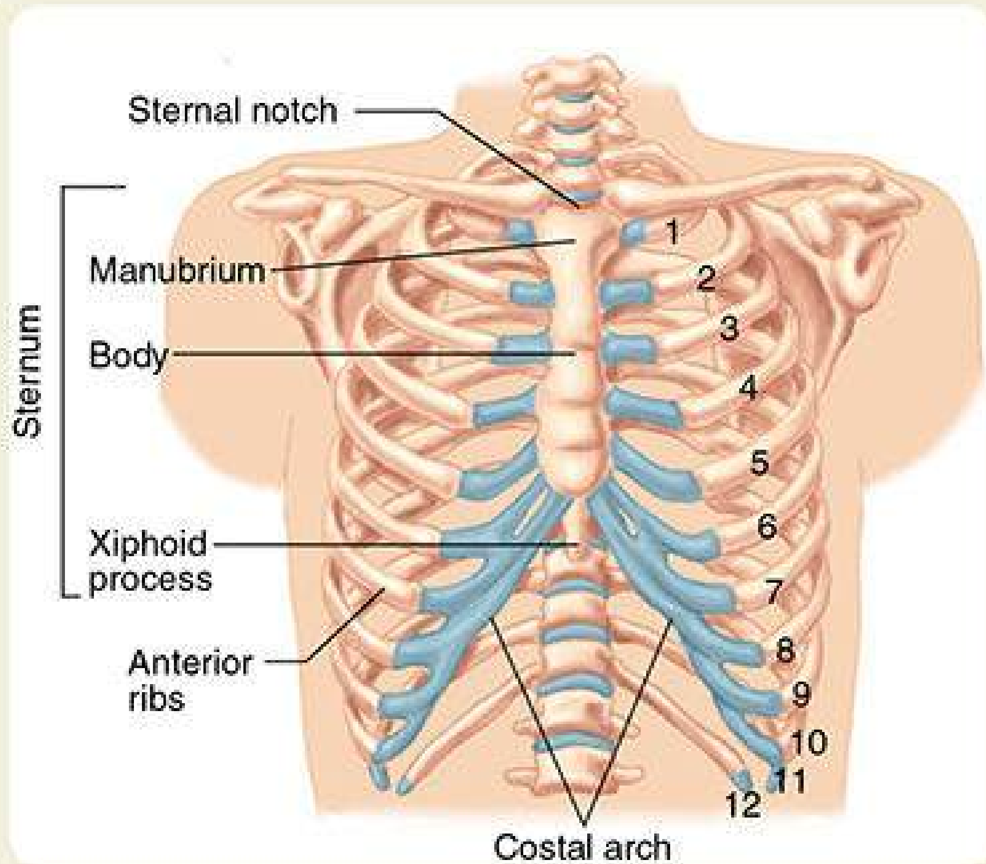


Figure 6-5 The thorax.

Anteriorly, in the midline of the chest is the **sternum**. The superior border of the sternum forms the easily palpable sternal notch. This is the location where the trachea enters the chest. The sternum has three components: the manubrium, the body, and the xiphoid process. The upper section of the sternum is called the **manubrium**. The body comprises the rest of the sternum except for a narrow, cartilaginous tip inferiorly, which is called the **xiphoid process** Figure 6-5.

The Appendicular Skeleton

Joints

Wherever bones come in contact, a **joint (articulation)** is formed. A joint consists of the ends of the bones that make up the joint and the surrounding connecting and supporting tissue Figure 6-6. Most joints in the body are named by combining the names of the bones that form that joint. For example, the sternoclavicular joint is the articulation between the sternum and the clavicle. Most joints allow motion—for example, the knee, hip, and elbow—whereas some bones fuse with one another at joints to form a solid, immobile, bony structure, such as the skull. Some joints have slight, limited motion in which the bone ends are held together by fibrous tissue. Such a joint is called a **symphysis**.

The bone ends of a joint are held together by a fibrous sac called the **joint capsule**. This sac is composed of connective tissue (connecting bone to bone). At certain points around the circumference of the joint, the capsule is lax and thin so motion can occur. In other areas, it is thick and resists stretching or bending. A joint such as the **sacroiliac joint** that is virtually surrounded by tough, thick ligaments will have little motion, whereas a joint such as the shoulder, with few ligaments, will be free to move in almost any direction (and will, as a result, be more prone to dislocation). In moving joints, the ends of the bones are covered with a thin layer of cartilage known as **articular cartilage**. This cartilage is a pearly white substance that allows the ends of the bones to glide easily. On the inner lining of the joint capsule is the **synovial membrane**. This special tissue is responsible for making a thick lubricant called **synovial fluid**. This oil-like substance allows the ends of the bones to glide over each other as opposed to rubbing and grating over each other.

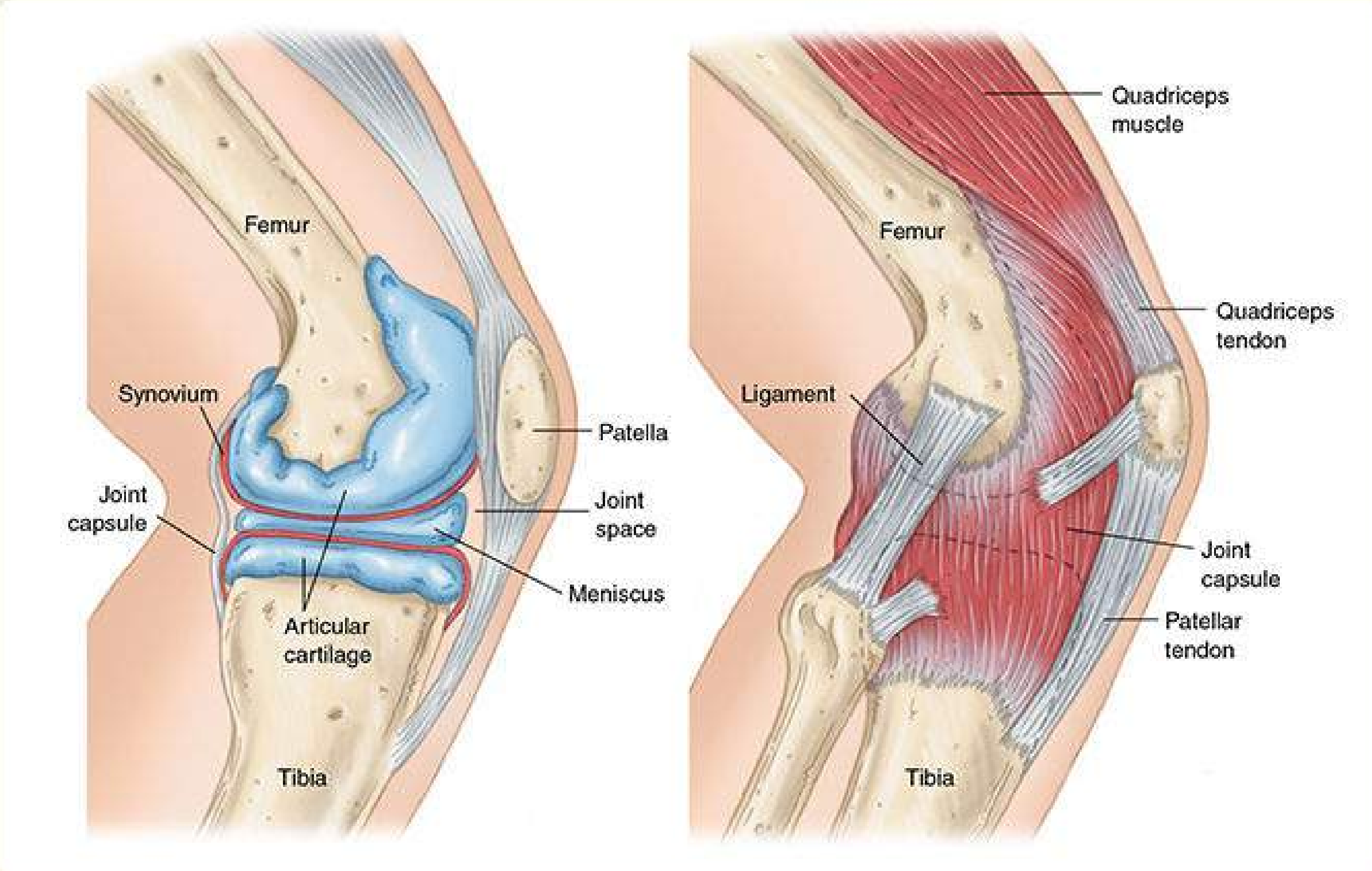


Figure 6-6 A joint consists of bone ends, the fibrous joint capsule, the synovial membrane, and ligaments. The degree to which a joint can move is determined by how the ligaments hold the bone ends and by the configuration of the bones themselves.

The degree to which a joint can move is determined by the extent to which the ligaments hold the bone ends together and also by the configuration of the bone ends themselves. The shoulder joint is a **ball-and-socket joint**, which allows rotation and bending **Figure 6-7**. The finger joints, elbow, and knee are **hinge joints**, with motion restricted to **flexion** (bending) and **extension** (straightening) **Figure 6-8**. Rotation is not possible because of the shape of the joint surfaces and the strong restraining ligaments on both sides of the joint. Although the amount of motion varies from joint to joint, all joints have a definite limit beyond which motion cannot occur. When a joint is forced beyond this limit, damage to some structure must occur. Either the bones that form the joint will break, or the supporting capsule and ligaments will be disrupted.

The Upper Extremities

The upper extremities extend from the shoulder girdle to the fingertips and are composed of the arm, forearm, hand, and fingers. The joints are the shoulder, elbow, wrist, and finger joints. The arm extends from the shoulder to the elbow, the forearm from the elbow to the wrist, and the hand from the wrist to the fingertips.

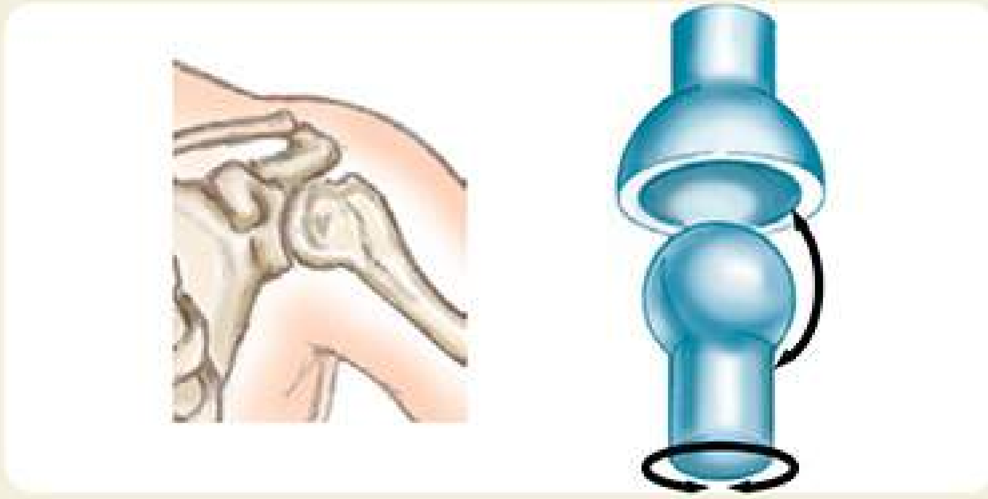


Figure 6-7 The shoulder is an example of a ball-and-socket joint.

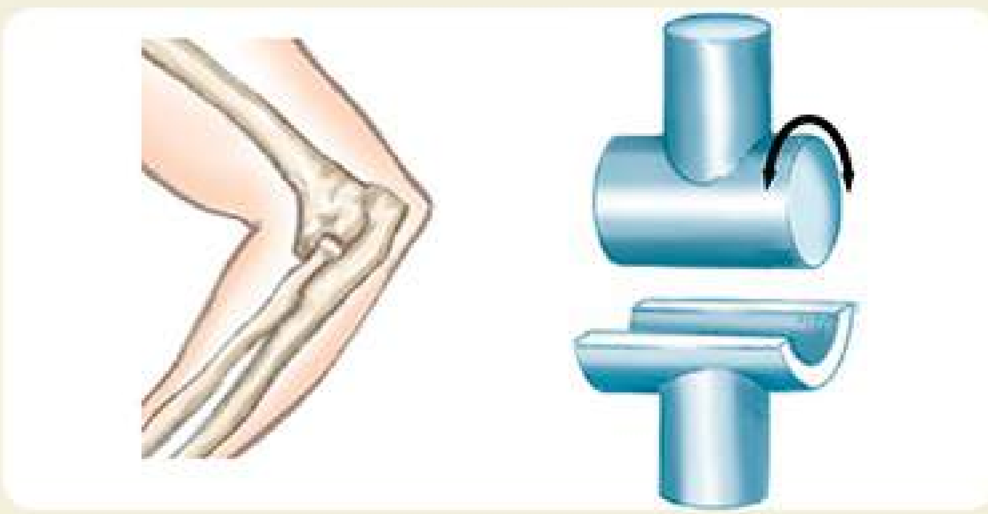


Figure 6-8 The elbow joints are hinge joints, which allow motion in only one plane (flexion and extension).

Shoulder Girdle

The **shoulder girdle** is where three bones come together, allowing the arm to move. These three bones are the **clavicle**, the scapula, and the humerus **Figure 6-9**. The clavicle (collar bone) overlies the superior boundaries of the thorax in front and articulates (joins) posteriorly with the **scapula** (shoulder blade), which lies in the muscular tissue of the posterior thoracic wall.

Arm

The supporting bone of the arm is the **humerus**. Its long, straight shaft serves as an effective lever for heavy lifting. The forearm is composed of the radius and the ulna. The **ulna** is larger in the proximal forearm, and helps to form the elbow joint. The **radius** is larger in the distal forearm. The radius lies on the lateral, or thumb, side of the forearm, and the ulna is on the medial, or little finger, side.

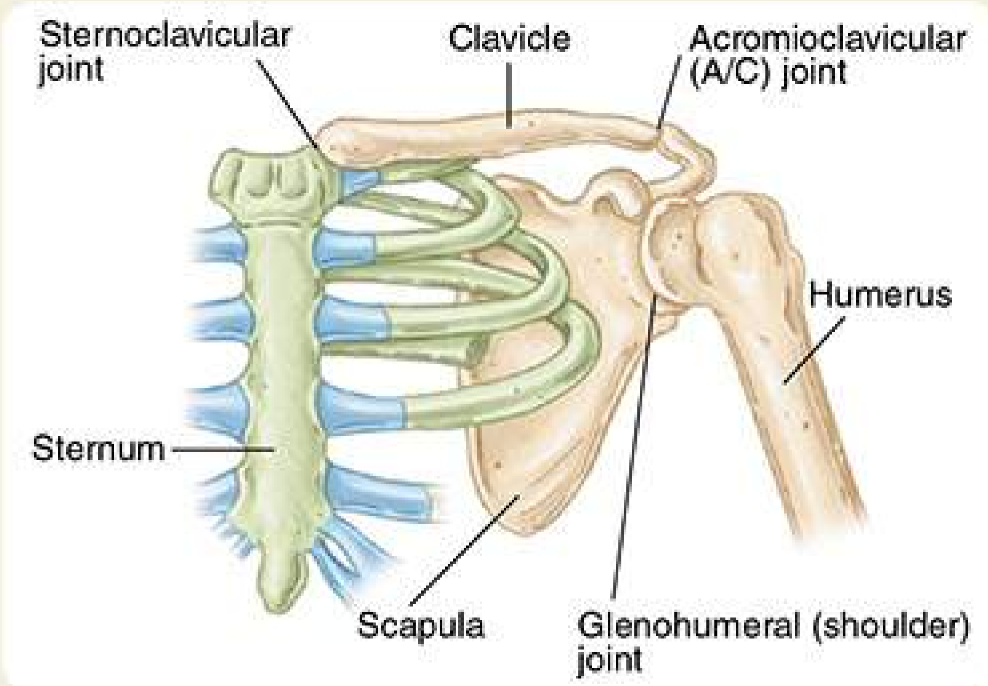


Figure 6-9 The bones of the shoulder girdle include the clavicle, the scapula, and the humerus.

Wrist and Hand

The wrist is a modified ball-and-socket joint formed by the ends of the radius and ulna and several small wrist bones **Figure 6-10**. There are eight bones in the wrist, called carpal bones. Extending from the carpal bones are five metacarpals which make up the hand. The anterior surface of the hand is referred to as the palm, while the back is referred to as the dorsal surface of the hand. The five fingers or digits are composed of bones called the phalanges. The thumb is composed of two phalanges; the other four digits each contain three phalanges.

The Pelvis

The pelvis is a closed, bony ring that consists of three bones: the sacrum and the two pelvic bones **Figure 6-11**. Each pelvic bone is formed by the fusion of three separate bones: the **ilium**, the **ischium**, and the **pubis**. These bones are joined together posteriorly by the sacrum. On the anterior side of this ring, the left pubis and the right pubis are joined. This area, the **pubic symphysis**, has cartilage within it that allows for slight motion of one side of the pelvis over the other. Pressure on the symphysis pubis during the physical examination can reveal fractures in the pelvis. These fractures can lead to life-threatening bleeding. The part of the pelvis where the leg connects to the hip joint is the **acetabulum** and is formed where the ilium, ischium, and pubic bones meet.

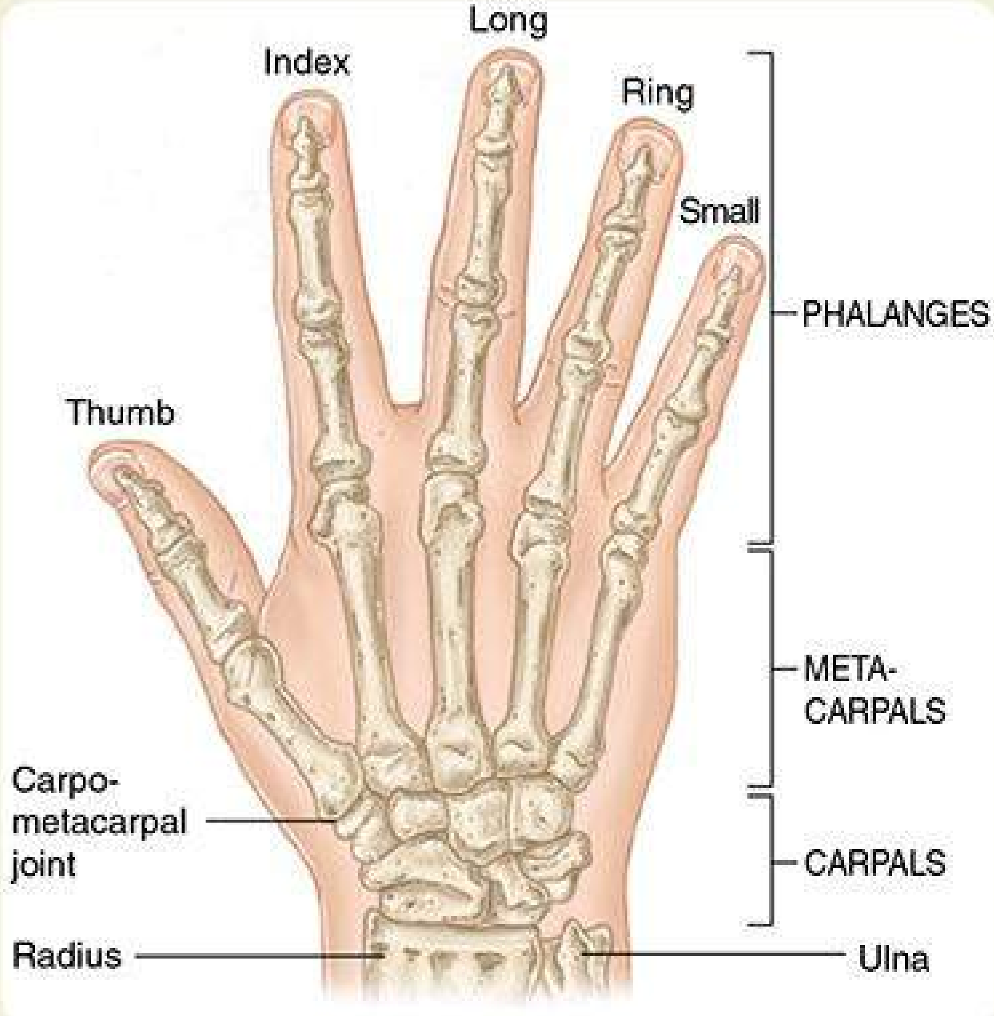


Figure 6-10 The major bones in the wrist and hand include the carpals, the metacarpals, and the phalanges.

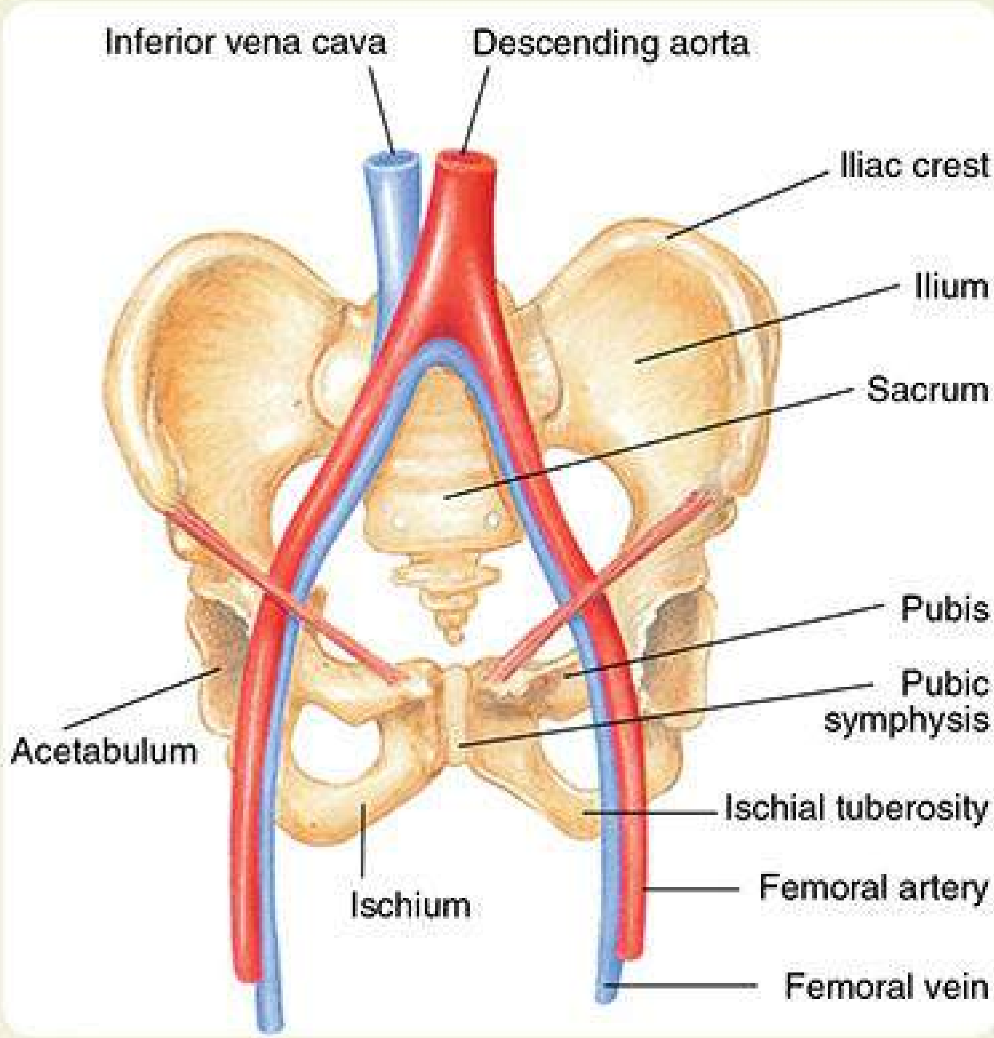


Figure 6-11 The pelvis is a closed, bony ring that consists of the sacrum, ilium, ischium, pubis, acetabulum, and pubic symphysis.

The Lower Extremities

The **femur** (*thighbone*) is the longest and one of the strongest bones in the body. At the superior end of the bone is a round structure called the **femoral head**. This is where the femur connects into the acetabulum (pelvic girdle) by a ball-and-socket joint. The femoral head attaches to the shaft of the femur through the femoral neck. The femur has two projections **Figure 6-12**. The projection on the lateral/superior portion of the junction between the femoral neck and shaft is the **greater trochanter**. The projection on the medial/inferior portion of the junction between the femoral neck and shaft is the **lesser trochanter**. Both projections are anchor points where the major muscles of the thigh connect to the femur.

The joint that connects the upper leg to the lower leg is the knee. The knee is a hinge joint, allowing only flexion and extension between the distal femur and the proximal tibia. Anterior to the knee is a specialized bone called the **patella** (knee cap). The lower leg lies between the knee and the ankle joint and is composed of the tibia and the fibula. The **tibia** (shinbone) is the larger bone and lies in the anterior of the leg. You can palpate the entire length of the tibia on the anterior surface of the leg just under the skin. The fibula lies on the lateral side of the leg. You can palpate the head of the fibula on the lateral aspect of the knee joint.

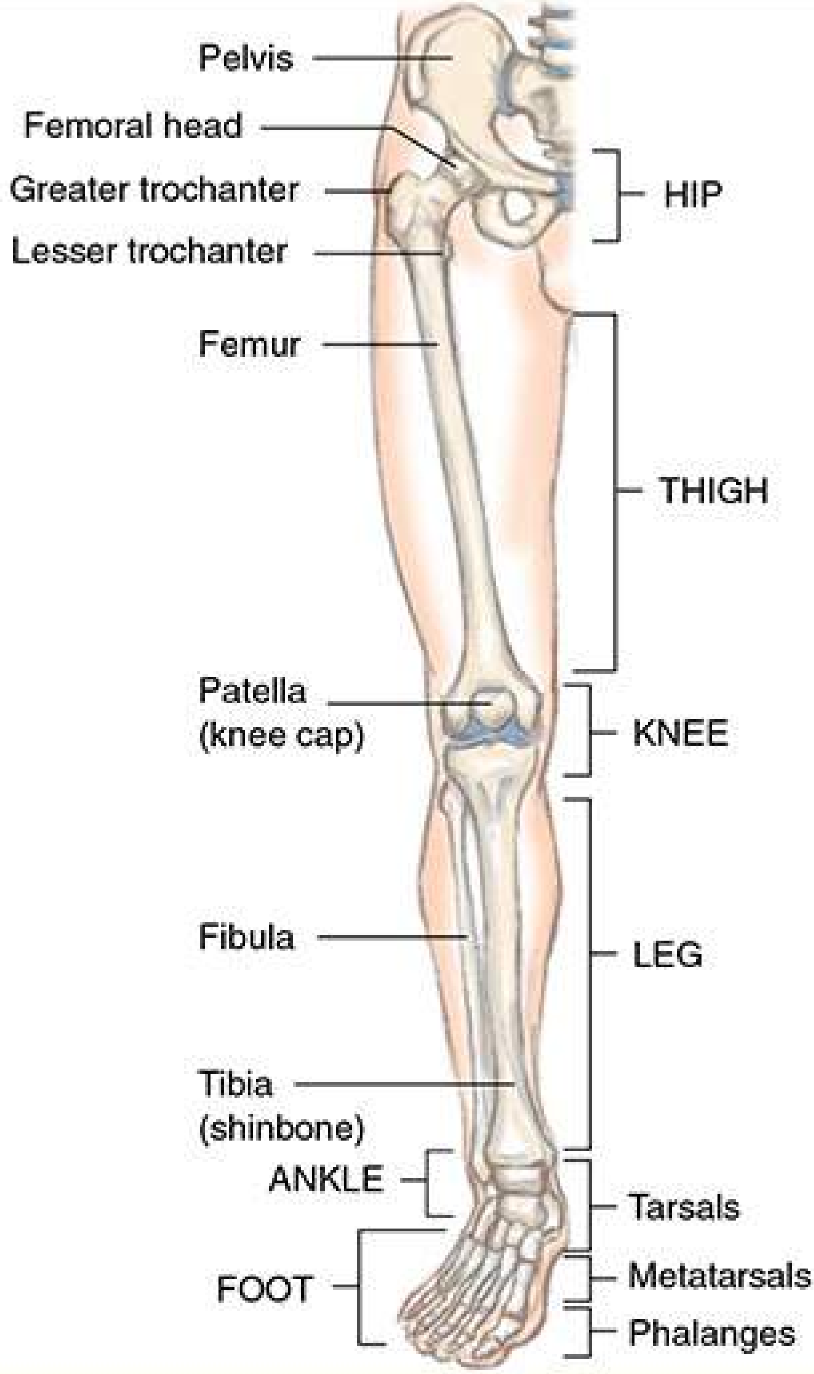


Figure 6-12 The major parts of the lower extremities include the femur, femoral head, greater and lesser trochanters, patella, tibia, and fibula.

Ankle and Foot

The ankle is a hinge joint that allows flexion and extension of the foot on the leg **Figure 6-13**. The foot contains seven tarsal bones. The talus is the second largest tarsal bone and joins with the distal tibia and fibula to form the ankle joint. The calcaneus, which forms the prominence of the heel, is the largest tarsal bone. Five metatarsal bones form the middle of the foot. The bottom surface of the foot is referred to as the plantar surface, while the top of the foot is described as the dorsum. The five toes are formed by 14 phalanges—two in the great toe and three in each of the smaller toes.

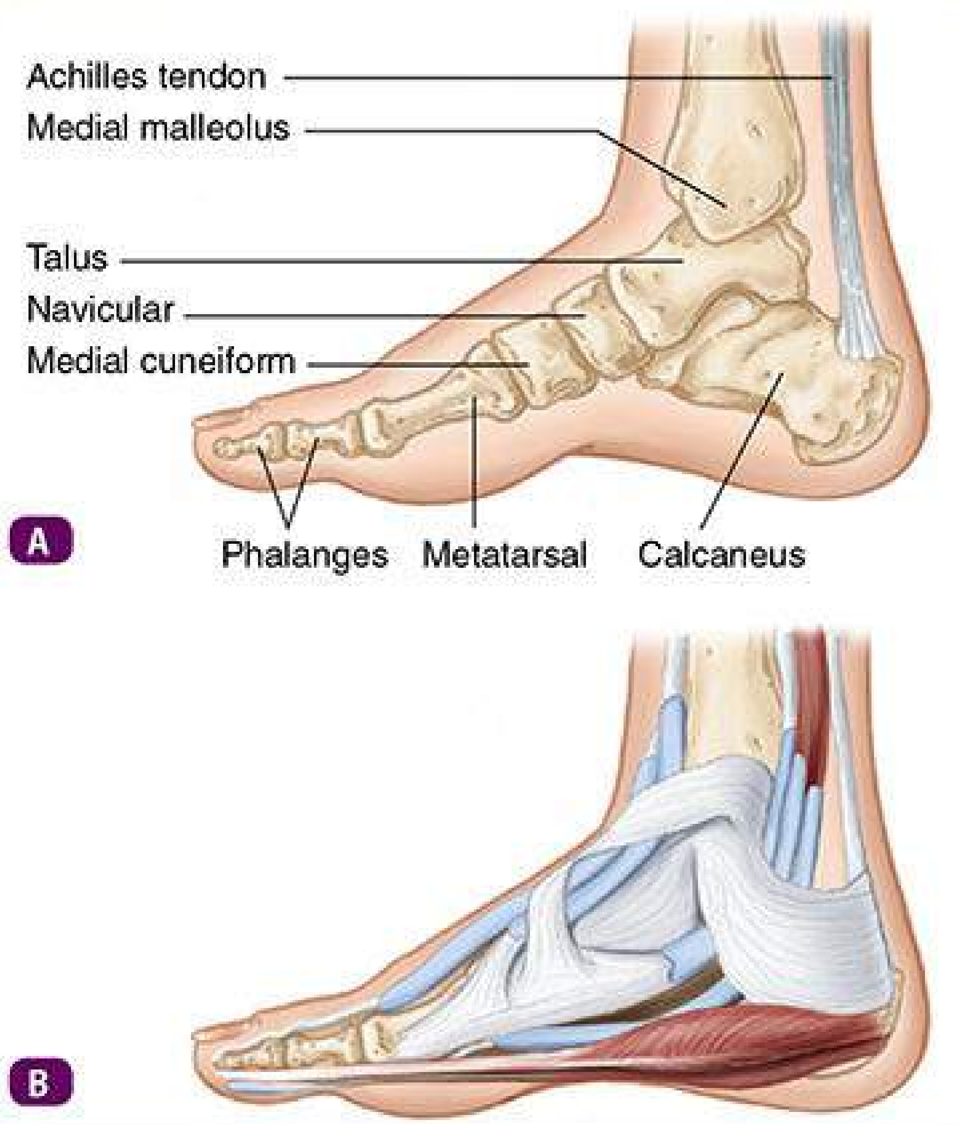


Figure 6-13 **A.** The surface landmarks of the foot, including the talus, the calcaneus, and the phalanges. **B.** Soft tissue of the ankle.

Safety Tips

As you gain a better understanding of the anatomy and physiology of the body, remember that these systems work together and not in isolation. A person who falls and breaks a leg may appear to have an isolated injury of the skeletal system. But then ask yourself the following questions: Is there bleeding inside the leg? Is there damage to the nerves, tendons, or ligaments? Has the injury disrupted the skin and is there now a risk of infection? A seemingly simple illness or injury can involve several body systems. Always perform a thorough patient assessment.

The Skeletal System: Physiology

The skeletal system is responsible for several functions: it gives the body shape, provides protection of fragile organs, and allows for movement. Another function of the skeletal system is the storage of calcium. Calcium is a mineral that helps to build hard and resilient bones. The bones are constantly being made and destroyed as stress is applied to them. Calcium is also important for other body systems and helps the heart, muscles, and nerves work properly.

The skeletal system also helps with the creation of various types of blood cells. Special cells are present in the marrow of certain types of bones that can transform themselves into red blood cells, white blood cells, and platelets. The cells, when stimulated, help to replace worn out cells in the blood.

The Musculoskeletal System: Anatomy

The human body is a well-designed system whose form, upright posture, and movement are provided by the **musculoskeletal system**. The term musculoskeletal refers to the bones and voluntary muscles of the body. The musculoskeletal system also protects the vital internal organs of the body. Muscles are a form of tissue that allow body movement. The three types of muscles are skeletal, smooth, and cardiac. **Skeletal muscle**, so named because it attaches to the bones of the skeleton, forms the major muscle mass of the body. **Smooth muscle** is found within blood vessels and intestines. For example, when you hear your stomach growling, you are hearing the rhythmic contractions of the smooth muscles of your intestines. **Cardiac muscle** is found only within the heart **Figure 6-14** and is able to create and conduct its own electrical impulses.

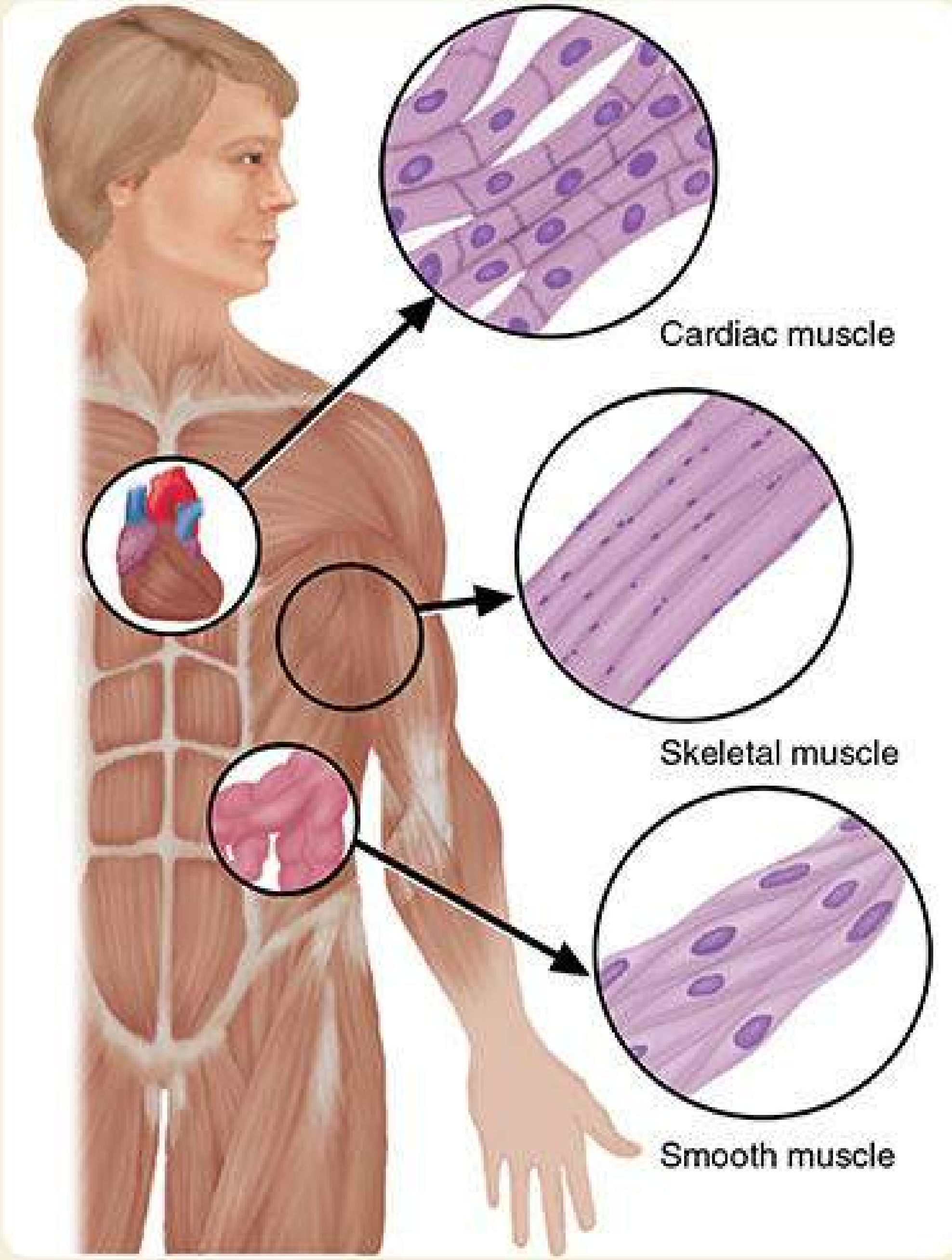


Figure 6-14 The three types of muscle are skeletal, smooth, and cardiac.

▶ Skeletal Muscle

Skeletal muscle is also called **voluntary muscle**, because all skeletal muscle is under direct voluntary control of the brain and can be stimulated to contract or relax at will. (By contrast, **involuntary muscle** is a muscle over which you have no conscious control, such as the heart.) Skeletal muscle is also called striated muscle because of its characteristic stripes. Movement of the body, like waving or walking, results from skeletal muscle contraction or relaxation. Usually, a specific motion is the result of several muscles contracting and relaxing simultaneously.

Most muscles within the body operate on the principle of antagonistic pairs. The muscles of the upper arm include the **biceps** muscle, which is located on the anterior aspect of the humerus. This muscle moves the lower part of the arm toward the head. If the muscle was working alone, you would have little control over the speed of that movement. The way the body achieves control and fine movement is to have the biceps compete against another muscle group. The biceps competes with the **triceps** muscle, which is called the three-headed muscle of the arm because there are three bundles of muscle that join together at the elbow. Without the triceps, you would slap yourself in the face every time you bend your arm. The biceps works to slow the movement of the triceps as the arm is extended.

There are more than 600 muscles in the musculoskeletal system. **Figure 6-15** and **Table 6-3** show the major muscles, their locations, and their functions.

The Musculoskeletal System: Physiology

The muscluloskeletal system has several functions. Your ability to move and be able to manipulate your environment is made possible by the contraction and relaxation of this system. A by-product of this movement is heat. When you get cold, your muscles involuntarily shake, or shiver, to produce heat and maintain homeostasis (a balance of all systems in the body). Shivering is an essential function. Muscles also protect the structures under them. For example, the intestines are protected by the rectus abdominus muscles.

The Respiratory System: Anatomy

The **respiratory system** consists of all the structures of the body that contribute to respiration, or the process of breathing **Figure 6-16**. It includes the nose, mouth, throat, larynx, trachea, bronchi, and bronchioles, which are all air passages or airways. The system also includes the lungs, where oxygen is passed into the blood and carbon dioxide removed. Finally, the respiratory system includes the diaphragm, the muscles of the chest wall, and accessory muscles of breathing, which permit normal respiratory movement. In this text, “airway” usually refers to the upper airway or the passage above the larynx (voice box).

The Upper Airway

The structures of the upper airway are located anteriorly and at the midline. The upper airway includes the nose, mouth (oral cavity), tongue, jaw (mandible), pharynx, and larynx. The larynx is typically considered the dividing line between the upper and lower airway. The larynx is a complex arrangement of tiny bones, cartilage, muscles, and two vocal cords. The larynx does not tolerate any foreign solid or liquid material, and any contact will result in a violent episode of coughing and spasm of the vocal cords. The nose and mouth lead to the oropharynx (throat). The pharynx is composed of the nasopharynx, oropharynx, and the laryngopharynx. The nostrils lead to the **nasopharynx** (above the roof of the mouth and soft palate), and the mouth leads to the oropharynx. The nasal passages and nasopharynx warm, filter, and humidify air as you breathe. Air enters through the mouth more rapidly and directly. As a result, it is less moist than air that enters through the nose.

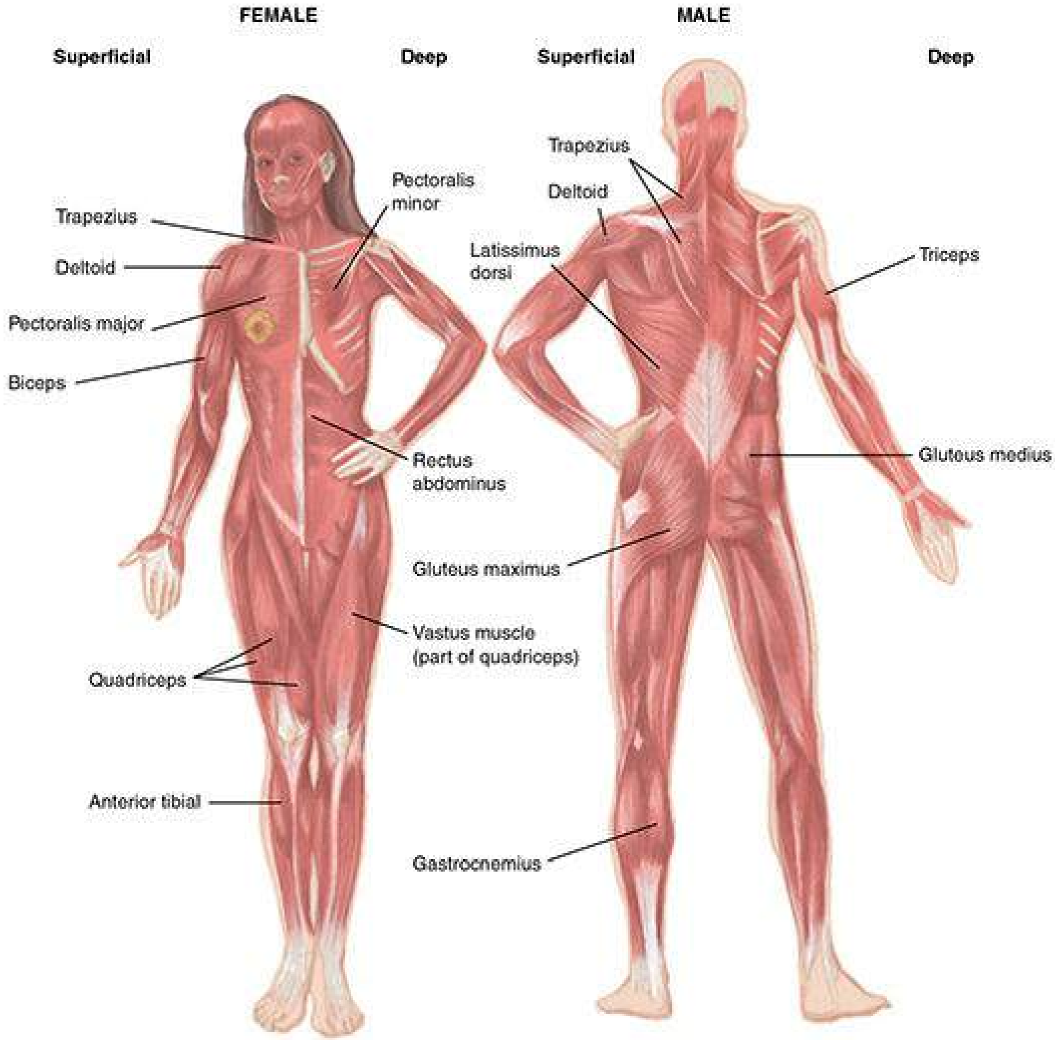


Figure 6-15 The major muscle groups.

Table 6-3 Muscles: Locations and Functions

Muscle Name	Location	Function
Biceps	Anterior, humerus	Flexes lower arm
Triceps	Posterior, humerus	Extends lower arm
Pectoralis	Anterior, thorax	Flexes and rotates arm
Latissimus dorsi	Posterior, thorax	Extends and rotates arm
Rectus abdominis	Anterior, abdomen	Flexes and rotates spine
Tibialis anterior	Anterior, tibia	Points foot toward head
Gastrocnemius	Posterior, tibia	Points foot away from head
Quadriceps (four separate muscles)	Anterior, femur	Extends lower leg
Biceps femoris	Posterior, femur	Flexes lower leg
Gluteus (three separate muscles)	Posterior, pelvis/buttocks	Extends and rotates thigh

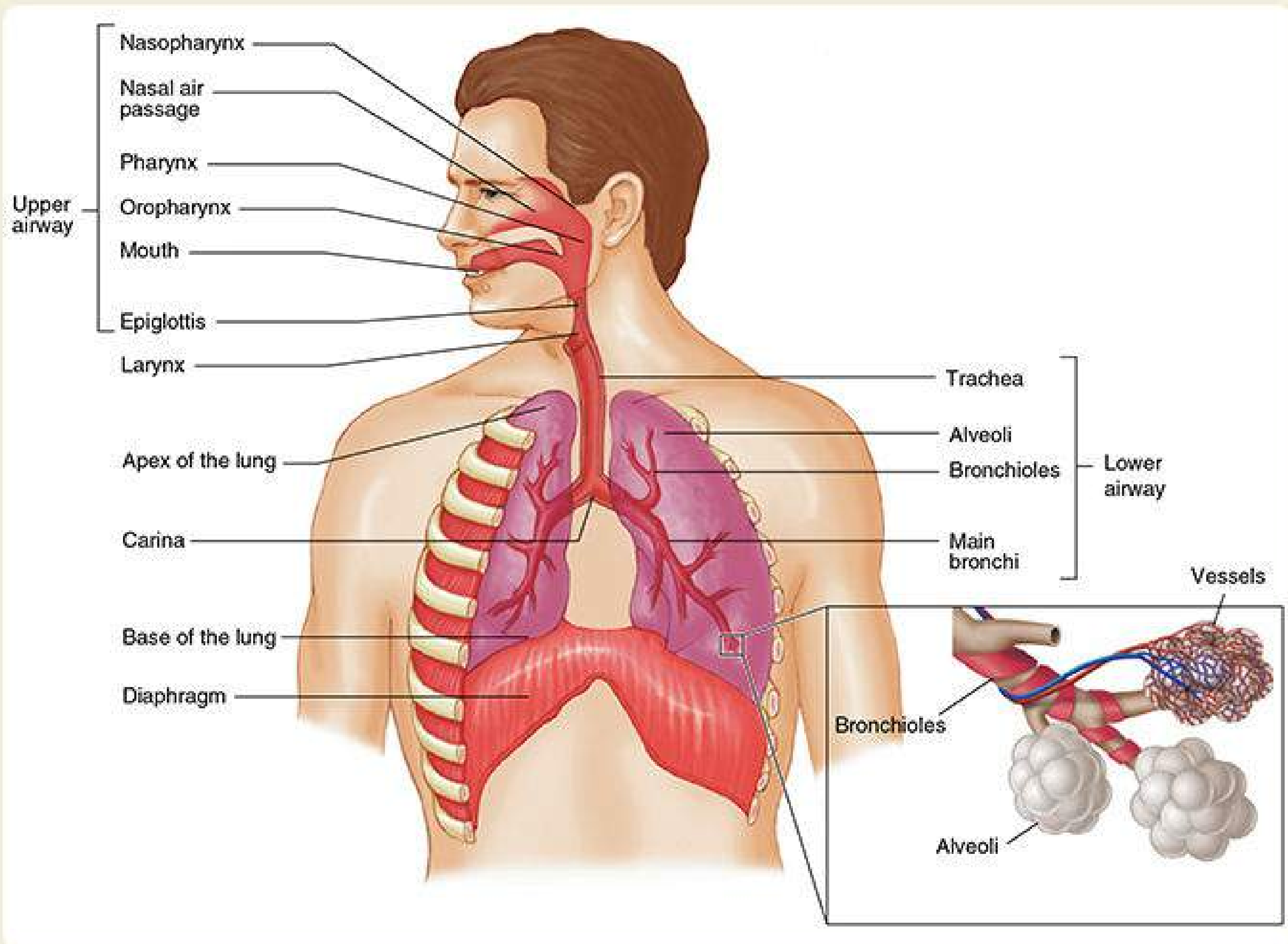


Figure 6-16 The respiratory system consists of all structures of the body that contribute to the process of breathing.

Two passageways are located at the bottom of the pharynx: the **trachea** (windpipe) and the esophagus, which is located immediately posterior to the trachea. The trachea is approximately 5 inches (13 cm) long and is a semirigid, enclosed air tube made up of rings of cartilage that are open in the back. The rings of cartilage keep the trachea from collapsing when air moves into and out of the lungs. Food and liquids enter the pharynx and pass into the esophagus, which carries them to the stomach (the digestive system is discussed later in the chapter). Air and other gases enter the trachea and go to the lungs.

Protecting the opening of the trachea is a thin, leaf-shaped flap called the **epiglottis**. This flap allows air to pass into the trachea but prevents food and liquid from entering the airway under normal circumstances. Air moves past the epiglottis into the larynx and the trachea.

The Lower Airway

The **Adam's apple**, or **thyroid cartilage**, which tends to be more visible in men, is in the anterior midline portion of the neck. The thyroid cartilage is actually the anterior part of the larynx. Tiny muscles open and close the vocal cords and control tension on them. Sounds are created as air is forced past the vocal cords, making them vibrate. The pitch of the sound changes as the cords open and close. You can feel the vibrations if you place your fingers lightly on the larynx as you speak or sing. The vibrations of air are shaped by the tongue and muscles of the mouth to form understandable sounds. Immediately below the thyroid cartilage is the palpable **cricoid cartilage**.

Between the thyroid and cricoid cartilage lies the **cricothyroid membrane**, which can be felt as a depression in the midline of the neck just inferior to the thyroid cartilage. Below the cricoid cartilage is the trachea. The trachea ends at the carina and divides into two smaller tubes. These tubes are the right and left mainstem bronchi, which enter the lungs. Each mainstem bronchus immediately branches within the lung into smaller and smaller airways.

Lungs

The two lungs are held in place by the trachea, the arteries and veins, and the pulmonary ligaments. Each lung is divided into lobes. The right lung has three lobes: the upper, middle, and lower lobes. The left lung has an upper lobe and a lower lobe. Each lobe is divided further into segments. The bronchioles end in about 700 million tiny, grapelike air sacs called **alveoli** Figure 6-17.

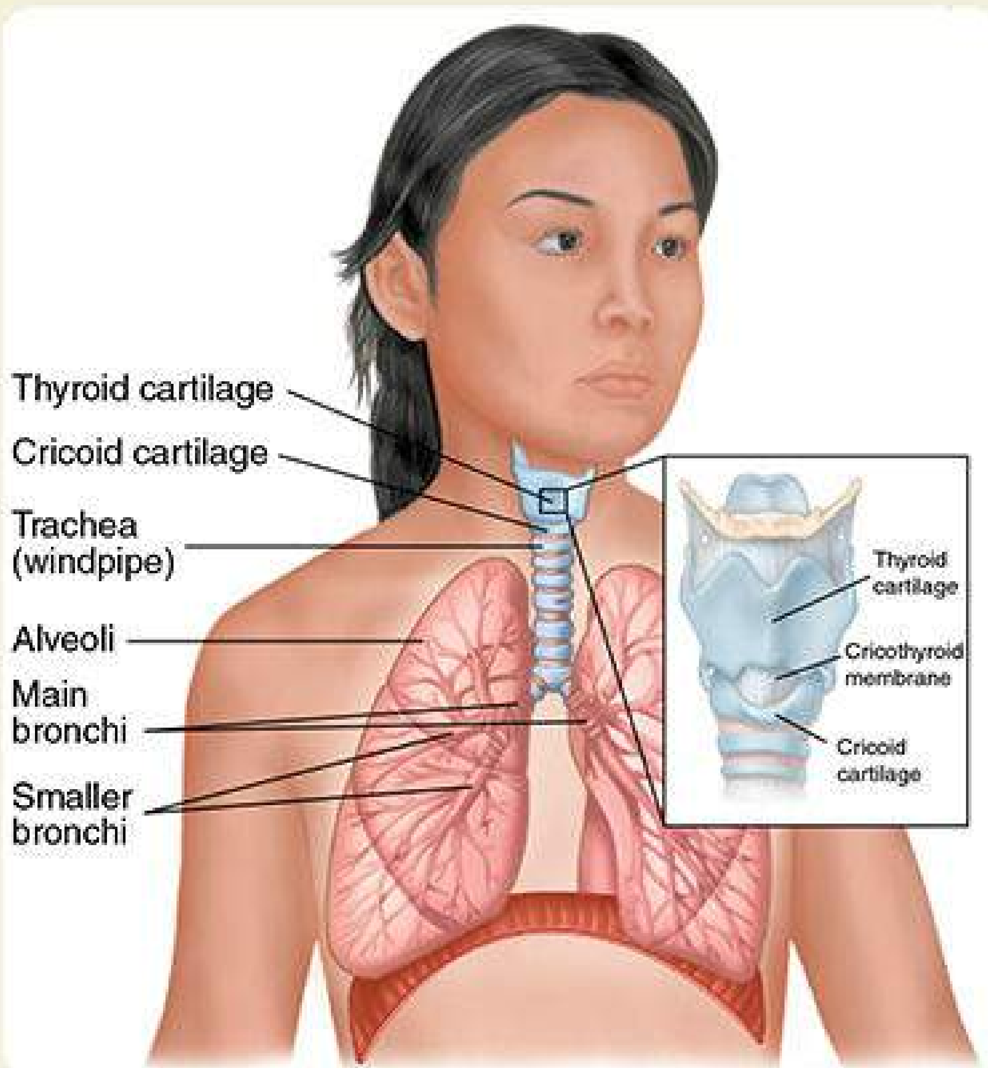


Figure 6-17 The lungs contain millions of air sacs (alveoli), which lie at the ends of air passages. Small blood vessels surround the alveoli, allowing for gas exchange.

YOU are the Provider PART 2

When you arrive at the scene, you find the patient lying on his side on the floor of his bedroom. His knees are drawn up to his abdomen, and he is in severe pain. As you assess the patient, your partner opens the jump kit and prepares to begin treatment.

Recording Time: 0 Minutes	
Appearance	Restless; diaphoretic; in severe pain
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, present and strong; skin, cool and clammy

The patient tells you that the pain is in the right upper side of his abdomen and that it began suddenly about 20 minutes ago.

2. On the sole basis of the patient's chief complaint, which organ or organs should you suspect is/are the cause of his condition?
3. What additional questions should you ask to gather more information about his chief complaint?

The primary purpose of all of the respiratory structures that have been discussed so far is to provide a pathway for air to reach the alveoli. The exchange of oxygen and carbon dioxide occurs within these alveoli. They do all the work and are referred to as the functional units of the respiratory system. The walls of the alveoli contain a network of tiny blood vessels (pulmonary capillaries) that carry the carbon dioxide from the body to the lungs and the oxygen from the lungs to the body.

The lungs cannot expand and contract themselves because they have no muscle. There is, however, a very definite mechanism in place to ensure that the lungs follow the motion of the chest wall and expand or contract with it. Covering each lung is a layer of smooth, glistening tissue called **pleura** Figure 6-18. Another layer of pleura lines the inside of the chest cavity. The two layers are called visceral pleura (covering the lungs) and parietal pleura (lining the chest wall). Between these two layers is a small amount of fluid that permits smooth gliding of the tissues. This is very similar in concept to how joints work.

Between the parietal pleura and the visceral pleura is the **pleural space**, called a *potential* space because under normal conditions, the space does not exist. These two layers are usually sealed tightly to one another by a thin film of fluid. When the chest wall expands, the lung is pulled with it and made to expand by the force exerted through these closely applied pleural surfaces. When blood or air leaks into the pleural space, however, the surfaces separate.

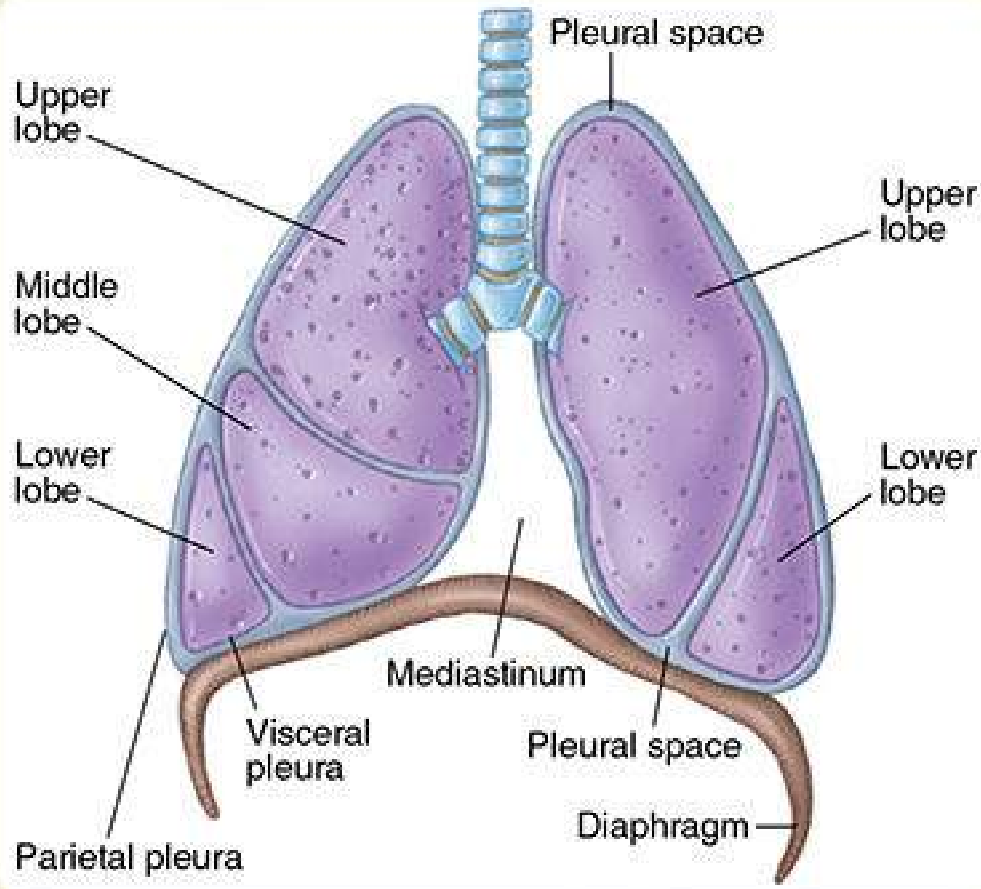


Figure 6-18 The pleura lining the chest wall and covering the lungs is an essential part of the breathing mechanism. The pleural space is not an actual space until blood or air leaks into it, causing the pleural surfaces to separate.

Muscles of Breathing

There are several muscles involved in making the lungs expand and contract. The primary muscle is the **diaphragm**. The diaphragm is unique because it has characteristics of voluntary (skeletal) and involuntary (smooth) muscles. It is a dome-shaped muscle that divides the thorax from the abdomen and is pierced by the great vessels and the esophagus **Figure 6-19**. It acts like a voluntary muscle when you take a deep breath, cough, or hold your breath. You control these variations in the way you breathe.

However, unlike other skeletal or voluntary muscles, the diaphragm performs an automatic function. Breathing continues during sleep and at all other times. Even though you can hold your breath or temporarily breathe faster or slower, you cannot continue these variations in breathing pattern indefinitely. When the concentration of carbon dioxide becomes too high, automatic regulation of breathing resumes. Therefore, although the diaphragm looks like voluntary skeletal muscle and is attached to the skeleton, it behaves, for the most part, like an involuntary muscle.

The other muscles involved in breathing are the neck (cervical) muscles, the intercostal muscles, the abdominal muscles, and the pectoral muscles. During inhalation, the diaphragm and intercostal muscles contract. When the diaphragm contracts, it moves down slightly, enlarging the thoracic cage from top to bottom. When the intercostal muscles contract, they move the ribs up and out. These actions combine to enlarge the chest cavity in all dimensions. As the chest cavity enlarges, pressure in the pleural space falls and air rushes into the lungs. This is referred to as negative pressure breathing because air is essentially sucked into the lungs. This part of the cycle is active, requiring the muscles to contract.

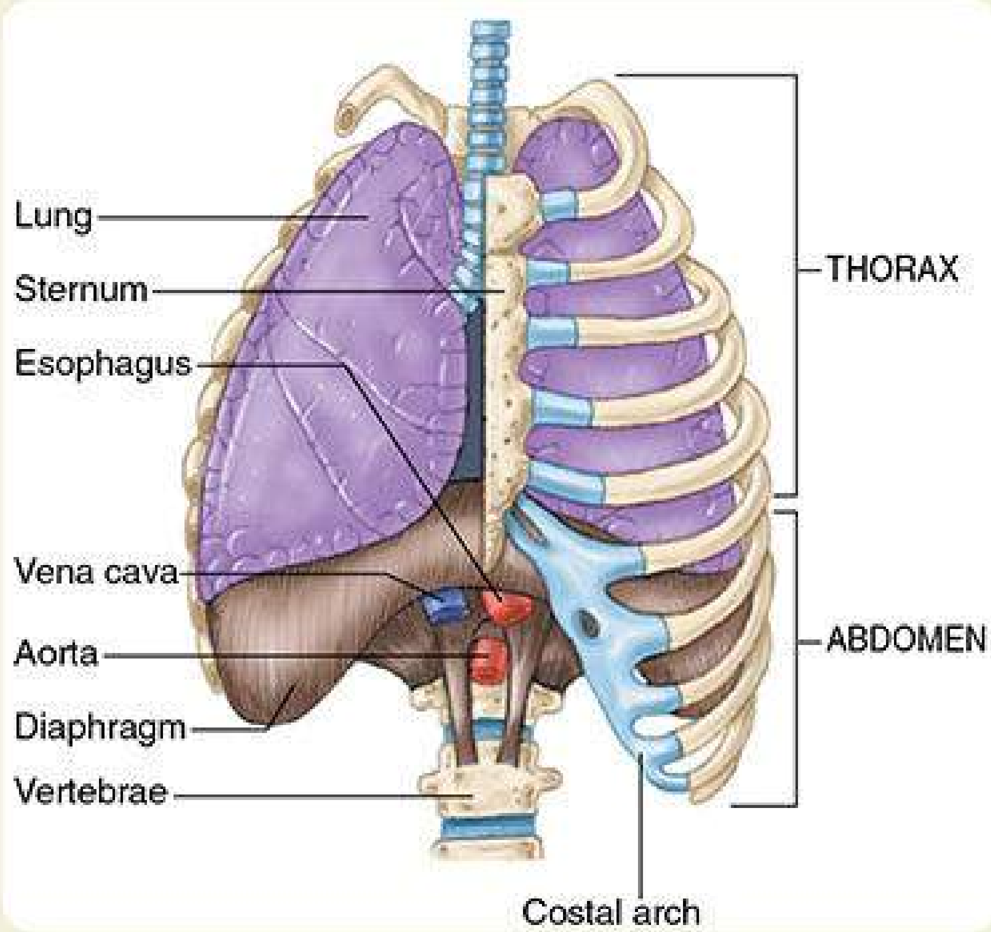


Figure 6-19 The dome-shaped diaphragm divides the thorax from the abdomen. It is pierced by the great vessels and the esophagus.

During exhalation, the diaphragm and the intercostal muscles relax. Unlike inhalation, exhalation does not normally require muscular effort. As these muscles relax, all dimensions of the thorax decrease, and the ribs and muscles assume a normal resting position. When the volume of the chest cavity decreases, air in the lungs is compressed into a smaller space. Pressure is increased, and air is pushed out through the trachea. This phase of the cycle is passive.

The process of breathing is typically easy and requires little muscular effort. But, now imagine breathing through a straw and suddenly the diameter of the straw decreases. The smaller the diameter of the straw, the more effort you will now have to exert to move air. As the resistance in the airway increases, you will begin to use accessory muscle groups, namely your abdominal and pectoral muscles, to assist the diaphragm in moving that air.

Words of Wisdom

When you assess a patient, make sure you assess both sides of the patient. It may seem like a waste of time to assess the left arm when the right arm is the one that is injured. However, you need to compare the sides to see whether there are differences. An abnormality on one arm may be "normal" if the same abnormality is found on the other arm. This idea of comparing sides applies to the respiratory system as well. You need to listen to both sides of the chest to evaluate the patient's lung sounds. Lung sounds can change on only one side of the chest, or they can change on both sides of the chest. Use all of the information you obtain from both sides of the body to help you make your patient care decisions.

The Respiratory System: Physiology

The function of the respiratory system is to provide the body with oxygen and eliminate carbon dioxide. The exchange of oxygen and carbon dioxide takes place in the lungs and in the tissues. It is a complicated process that occurs automatically unless the airways or the lungs become diseased or damaged. There are two separate, yet interdependent, overall functions of the respiratory system: ventilation and respiration.

Ventilation is the simple movement of air between the lungs and the environment. It requires chest rise and fall. You are providing artificial ventilation when you assist a patient who is not breathing with a bag-valve mask (BVM)—a large bag filled with air that, when squeezed, pushes air out one end. The typical device holds approximately 1,000 to 1,200 mL of air. BVMs are designed to rapidly reinflate and allow you to control the amount of air that is moved to achieve chest rise and fall in any given patient. Artificial ventilation is provided in the hope that your patient will resume respiration. **Respiration** is the process of gas exchange. Respiration provides the much-needed oxygen to cells and removes the waste product carbon dioxide. This exchange of gases also helps to control the pH of the blood.

Respiration

As blood travels through the body, it gives its oxygen and nutrients to various tissues and cells. Oxygen passes from the blood through the capillaries to tissue cells. In the reverse process, carbon dioxide and cell waste pass from tissue cells through capillaries to the blood **Figure 6-20**.

Each time you take a breath, the alveoli receive a supply of oxygen-rich air. Recall that the oxygen then passes into a network of pulmonary capillaries, which are located in the walls of the alveoli. The walls of the capillaries and the alveoli are extremely thin. Thus, air in the alveoli and blood in the capillaries are separated by two very thin layers of tissue.

Oxygen and carbon dioxide pass rapidly across these thin tissue layers by diffusion. **Diffusion** is a passive process in which molecules move from an area with a higher concentration of molecules (the air) to an area of lower concentration (the bloodstream). There are more oxygen molecules in the alveoli than in the blood. Therefore, the oxygen molecules move from the alveoli into the blood. Because there are more carbon dioxide molecules in the blood than in the inhaled air, carbon dioxide moves from the blood into the alveoli. This process is completely passive—nature does all the work.

The blood does not use all the inhaled oxygen as it passes through the body. Exhaled air contains 16% oxygen and 3% to 5% carbon dioxide; the rest is nitrogen **Figure 6-21**.

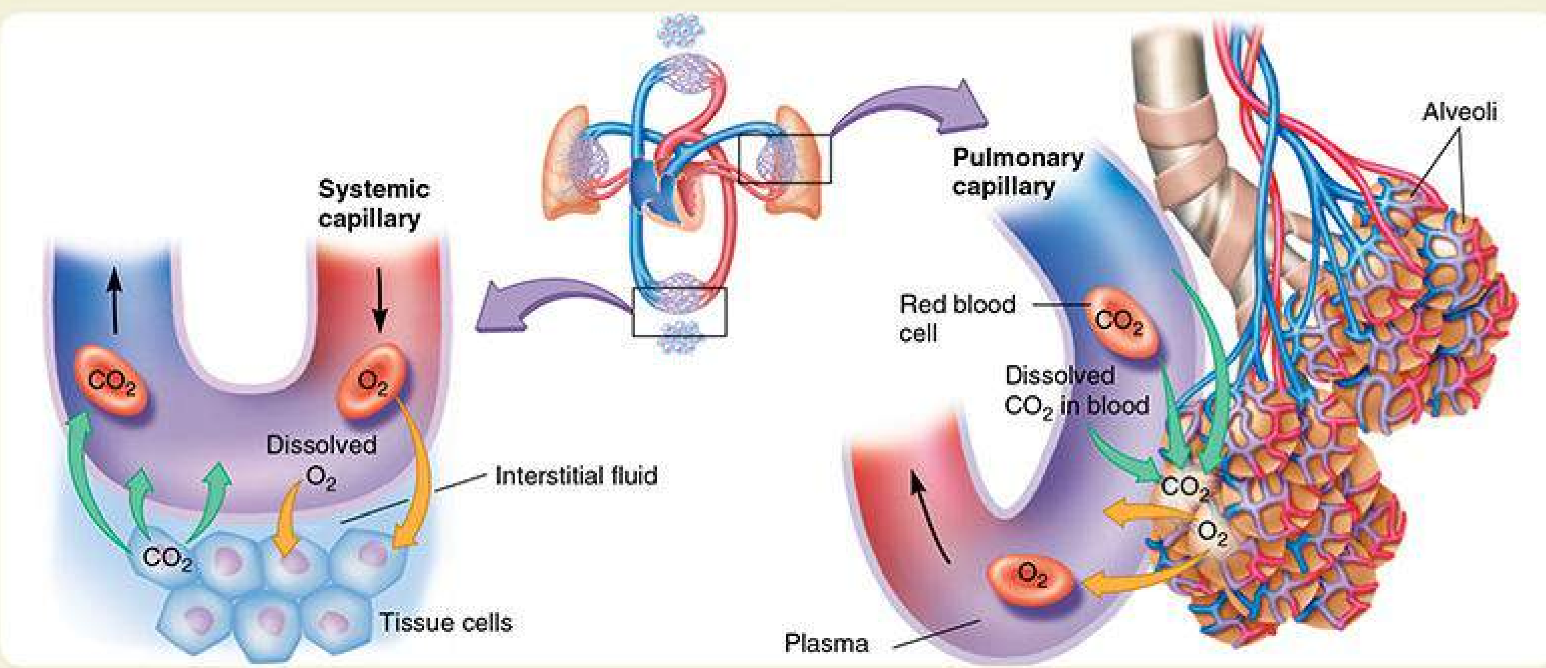


Figure 6-20 In the capillaries, oxygen (O_2) passes from the blood to the tissue cells, and carbon dioxide (CO_2) and waste pass from the tissue cells to the blood.

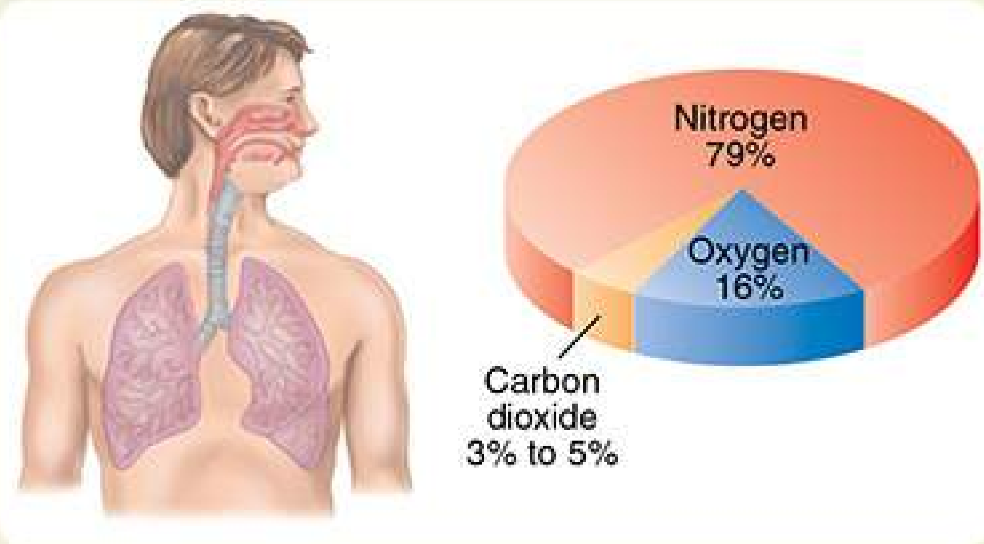


Figure 6-21 The components of exhaled air include oxygen, carbon dioxide, and nitrogen.

The Chemical Control of Breathing

The brain—or more specifically, the brain stem—controls breathing. The nerves in this area act as sensors for the level of carbon dioxide in the blood and subsequently the spinal fluid. The brain automatically controls breathing if the level of carbon dioxide or oxygen in the arterial blood is too high or too low. In fact, adjustments can be made in just one breath. For these reasons, you cannot hold your breath indefinitely or breathe rapidly and deeply indefinitely.

Breathing occurs as the result of a buildup of carbon dioxide, which causes the pH to decrease in the **cerebrospinal fluid (CSF)**. CSF is a colorless fluid in and around the brain and spinal cord that cushions these structures and filters out impurities and toxins. The cells are constantly working to eliminate carbon dioxide to regulate the acid–alkaline balance of the body. When the level of carbon dioxide becomes too high, a slight change occurs in the pH (the measure of acidity) of the CSF. The medulla oblongata (a portion of the brain stem), which is sensitive to pH changes, stimulates the phrenic nerve, sending a signal to the diaphragm to increase its rate of contraction. As the diaphragm becomes more active, the respiratory rate and tidal volume increase (discussed later in this chapter). As minute volume increases more carbon dioxide is exhaled. The primary reason you breathe is to lower your level of carbon dioxide, not to increase your level of oxygen.

The body also has a “backup system” to control respiration called the **hypoxic drive**. When the oxygen level falls, this system will also stimulate breathing. There are areas in the brain, the walls of the aorta, and the carotid arteries that act as oxygen sensors. These sensors are easily satisfied by minimal levels of oxygen in the arterial blood. Therefore, the backup system, the hypoxic drive, is much less sensitive and less powerful than the carbon dioxide sensors in the brain stem.

Special Populations

The anatomy of the respiratory system in children is proportionally smaller and less rigid than in an adult **Figure 6-22**. A child’s nose and mouth are much smaller than those of an adult. The larynx, cricoid cartilage, and trachea are smaller, softer, and more flexible as well. This makes the mechanics of breathing much more delicate. A child’s pharynx is also smaller and less deeply curved. The tongue takes up proportionally more space in a child’s mouth than in an adult’s mouth.

These anatomic differences are important for you to understand. For example, the smaller larynx of a child becomes obstructed more easily. The chest wall in children is softer. Therefore, children depend more heavily on the diaphragm for breathing. You will notice that a child’s abdomen moves in and out considerably with each breath, especially in an infant. Infants younger than 1 month do not know how to breathe through their mouth. Smaller children also have proportionally larger heads compared with the rest of their body. This will affect the way you treat a suspected spinal injury. Carefully consider these differences as you assess and treat an infant or a child.

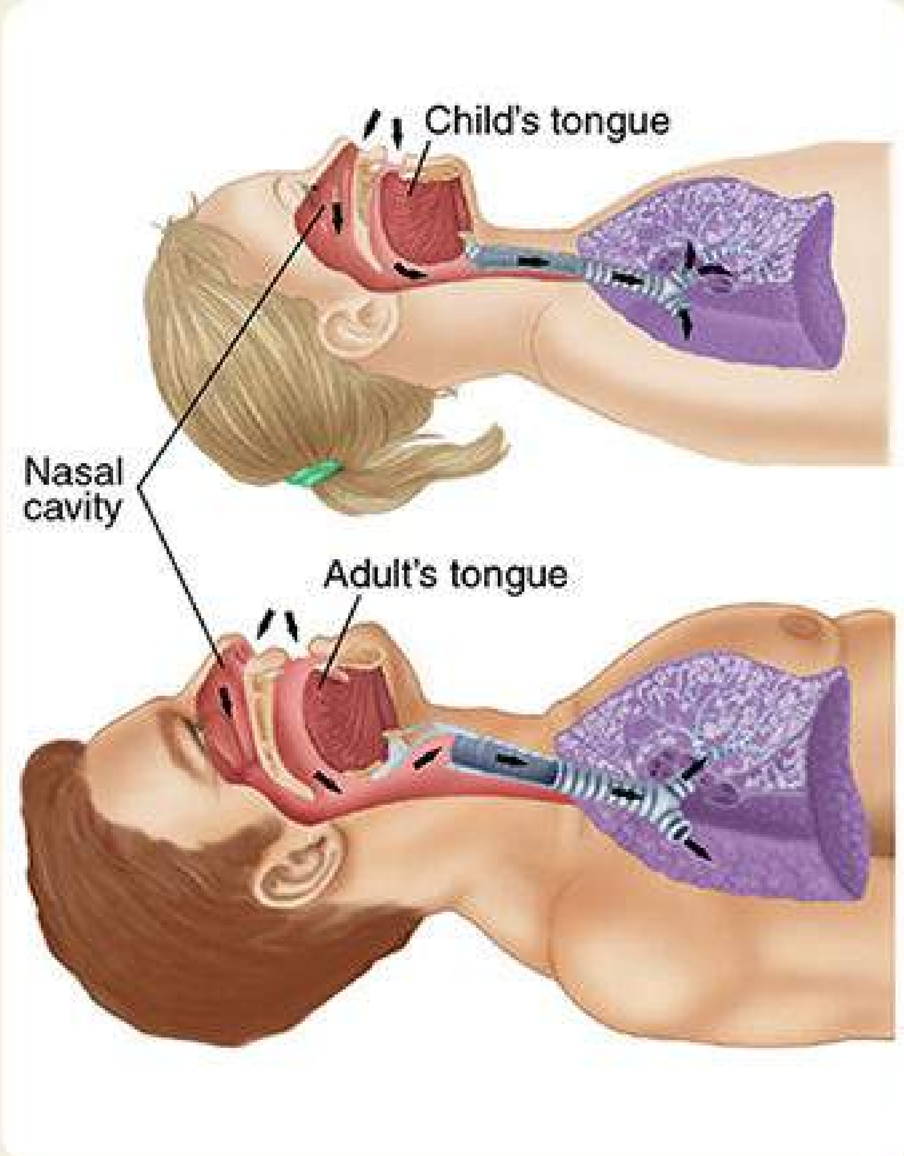


Figure 6-22 The respiratory system of a child is proportionally smaller and less rigid than that of an adult.

The Nervous System Control of Breathing

The exact way breathing occurs is complicated and also poorly understood by science. It is known that the medulla oblongata is primarily responsible for initiating the ventilation cycle and is primarily stimulated by high carbon dioxide levels. The function of the medulla is to keep you breathing without having to think about it. The medulla helps control the rhythm of breathing, initiates inspiration, sets the base pattern for respirations, and sends signals down the phrenic nerve to the diaphragm, triggering it to contract.

Special Populations

Normal breathing patterns in infants and children are essentially the same as those in adults. However, infants and children breathe faster than adults. An infant who is breathing normally will have respirations of 30 to 60 breaths/min. A child will have respirations of 12 to 40 breaths/min. Like adults, infants and children who are breathing normally will have smooth, regular inhalation and exhalation, equal breath sounds, and regular rise and fall movements on both sides of the chest.

Breathing problems in infants and children often appear the same as breathing problems in adults. Signs such as increased respirations, an irregular breathing pattern, unequal breath sounds, and unequal chest expansion indicate breathing problems in adults and children. Other signs that an infant or child is not breathing normally include the following:

- Muscle retractions, in which the muscles of the chest and neck are working extra hard in breathing
- Nasal flaring, in which the nostrils flare out as the child breathes
- Seesaw respirations in infants, in which the chest and abdominal muscles alternately contract to look like a seesaw

Exhalation becomes active when infants and children have trouble breathing. Normally, inhalation alone is the active, muscular part of breathing, as described earlier. However, with labored breathing, both inhalation and exhalation are hard work and involve the use of the accessory muscles. With labored breathing, exhalation is not passive. Instead, air is forced out of the lungs during exhalation, and the child will often begin to wheeze.

The pons, another area within the brain stem, has two areas, both of which help augment respirations during emotional or physical stress. The pons is involved in changing the depth of inspiration, expiration, or both. The medulla and the pons work together to help you get the right amount of air when you need it. The anatomy and physiology of the nervous system is discussed in more detail later in the chapter.

Ventilation

A substantial amount of air can be moved within the respiratory system. **Figure 6-23** shows the typical volumes. An adult man has a total lung capacity of 6,000 mL (equivalent to three 2-liter bottles of soda). An adult woman has about one-third less total capacity because the lung size is smaller.

Tidal volume is the amount of air that is moved into or out of the lungs during a single breath, generally 500 mL in an adult. **Inspiratory reserve volume** is the deepest breath you can take after a normal breath. Conversely, **expiratory reserve volume** is the maximum amount of air that you can forcibly breathe out after a normal breath. Gas remains in the lungs after exhalation simply to keep the lungs open. This is the **residual volume**. A loss of residual volume occurs when a person is hit in the chest and has the “wind knocked out” of him or her.

Dead space is the portion of the respiratory system that has no alveoli, and, therefore, little or no exchange of gas between air and blood occurs. The mouth, trachea, bronchi, and bronchioles are all considered dead space. When you ventilate a patient with any device, you create more dead space. Gas must first fill the device before it can be moved into the patient.

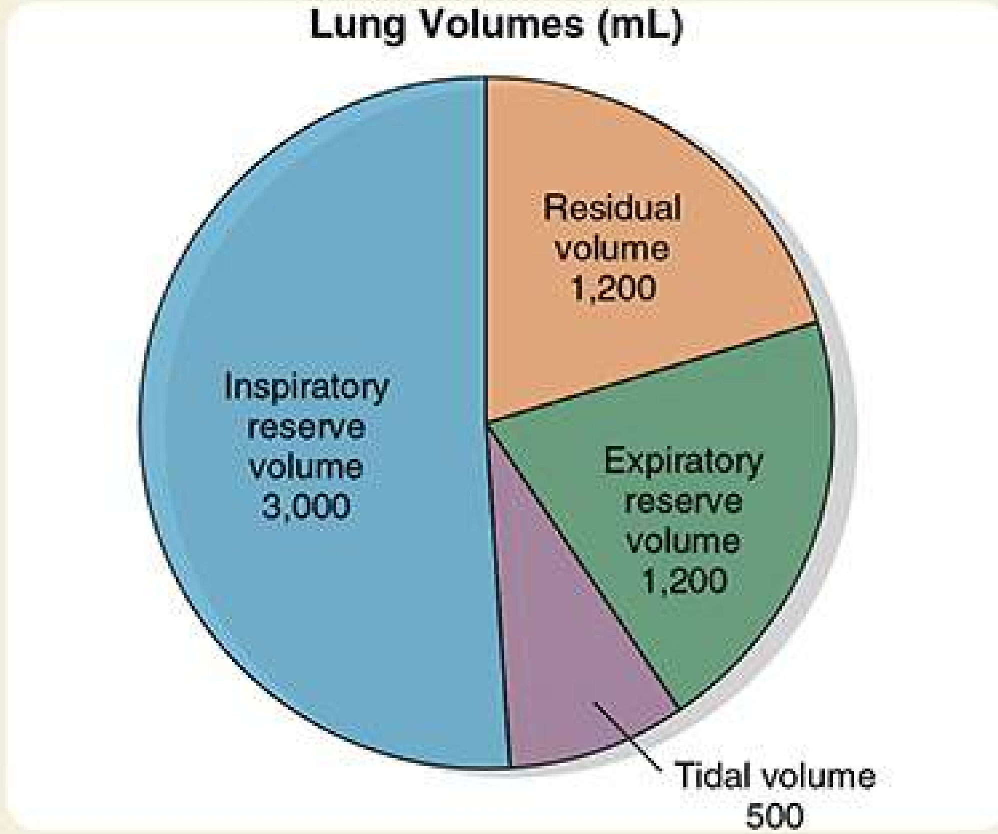


Figure 6-23 Lung volumes.

When you assess your patient, you need to accurately determine whether he or she is having trouble breathing. Often, EMTs will look at the patient's respiratory rate; this rate, however, provides only part of the information that is needed. The depth of each breath is critical information to know when assessing ventilation. **Minute volume** is another measure used to assess the amount of air that moves in and out of the lungs in 1 minute.

$$\text{Minute Volume} = \text{Respiratory Rate} \times \text{Tidal Volume}$$

This calculation helps you to determine if a patient is breathing adequately. While riding in the ambulance it will be difficult to determine the patient's exact tidal volume, but you will be able to estimate it. Consider the scenario of a patient who is breathing at a normal rate of 20 breaths/min. Yet, when you look at the patient's chest, it is barely moving. When you feel for air movement out of the mouth, you find very little movement. The patient is in trouble and needs your assistance now! Even though the patient's respiratory rate is normal, the amount of air being moved is inadequate. The minute volume is too low, and the patient needs ventilatory assistance. Always evaluate the amount of air being moved with each breath when assessing a patient's respirations.

Characteristics of Normal Breathing

You can think of a normal breathing pattern as a bellows system. Normal breathing should appear easy, not labored. As with a bellows that is used to move air to start a fire, breathing should be a smooth flow of air moving into and out of the lungs.

Normal breathing has the following characteristics:

- A normal rate and depth (tidal volume)
- A regular rhythm or pattern of inhalation and exhalation
- Clear, audible breath sounds on both sides of the chest
- Regular rise and fall movement on both sides of the chest
- Movement of the abdomen

Inadequate Breathing Patterns in Adults

An adult who is awake, alert, and speaking to you in full sentences usually has no immediate airway or breathing problems. However, keep supplemental oxygen on hand to assist with breathing should it become necessary. An adult who is not breathing well may appear to be working hard to breathe. This type of breathing pattern is called **labored breathing**. Labored breathing requires effort and may involve the accessory muscles of the chest, neck, and abdomen. The person may also be breathing much slower (fewer than 12 breaths/min) or much faster (more than 20 breaths/min) than normal. An adult at rest who is breathing normally will have respirations of 12 to 20 breaths/min Table 6-4.

Other signs that a person is not breathing normally include the following:

- Muscle retractions above the clavicles, between the ribs, and below the rib cage, especially in children
- Pale or cyanotic (blue) skin
- Cool, damp (clammy) skin
- Tripod position Figure 6-24 (a position in which the patient leans forward onto two arms)

Table 6-4 Normal Respiratory Rate Ranges

Adults	12 to 20 breaths/min
Children	12 to 40 breaths/min
Infants	30 to 60 breaths/min

Data Adapted From: Pediatric Advanced Life Support, 2012, the American Heart Association.

Figure 6-24 A patient in the tripod position will sit leaning forward on outstretched arms with the head and chin thrust slightly forward.

A patient in cardiac arrest may appear to be breathing. These occasional, gasping breaths are called **agonal gasps** and occur when the respiratory center in the brain continues to send signals to the breathing muscles. These gasps are not adequate because they are slow and generally shallow. In patients with agonal gasps, you will need to provide artificial ventilations and, most likely, chest compressions, both of which will be discussed in later chapters.

The Circulatory System: Anatomy

The **circulatory system** is a complex arrangement of connected tubes, including the arteries, arterioles, capillaries, venules, and veins **Figure 6-25**. Another name for this system is the cardiovascular (heart/ blood vessels) system. The circulatory system is entirely closed, with capillaries connecting arterioles and venules. There are two circuits in the body: the **systemic circulation** in the body and the **pulmonary circulation** in the lungs. The systemic circulation, the circuit in the body, carries oxygen-rich blood from the left ventricle through the body and back to the right atrium. In the systemic circulation, as blood passes through the tissues and organs, it gives up oxygen and nutrients and absorbs cellular wastes and carbon dioxide. The cellular wastes are eliminated in passages through the liver and kidneys. The pulmonary circulation, the circuit in the lungs, carries oxygen-poor blood from the right ventricle through the lungs and back to the left atrium. In the pulmonary circulation, as blood passes through the lungs, it is refreshed with oxygen and gives up carbon dioxide.

The Heart

The **heart** is a hollow muscular organ approximately the size of a clenched fist. It is made of a specialized muscle tissue called cardiac muscle or **myocardium** and actually works as two paired pumps; the left side is more muscular. A wall called the septum divides the heart down the middle into right and left sides. Each side of the heart is divided again into an upper chamber (**atrium**) and a lower chamber (**ventricle**). The left side of the heart, which pumps blood to the body, is a high-pressure pump; the right side supplies blood to the lungs and is a low-pressure pump.

The heart is an involuntary muscle. As such, it is under the control of the autonomic nervous system. However, it has its own electrical system and continues to function even without its central nervous system control. It is distinct from skeletal or smooth muscle in its requirement for a continuous supply of oxygen and nutrients.

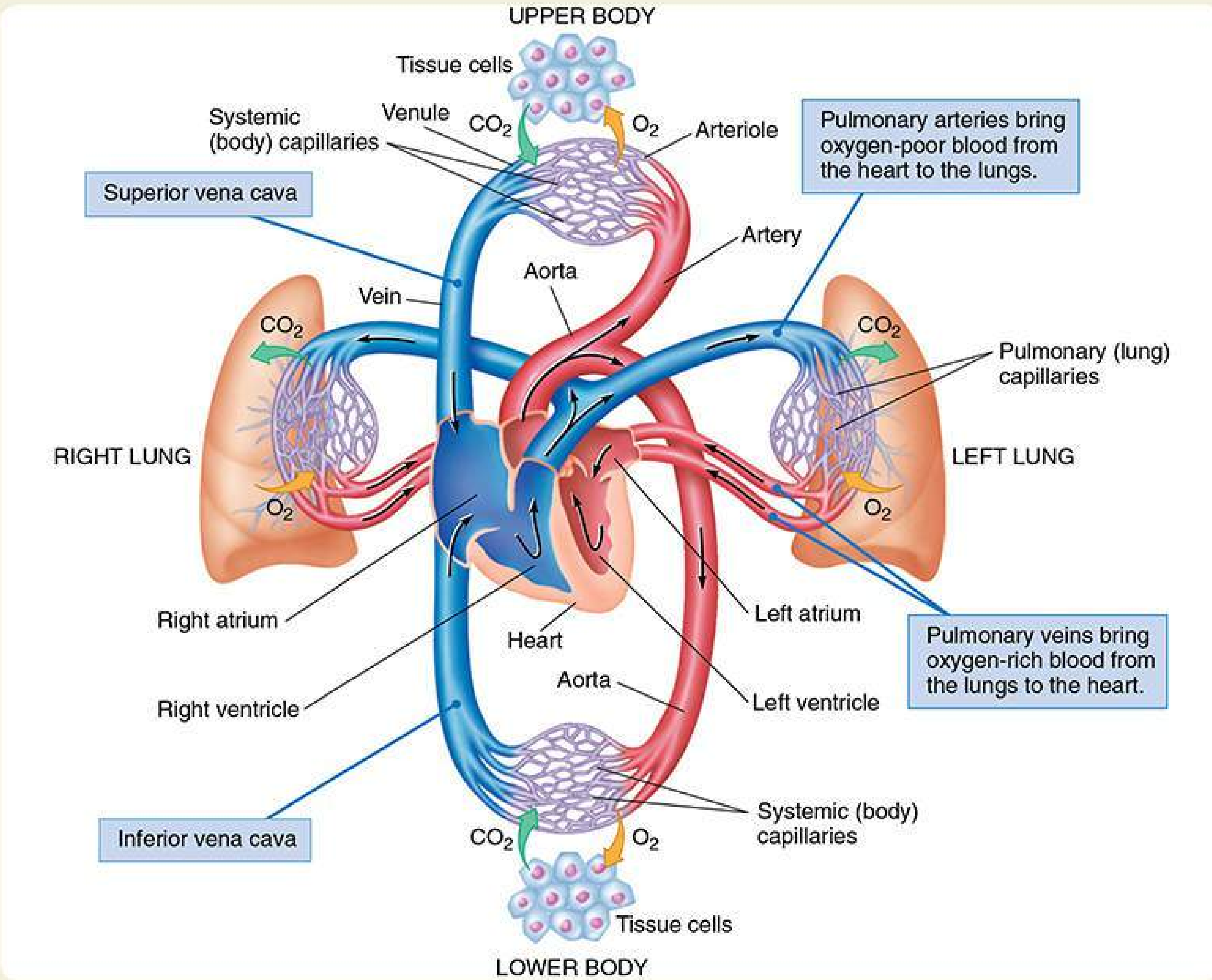


Figure 6-25 The circulatory system includes the heart, arteries, veins, and interconnecting capillaries. The capillaries are the smallest vessels and connect venules and arterioles. At the center of the system, and providing its driving force, is the heart. Blood circulates through the body under pressure generated by the two sides of the heart.

The heart must function continuously from birth to death and has developed special adaptations to meet the needs of this continuous function. It can tolerate a serious interruption of its own blood supply for only a very few seconds before the signs of a heart attack develop. Thus, its blood supply is rich and well distributed.

Circulation

The heart muscle's blood supply comes from the aorta. The aorta has two branches at its base that form the left and right coronary arteries. These arteries supply the heart muscle with oxygenated blood **Figure 6-26**.

The right side of the heart receives blood from the veins of the body **Figure 6-27A**. The blood enters from the superior and inferior venae cavae into the right atrium and then passes through the tricuspid valve to fill the right ventricle. After the right ventricle is filled, the tricuspid valve closes to prevent backflow after the right ventricular muscle contracts. Contraction of the right ventricle causes blood to flow through the pulmonic valve into the pulmonary artery and the pulmonary circulation.

The left side receives oxygenated blood from the lungs through the **pulmonary veins** into the left atrium, where the blood passes through the mitral valve into the left ventricle **Figure 6-27B**. Contraction of this most muscular of the pumping chambers pumps the blood through the aortic valve into the aorta and then to the arteries of the body.

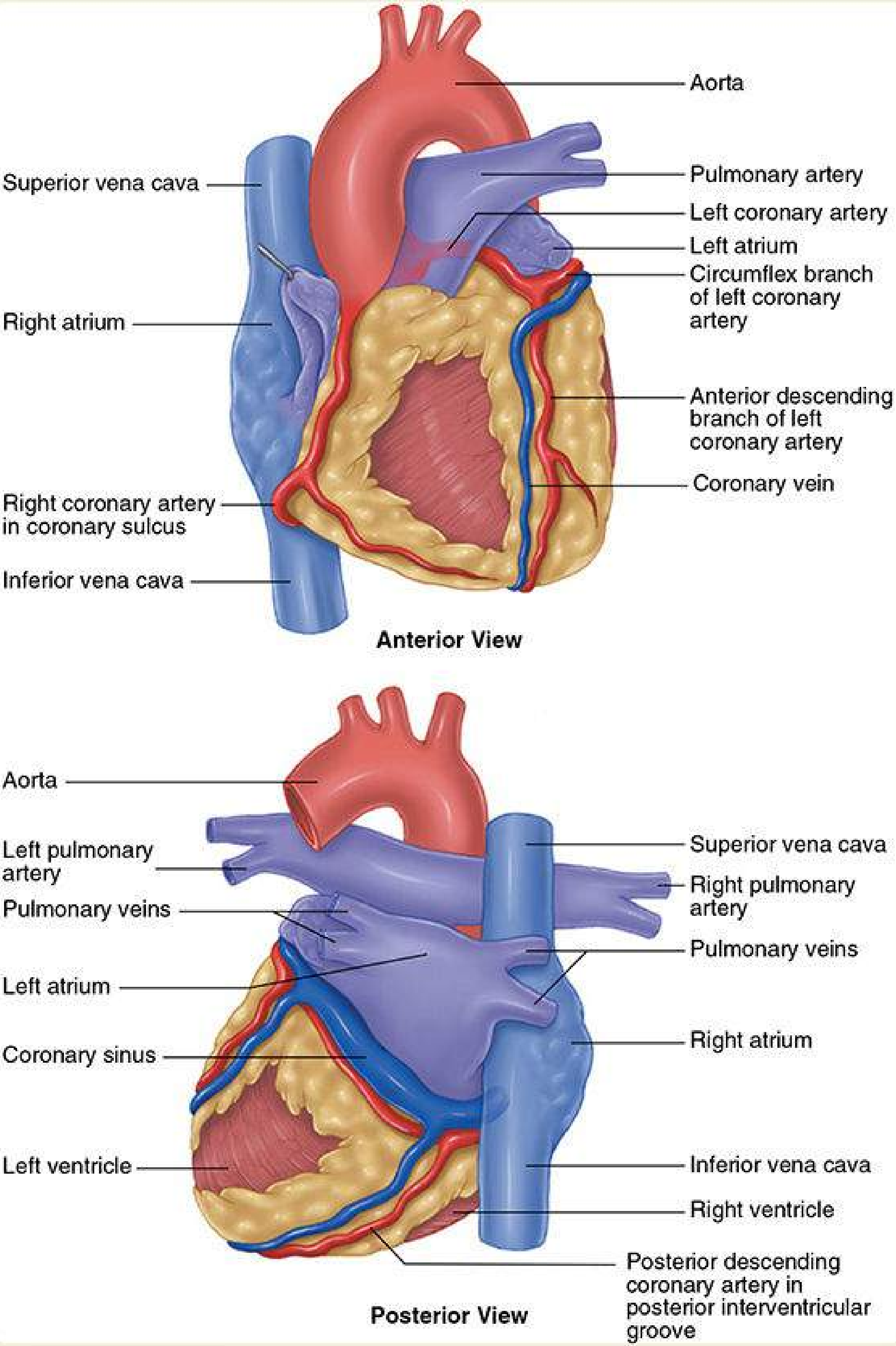


Figure 6-26 The two main coronary arteries supply the heart with blood.

The flow of blood through the four heart chambers is governed by one-way valves. The valves prevent the backflow of blood and keep it moving through the circulatory system in the proper direction. The **chordae tendineae** are thin bands of fibrous tissue that attach to the valves in the heart and prevent them from inverting. When a valve controlling the filling of a heart chamber is open, the other valve allowing it to empty is shut and vice versa. Normally, blood moves in only one direction through the entire system.

Normal Heartbeat

In the normal adult, the resting heartbeat may range from 60 to 100 beats/min. A very well-conditioned athlete may have a normal resting **heart rate (HR)** of 50 to 60 beats/min. During vigorous physical activity, the heart rate may rise to as fast as 180 beats/min. At each beat, 70 to 80 mL of blood is ejected from the adult heart. The amount of blood moved in one beat is called the **stroke volume (SV)**. In 1 minute, the entire blood volume of 5 to 6 L is circulated through all the vessels. The amount of blood moved in 1 minute is called the **cardiac output (CO)**. Cardiac output is equal to heart rate times stroke volume. Mathematically, cardiac output can be expressed as follows:

$$CO = HR \times SV$$

For example:

70 beats/min × 75 mL/beat = 5,250 mL/min or 5.25 L/min

Electrical Conduction System

A network of specialized tissue that is capable of conducting electrical current runs throughout the heart. The flow of electrical current through this network causes smooth, coordinated contractions of the heart. These contractions produce the pumping action of the heart. Each mechanical contraction of the heart is associated with two electrical processes. The first is depolarization, during which the electrical charges on the surface of the muscle cell change from positive to negative. The second is repolarization, during which the heart returns to its resting state and the positive charge is restored to the surface.

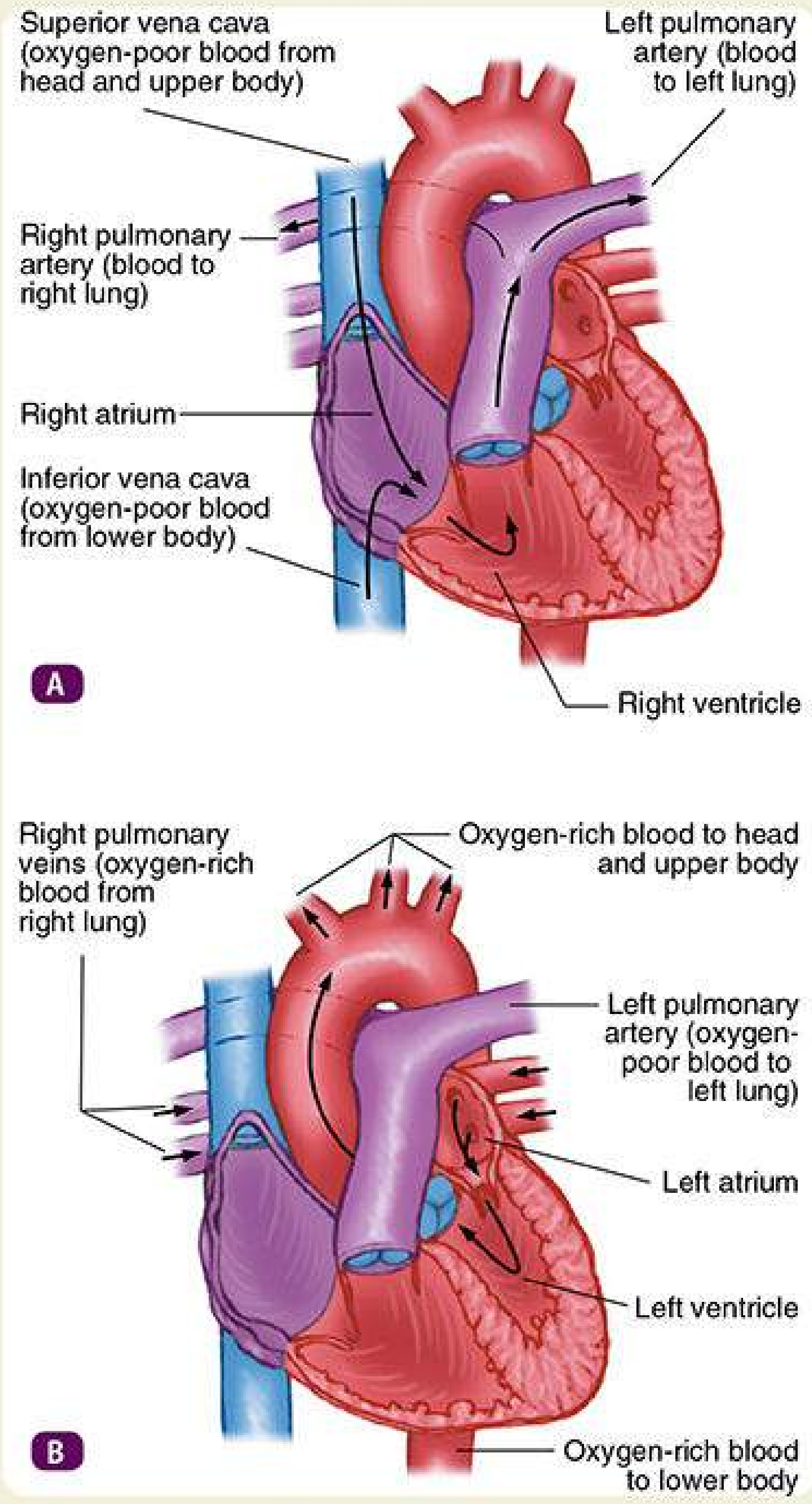


Figure 6-27 **A.** The right (slower pressure) side of the heart pumps blood from the body through the lungs. **B.** The left (higher-pressure) side of the heart pumps oxygen-rich blood to the rest of the body.

When the heart is working normally, the electrical impulse begins high in the atria at the sinoatrial node, then travels to the atrioventricular node and bundle of His, and moves through the Purkinje fibers to the ventricles. This movement produces a smooth flow of electricity through the heart, which depolarizes the muscle and produces a coordinated pumping contraction. Just as the walls of the heart can be injured when deprived of blood flow and oxygen, if areas of the heart's conduction system are deprived of blood flow and oxygen, serious abnormalities of the heart's rate, rhythm, and coordinated contraction can occur. Simply put, when the conduction system is injured, the heart will not beat properly. This may lead to dangerously low blood pressure which, if untreated, can result in the patient experiencing a loss of consciousness or cardiac arrest. Blood pressure is discussed later in the chapter.

Words of Wisdom

Many of the abnormal cardiac rhythms associated with cardiac arrest can be effectively treated with defibrillation. Therefore, any patient in cardiac arrest should have an automated external defibrillator (AED) applied as soon as possible.

Arteries

The arteries carry blood from the heart to all body tissues **Figure 6-28**. They branch into smaller arteries and then into arterioles. The arterioles, in turn, branch into the vast network of capillaries. The walls of an artery are made of fine, circular muscle tissue. Some arteries are made of fine circular muscle and elastic tissue.

Arteries contract to accommodate loss of blood volume and increase blood pressure. Blood is supplied to tissues as they need it. For example, the digestive system is supplied with more blood after you eat a meal. The leg muscles are more heavily supplied when jogging. Some tissues need a constant blood supply, especially the heart, kidneys, and brain. Other tissues, such as the muscles in the extremities, the skin, and intestines, can function with less blood when at rest. The ability to respond to the needs of the body owes itself to the way arteries are constructed. The middle layer of the artery is the **tunica media**, where the smooth muscles are found that can contract and dilate to change the diameter of the blood vessel.

The **aorta** is the main artery leaving the back left side of the heart; it carries freshly oxygenated blood to the body. This blood vessel is found just in front of the spine in the chest and abdominal cavities. The aorta has many branches that supply the body's vital organs. The coronary arteries supply the heart; the carotid arteries supply the head; the hepatic arteries supply the liver; the renal arteries supply the kidneys; and the mesenteric arteries supply the digestive system. The aorta divides at the level of the umbilicus into the two common iliac arteries that lead to the lower extremities. All of the aorta's branches ultimately become arterioles leading into the body's capillary network.

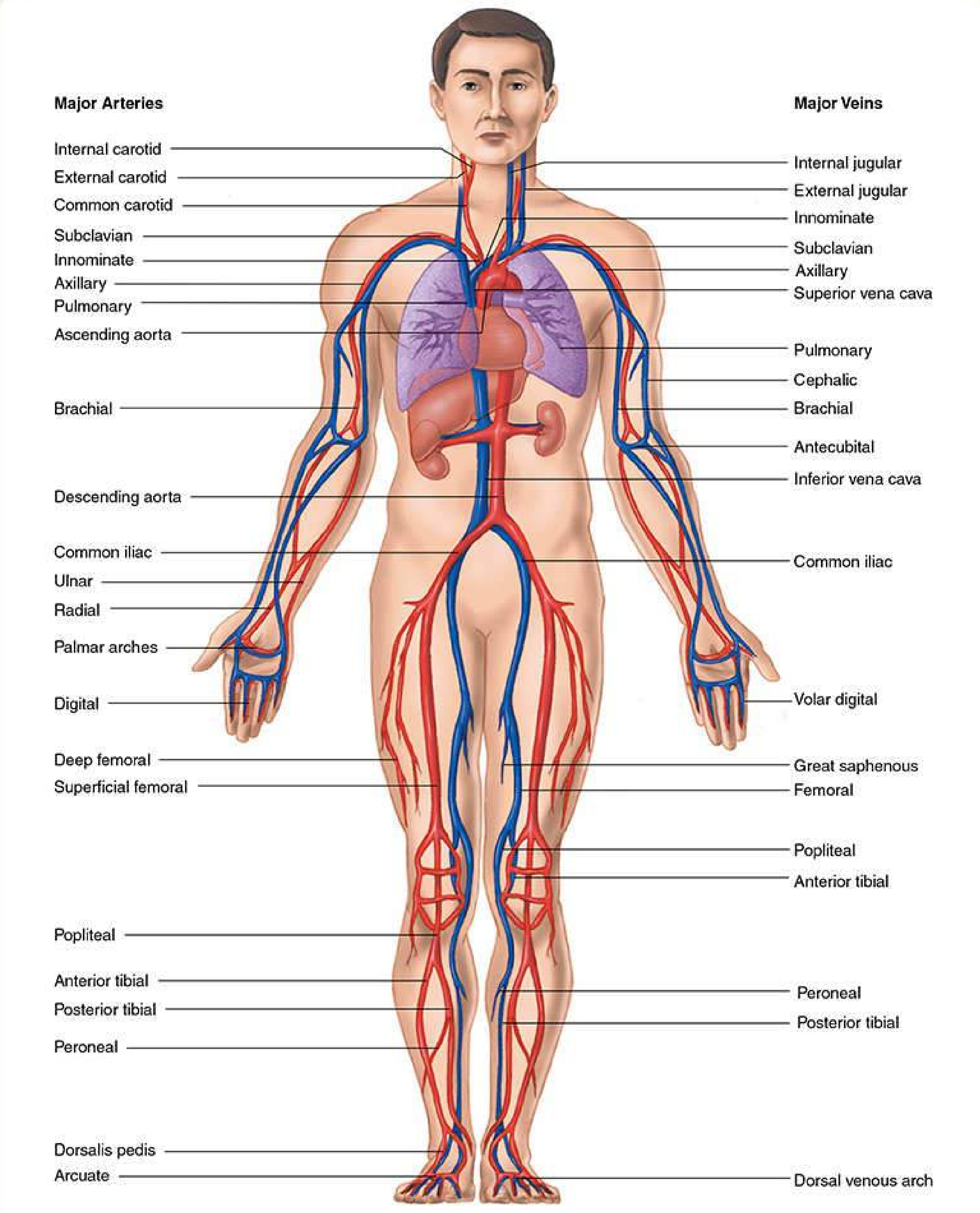


Figure 6-28 The main arteries supply blood to a vast network of smaller arteries and arterioles. Venules deliver oxygen-poor blood to the veins that return blood to the heart.

The **pulmonary artery** begins at the right side of the heart and carries oxygen-depleted blood to the lungs. It divides into finer and finer branches until it meets with the pulmonary capillary system located in the thin walls of the alveoli. These arteries are the only ones in the body that carry oxygen-depleted blood.

Arteries branch into smaller arteries and then into arterioles. **Arterioles** are the smallest branches of an artery leading to the vast network of capillaries.

The **pulse**, which is palpated most easily at the neck, wrist, or groin, is created by the forceful pumping of blood out of the left ventricle and into the major arteries. It is present throughout the entire arterial system. It can be felt most easily where the larger arteries near the skin can be pushed against a solid structure, like a bone or large muscle **Figure 6-29**. Pulses and their locations are listed in **Table 6-5**.

Capillaries

In the body, there are billions of cells and billions of capillaries. **Capillary vessels** are fragile divisions of the arterial system that allow contact between the blood and the cells of the tissues. Oxygen and other nutrients pass from blood cells and plasma in the capillaries to the individual tissue cells through the very thin wall of the capillary. Carbon dioxide and other metabolic waste products pass in a reverse direction from the tissue cells to the blood to be carried away. Blood in arteries is characteristically bright red, because its hemoglobin is rich in oxygen. Blood in the veins is dark blue-red, because it has passed through a capillary bed and given up its oxygen to the cells. Capillaries connect directly at one end with the flow-regulating arterioles and at the other with the venules.

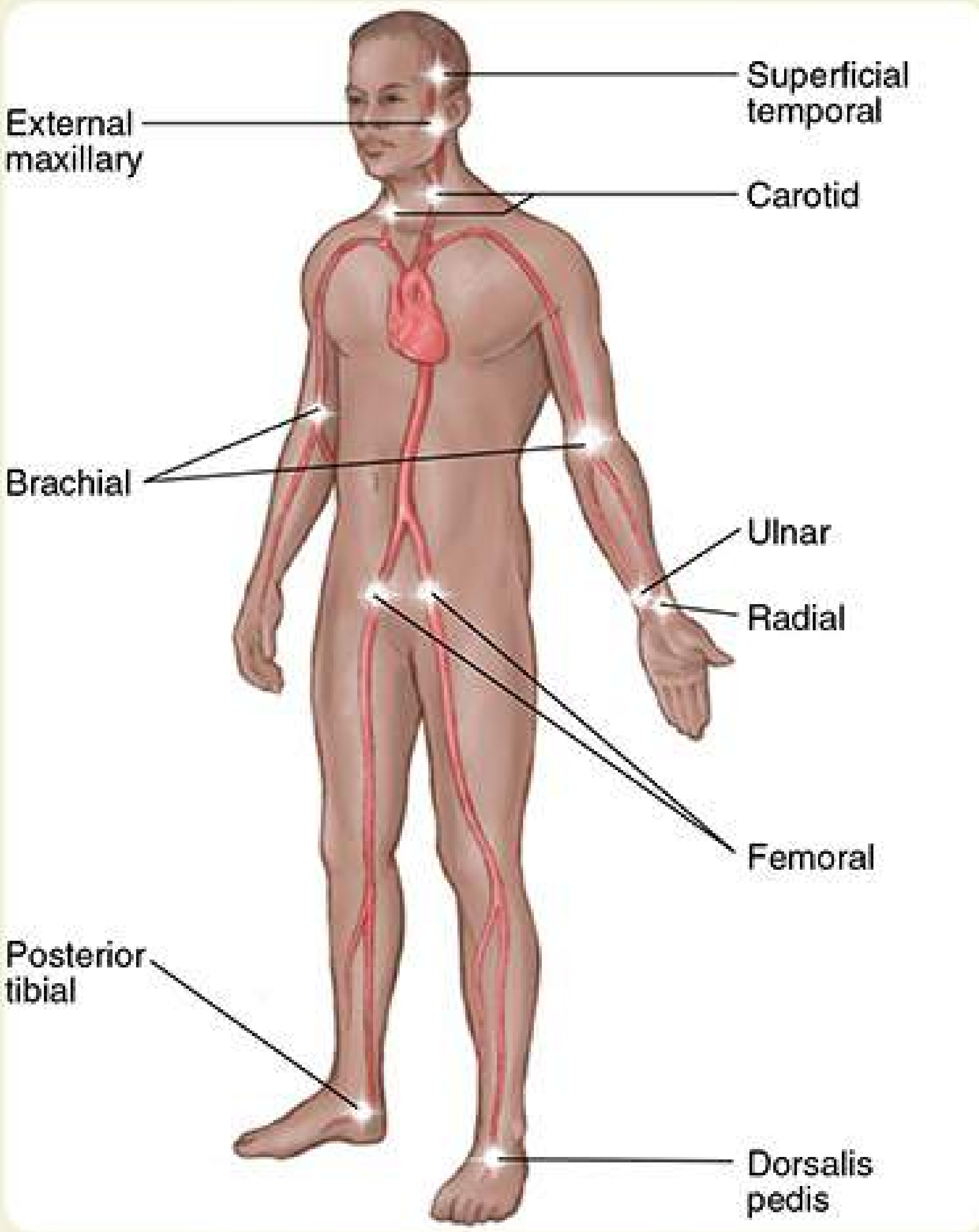


Figure 6-29 The central and peripheral pulses can be felt where the large arteries are near the skin.

Capillaries allow blood to move through them a single cell at a time. This slows the movement of blood. However, the design of this system can result in a backup of the blood cells. To solve this problem, the body has two systems in place to keep the blood cells moving. The first system consists of built-in bypasses at the capillary level. These are called arteriovenous shunts. This means that some of the blood cells will exit the arteriole only to be shunted to the venule without ever reaching the true capillary. These blood cells do not get to offload their oxygen. It may take several passes for any particular blood cell to actually reach the true capillaries where the work of delivering oxygen supplies and removing waste is done.

Table 6-5 Pulses

Central Versus Peripheral	Pulse Name	Location Where Felt
Central pulses	Carotid artery pulse	At the upper portion of the neck
	Femoral artery pulse	In the groin
Peripheral pulses	Radial artery pulse	At the wrist at the base of the thumb
	Brachial artery pulse	On the medial aspect of the arm, midway between the elbow and shoulder
	Posterior tibial artery pulse	Posterior to the medial malleolus
	Dorsalis pedis artery pulse	On the top of the foot

The other system built into the capillaries that helps control the flow of blood cells is made up of sphincters. Sphincters are small muscles in the arterioles that can be opened or closed. For example, when a patient is bleeding, chemical commands are sent to the sphincters to close. This prevents all blood cells from entering the capillaries. Blood is shunted off to another venule while still carrying oxygen. The benefit is that available blood is shunted into the major blood vessels, keeping them filled. The disadvantage is that waste is not being removed and nutrients are not being delivered to the cells.

This can go on temporarily, but eventually the tissues will be damaged if the cellular waste is not removed.

Veins

Once oxygen-depleted blood passes through the network of capillaries, it moves to the venules, which are the smallest branches of the veins. The blood returns to the heart via a network of larger and larger veins. Veins have much thinner walls than arteries and are generally larger in diameter. The veins become larger and larger and ultimately form two major vessels, called the superior and inferior venae cavae. These two veins lie just to the right of the spine and collect blood just before it enters the heart. Because pressure generated by the heart dissipates as blood passes through the capillaries, venous blood flow is assisted by gravity, skeletal muscle contraction, and intrathoracic pressure changes from breathing. One-way flow in the veins is governed by valves within the veins.

The **superior vena cava** carries blood returning from the head, neck, shoulders, and upper extremities. Blood from the abdomen, pelvis, and lower extremities passes through the **inferior vena cava**. The superior and inferior venae cavae join at the right atrium of the heart. The right ventricle receives blood from the right atrium and pumps it through the pulmonary arteries into the lungs. The venae cavae, aorta, and pulmonary arteries and veins are collectively known as the great vessels.

Recall that the body's ability to change blood flow is critical to survival. The body constricts blood vessels to change the size of the total blood volume container. A smaller container that has the same amount of liquid as the original container means a higher liquid pressure.

The state of the blood vessels—how dilated or constricted they are—is referred to as the **systemic vascular resistance (SVR)**. SVR is the resistance to blood flow within all of the blood vessels except the pulmonary vessels. The pathophysiology section of this chapter will discuss how various types of shock impact container size. In some types of shock, blood vessels dilate, the container becomes too large, and the patient's blood pressure falls dramatically **Table 6-6**.

Words of Wisdom

The terms *shock* and *hypoperfusion* are usually synonymous, at least when they are applied to multiple body systems. Localized hypoperfusion, however, such as from arterial occlusion (blockage), is not shock.

YOU are the Provider — PART 3

Your partner obtains and records the patient's vital signs and then gives him supplemental oxygen while you complete your assessment. The patient tells you he has a history of gallbladder problems. Based on your assessment and the patient's medical history, you suspect that the gallbladder is the origin of his pain.

Recording Time: 2 Minutes	
Respirations	24 breaths/min; adequate depth
Pulse	110 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	142/82 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)

4. What additional symptoms would you expect the patient to experience based on the function of the gallbladder?

Table 6-6 Effects of Blood Vessel Diameter on Blood

State	Effects
Constricted blood vessel	Decreased size of container Increased pressure within container
Normal diameter	Balance of size and pressure
Dilated blood vessel	Increased size of container Decreased pressure within container

The Spleen

The spleen is a solid organ located under the rib cage in the left upper part of the abdomen. The spleen is actually part of the lymphatic system, but because it processes blood, it will be discussed here. At any one time there is about 450 mL of blood in the spleen. In the event of sudden blood loss, the body is able to squeeze the spleen and move this blood reservoir into the general circulation. Filtering is the basic duty of the spleen. Virtually all of the blood in the body passes though the spleen where it is filtered. Worn out blood cells, foreign substances, and bacteria are removed from the blood, and hemoglobin is recycled. Another function of this organ is to assist in the immune response.

The spleen is particularly susceptible to injury from blunt trauma because it is made of delicate tissue and because it is located directly under the flexible lower ribs, with very little soft tissue to cushion it. Therefore, it is one of the most frequently injured abdominal organs in patients with blunt trauma. Because the spleen is highly vascular, injury can lead to severe internal bleeding.

Blood Composition

Blood is a complex, thick, red fluid composed of plasma, red blood cells (erythrocytes), white blood cells (leukocytes), platelets, and protein molecules. The work of the circulatory system is to accomplish movement of blood, or perfusion.

Plasma is a sticky, yellow fluid that carries the blood cells and nutrients. This is the liquid portion of the blood. The primary components are water and proteins. All of the other components together make up 1% of the plasma:

- **Water:** Constitutes 92% of plasma
- **Proteins:** Constitute 7% of the plasma. The majority of this protein is albumin, which has a role in controlling the movement of water into and out of the circulation. Also includes clotting factors, enzymes, and some hormones
- **Oxygen:** Very little oxygen is dissolved in the plasma; almost all oxygen is bound to hemoglobin (found in red blood cells)
- **Carbon dioxide:** Transported as bicarbonate in the plasma
- **Nitrogen:** The air that you breathe is mostly nitrogen; therefore, this gas is dissolved within the plasma
- **Nutrients:** Fuel for the cells
- **Cellular wastes:** Lactic acid, carbon dioxide, etc

- **Others:** Hormones, other cellular products

Red blood cells (erythrocytes) contain hemoglobin, which gives blood its red color. Hemoglobin is responsible for carrying oxygen. The majority of carbon dioxide is carried by conversion to carbonic acid, which dissolves in the plasma. A small amount of carbon dioxide is carried by hemoglobin. **White blood cells** (leukocytes) play a role in the body's immune defense mechanisms against infection. **Platelets** are tiny, disc-shaped elements that are much smaller than the cells. They are essential in the initial formation of a blood clot, the mechanism that stops bleeding.

The Circulatory System: Physiology

Blood pressure (BP) is the pressure the blood exerts against the walls of the arteries as it passes through them. When the cardiac muscle of the left ventricle contracts, it pumps blood from the ventricle into the aorta. This muscular contraction phase is called **systole**. When the muscle of the ventricle relaxes, the ventricle fills with blood. This phase is called **diastole**. The pulsed, forceful ejection of blood from the left ventricle of the heart into the aorta is transmitted through the arteries as a pulsatile pressure wave. This pressure wave keeps the blood moving through the body. The high and low points of the wave can be measured with a **sphygmomanometer** (blood pressure cuff) and are expressed numerically in millimeters of mercury (mm Hg). The high point is called the systolic blood pressure (measured as the heart muscle is contracting). The low point is called the diastolic blood pressure (measured when the heart muscle is in its relaxation phase). There are several pressures within the circulatory system that are essential to understanding how this system works. Table 6-7 shows the various pressures from within the circulatory system and their meaning.

The average adult has approximately 6 L of blood in the vascular system. Children have less, 2 to 3 L, depending on their age and size. Infants have only about 300 mL. The loss of an amount of blood that may be insignificant for an adult could be fatal for an infant.

Normal Circulation in Adults

In all healthy people, the circulatory system is automatically adjusted and readjusted constantly so 100% of the capacity of the arteries, veins, and capillaries holds 100% of the blood at that moment. All of the vessels are never fully dilated or constricted. The size of arteries and veins is controlled by the nervous system, according to the amount of blood that is available and many other factors, to keep blood pressure normal at all times. Under the condition of normal pressure, with a system that can hold just 100% of the blood available, all parts of the system will have adequate blood supply all the time.

Perfusion is the circulation of blood in an organ or tissue in adequate amounts to meet the cells' current needs. Blood enters an organ or tissue through the arteries and leaves it through the veins Figure 6-30. Loss of normal blood pressure is an indication that blood is no longer circulating efficiently to every organ in the body. (However, a "good blood pressure" does not indicate that it is reaching all parts of the body.) There are many reasons for loss of blood pressure. The result in each case is the same: organs, tissues, and cells are no longer adequately perfused or supplied with oxygen and food, and wastes can accumulate. Under these conditions, cells, tissues, and whole organs may die. The state of inadequate circulation, when it involves the entire body, is called **shock**, or hypoperfusion.

Table 6-7 Cardiovascular Pressures

Name	Description	Clinical Significance
Systolic blood pressure	Pressure within the arteries when the heart is contracting; left ventricular force	Indicates heart pumping effectiveness Indicates blood available to the heart
Diastolic blood pressure	Pressure within the arteries when the heart is at rest	Indicates adequate cardiac relaxation and pressure in the arteries between heart beats Indicates amount of blood within blood vessels
Pulse pressure	Difference between systolic blood pressure and diastolic blood pressure	Relationship between systolic and diastolic pressures; provides information about the body's response to stress
Preload	Amount of blood returning to the heart	Too little preload, and blood pressure falls Too high preload, and the heart cannot move blood effectively
Afterload	Pressure to be overcome when left ventricle contracts (pressure within the aorta)	Diastolic pressure is the same as afterload
Cardiac output (CO)	Amount of blood moved in 1 minute	$CO = SV \times HR$
Stroke volume (SV)	Amount of blood moved in one beat of the heart (left ventricle)	Weak left ventricle moves less blood per beat than a strong left ventricle
Systemic vascular resistance (SVR)	Resistance to blood flow within all of the blood vessels (except the pulmonary vessels)	The higher the SVR, the smaller the container; therefore, the higher the pressure of blood within the vessel

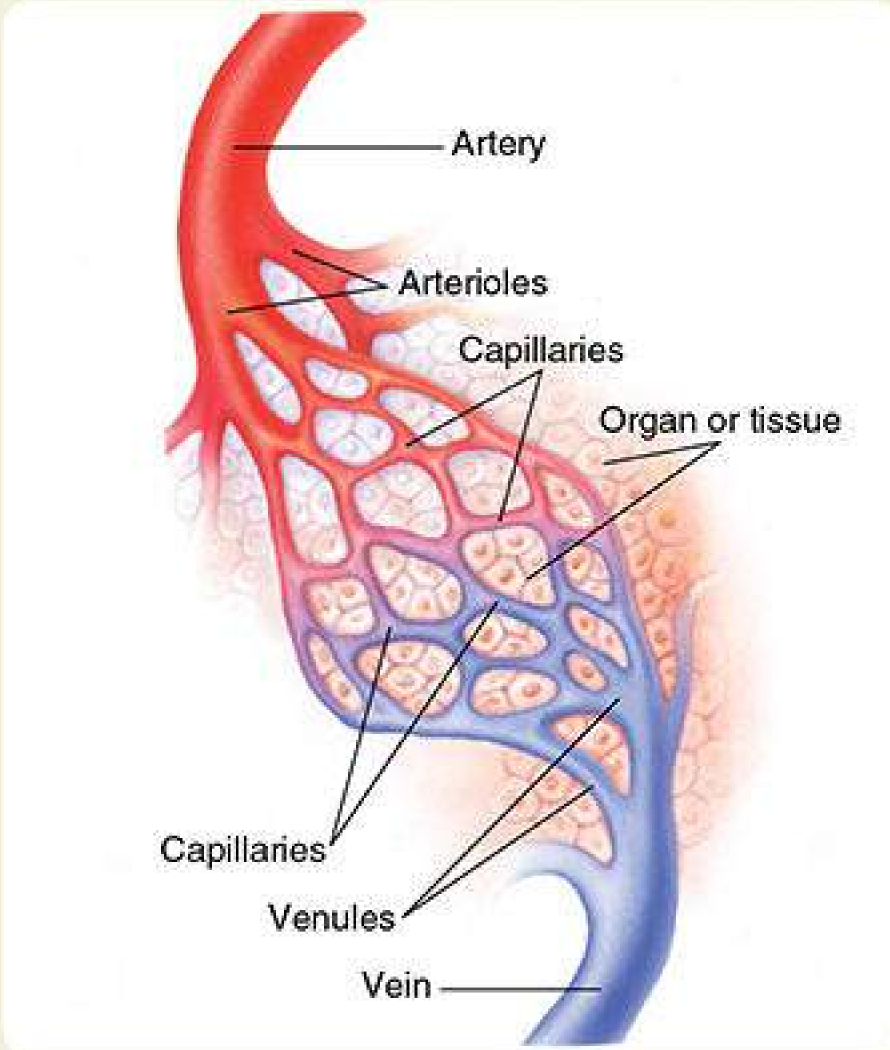


Figure 6-30 Blood enters an organ or tissue through the arteries and leaves through the veins. This process, called perfusion, provides adequate blood flow to the tissue to meet the cells' needs.

▶ Inadequate Circulation in Adults

When a patient has a small amount of blood loss, the arteries, veins, and heart automatically adjust to the smaller new volume. The adjustment occurs in an effort to maintain adequate pressure throughout the circulatory system and maintain circulation for every organ. The adjustment occurs very rapidly after the loss, usually within minutes. Specifically, the vessels constrict to provide a smaller bed for the reduced volume of blood to fill, and the heart pumps more rapidly to circulate the remaining blood more efficiently. As the blood pressure falls, the pulse increases in an attempt to keep the cardiac output constant at 5 to 6 L per minute. If the loss of blood is too great, the adjustment fails, and the patient goes into shock. This can be expressed by the following formula, in which MAP is mean arterial pressure, HR is heart rate, SV is stroke volume, and SVR is systemic vascular resistance:

$$MAP = (HR \times SV) \times SVR$$

Since heart rate (HR) times stroke volume (SV) equals cardiac output (CO), this can also be written as:

$$MAP = CO \times SVR$$

Figure 6-31 illustrates this formula.

The Function of Blood

Most blood is unevenly distributed throughout the body. Approximately 30% of blood is found within the heart, arteries, and capillaries. Seventy percent of blood is found within the veins and venules. This may seem confusing, but if you remember that the heart and arteries are high-pressure systems and veins are low-pressure systems, it becomes clearer. As blood pressure falls, blood flow slows down and there is more blood in the veins. The blood flows away from the left ventricle and moves back to the right atria.

Consider the movement of blood and its ultimate function of perfusion. You know that capillaries are the smallest portions of the circulatory system where materials are able to exit and enter the bloodstream. Nutrients move from the capillaries into the **interstitial space** (space between the cells) and into the cells. Wastes move from the cells through the interstitial space and into the capillaries.

Inside the capillary, two main forces are at work: hydrostatic pressure and oncotic pressure. **Hydrostatic pressure** occurs as fluid pushes against the vessel walls to force fluid out of the capillary. **Oncotic pressure** is the opposing force and occurs because proteins in the blood plasma cause water to be pulled into the capillary by diffusion.

The movement of fluid into and out of the capillaries occurs as follows. Blood flows into the arterial side of the capillary. Water is forced out because the pressure is high. At the same time, water is trying to enter the capillary. Pressure on the arterial side is higher, so the hydrostatic pressure is also higher, and water, carrying nutrients, leaves the capillary and enters the interstitial space. The hydrostatic pressure is greatly diminished, however, by the time the fluid reaches the venous side because the effort of pushing the fluid out of the capillary decreased its force. This decrease in pressure is beneficial because oncotic pressure is still pushing fluid into the capillary and the pressure is higher. Water, with all of the wastes from the cells, enters the venous side of the capillary. These wastes are then carried away **Figure 6-32**.

Another function of blood is the ability to clot. Coagulation, or clotting, occurs as the result of a very complex chemical process that creates small fibers near the injured blood vessel, trapping red blood cells. This chemical process involves platelets and clotting factors that are in the bloodstream. **Table 6-8** outlines the major functions of the blood.

Blood under pressure will gush or spurt intermittently from an artery. When blood comes from a vein, it flows in a steady stream. From capillaries, blood will ooze at many tiny individual points. Clotting normally takes from 6 to 10 minutes.

Nervous System Control of the Cardiovascular System

The nervous system, discussed next, has direct effects on the cardiovascular system. The sympathetic nervous system sends commands to the adrenal glands where two hormones, **epinephrine** (also known as adrenaline) and **norepinephrine** (also known as noradrenaline), are secreted to stimulate the heart and blood vessels. The release of epinephrine and norepinephrine affects receptors within the heart and blood vessels and improves the ability to cope with stress, known as the fight-or-flight reaction. Two types of receptors within the heart and blood vessels will be discussed next so you can understand how the nervous system controls the circulatory system.

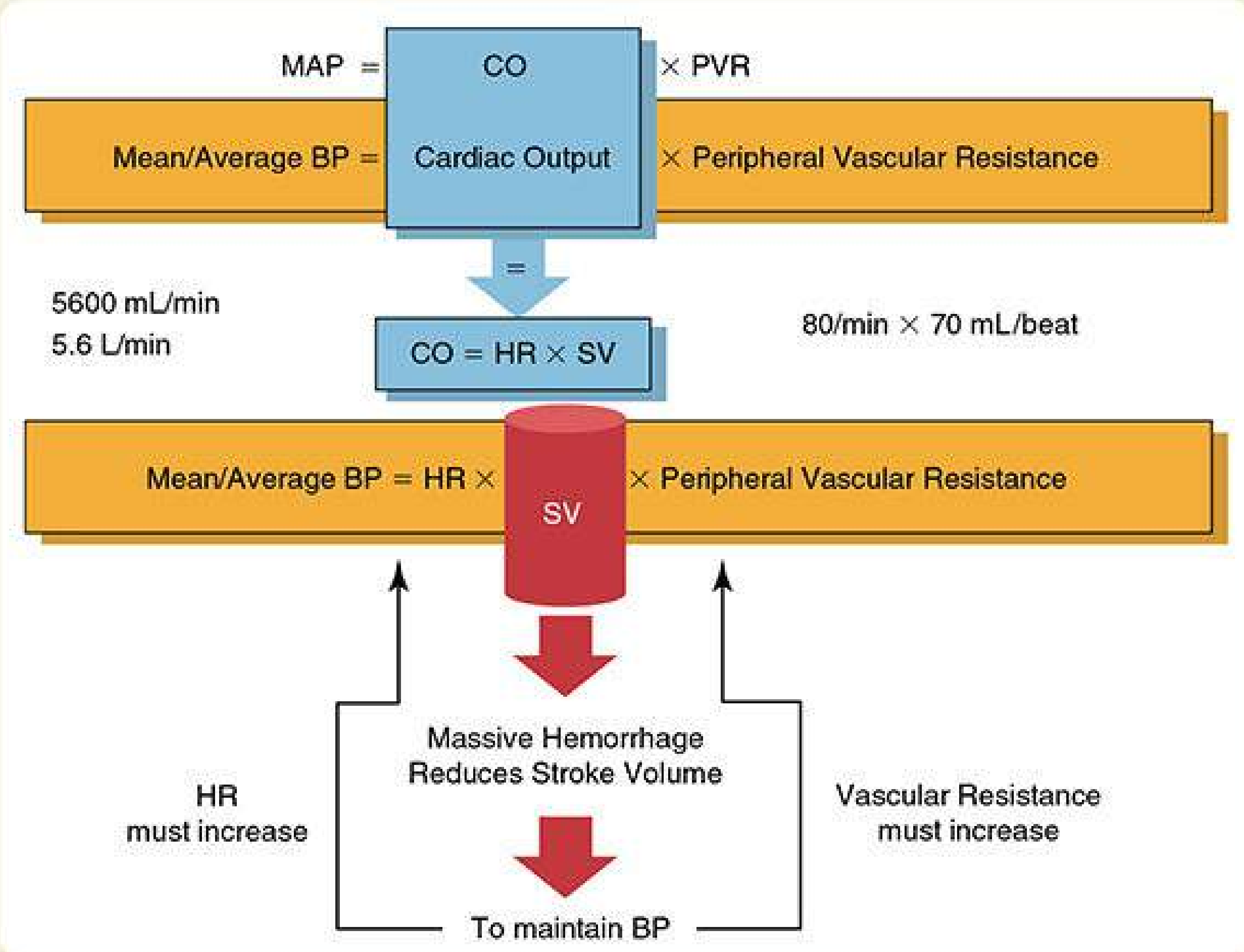


Figure 6-31 Significant blood loss results in reduced stroke volume. To compensate, the body increases heart rate and systemic vascular resistance to maintain mean arterial pressure.

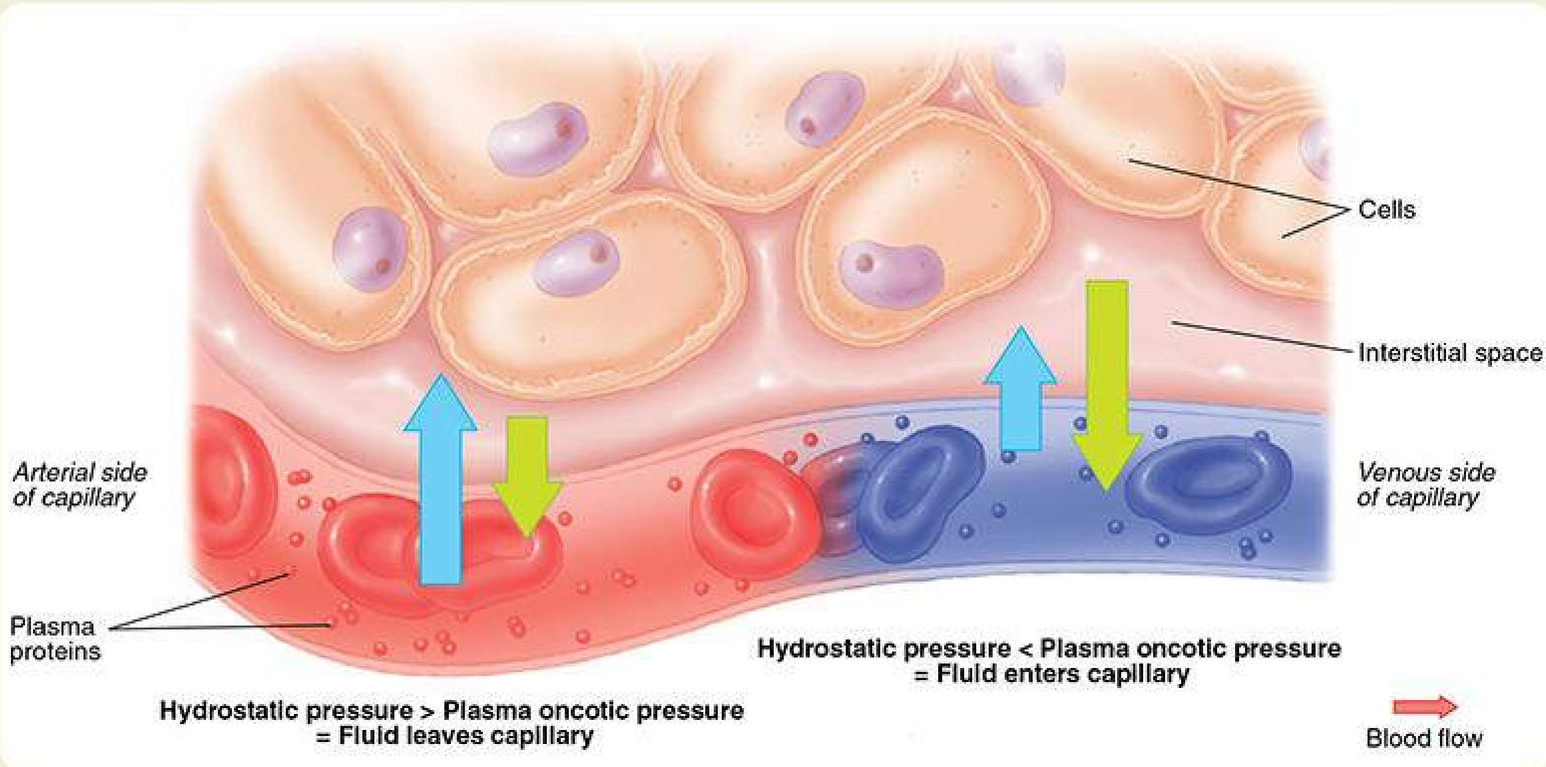


Figure 6-32 Fluid movement from capillaries to interstitial space and back.

The heart and blood vessels have **alpha-adrenergic receptors** and **beta-adrenergic receptors** within them. **Adrenergic** simply means related to the adrenal gland, where epinephrine and norepinephrine are made. The alpha-adrenergic receptors are found in the blood vessels. When stimulated, the blood vessels constrict, thereby increasing blood pressure. The beta-adrenergic receptors are found in the heart and lungs. When beta-1 receptors are stimulated, they cause the heart to increase its rate and also squeeze harder with each contraction. This increases cardiac output. When beta-2 receptors are stimulated, the bronchi in the lungs dilate. This allows more air to be inhaled and exhaled; therefore, more oxygen is available to the cells of the body. Together, the alpha- and beta-adrenergic receptors prepare the body for fight or flight.

Table 6-8 Functions of the Blood and the Components of Blood in Use

Function	Component of the Blood in Use
Fights infection	White blood cells
Transports oxygen	Red blood cells (hemoglobin)
Transports carbon dioxide	Plasma
Controls (buffer) pH	Chemicals within the plasma
Transports wastes and nutrients	Plasma (water)
Clotting (coagulation)	Platelets and clotting factors in the plasma

Table 6-9 Nervous System Effects on the Cardiovascular System

Portion of Nervous System	Receptor	Stimulation Area	Effect When Stimulated
Sympathetic nervous system	Alpha-1	Blood vessels	Constricted blood vessels; skin becomes pale, cool, clammy
	Beta-1	Heart	Increased heart rate
			Increased force of heart contraction
	Beta-2	Lungs	Bronchodilation
Parasympathetic nervous system	Muscarinic	Heart	Decreased heart rate
			Decreased force of contraction

The parasympathetic nervous system also has effects on the cardiovascular system. When stimulated, this system causes the heart to slow and beat more weakly. Although the sympathetic and parasympathetic divisions function in opposition to each other, this opposition is considered complementary rather than antagonistic. The net effect is a dynamic body able to respond quickly for fight or flight Table 6-9.

The brain needs to know how the body is performing so that adjustments in the pressure exerted by circulating blood can be made. How is the brain alerted to what is happening at the feet, the liver, or the heart? Signals are sent through the nervous system from special pressure sensors (baroreceptors) spread throughout the body, which allow the brain to receive information about blood pressure. Remember, the main function of the cardiovascular system is to perfuse blood throughout the body. The main locations for these pressure receptors are found in the arch of the aorta and the carotid arteries. By measuring the pressure in these two locations, the body can ensure that the most vulnerable and most important cells get oxygen.

With this information, the brain is able to act to maintain perfusion. To see the system in action, you may want to try this test. Kneel down to the floor. Now, as fast as you can, jump up. Did you pass out? Most likely you did not pass out because these systems with their pressure sensors are designed to maintain perfusion.

When you jumped up quickly, gravity was relocating the blood out of your brain. The baroreceptors detected the decrease in blood pressure at the carotid arteries. A signal was sent to the brain. The brain understood the implication of low blood pressure and immediately turned on the sympathetic nervous system. The blood vessels contracted, and the heart rate increased. The heart pumped harder. Your blood pressure returned to normal and may even have gone slightly high. Again, the baroreceptors detected this change. Signals were sent to the brain. The sympathetic nervous system was turned off. The parasympathetic nervous system was turned on. The heart rate slowed, and the force of the heart's contractions weakened. All of this happened in a fraction of a second. That is how responsive the cardiovascular system can be.

The Nervous System: Anatomy and Physiology

The **nervous system** is perhaps the most complex organ system within the human body. It is composed of two major structures, the brain and the spinal cord, and thousands of nerves that allow every part of the body to communicate. This system is responsible for fundamental functions such as controlling breathing, heart rate, and blood pressure. However, what makes the nervous system so special is that it allows the performance of higher level activity. Reading a good book, enjoying music, having a discussion with a friend, and even watching television require the brain to engage memory, understanding, and thought. Here is where the true complexity of the nervous system can be seen.

The nervous system is divided into two main portions: the **central nervous system (CNS)** (the brain and spinal cord) and the **peripheral nervous system (PNS)** (the nerves outside of the brain and spinal cord that link the CNS to various organs of the body). The **somatic nervous system** regulates activities over which there is voluntary control, such as walking, talking, and writing. The **autonomic nervous system** controls the many body functions that occur without voluntary control, including digestion, dilation and constriction of blood vessels, sweating, and all other involuntary actions that are necessary for basic body functions. Thus, the nervous system as a whole can be divided anatomically into the central and peripheral nervous systems and functionally into somatic (voluntary) and autonomic (involuntary) components Figure 6-33.

The Central Nervous System

Brain

The **brain** is the controlling organ of the body. It is the center of consciousness. It is responsible for all of your voluntary body activities, your perception of your surroundings, and the control of your reactions to the environment. In addition, the brain enables you to experience all the unique thoughts and feelings that make you an individual. The brain is subdivided into several areas, all of which have specific functions. Three major subdivisions of the brain are the cerebrum, the cerebellum, and the brain stem Figure 6-34.

The **cerebrum**, which is the largest part of the brain and is sometimes called the gray matter, makes up about three-fourths of the volume of the brain and is composed of four lobes: frontal, parietal, temporal, and occipital. The cerebrum on one side of the brain controls activities on the opposite side of the body. Each lobe of the cerebrum is responsible for a specific function. For example, one group of brain cells in the frontal lobe is responsible for the activity of all the voluntary muscles of the body. Brain cells in this area generate impulses that are sent along nerve fibers that extend from each cell into the spinal cord. An area in the parietal lobe has cells that receive sensory impulses from the peripheral nerves of the body. Other parts of the cerebrum are responsible for other body functions. For example, the occipital region, in the back of the cerebrum, receives visual impulses from the eyes; other areas control hearing, balance, and speech. Still other parts of the cerebrum are responsible for emotions and other characteristics of an individual's personality.

The **cerebellum**, which is located underneath the great mass of cerebral tissue, is sometimes called the little brain. The major function of this area is to coordinate the various activities of the body, particularly body movements. Without the cerebellum, very specialized muscular activities such as writing would be impossible.

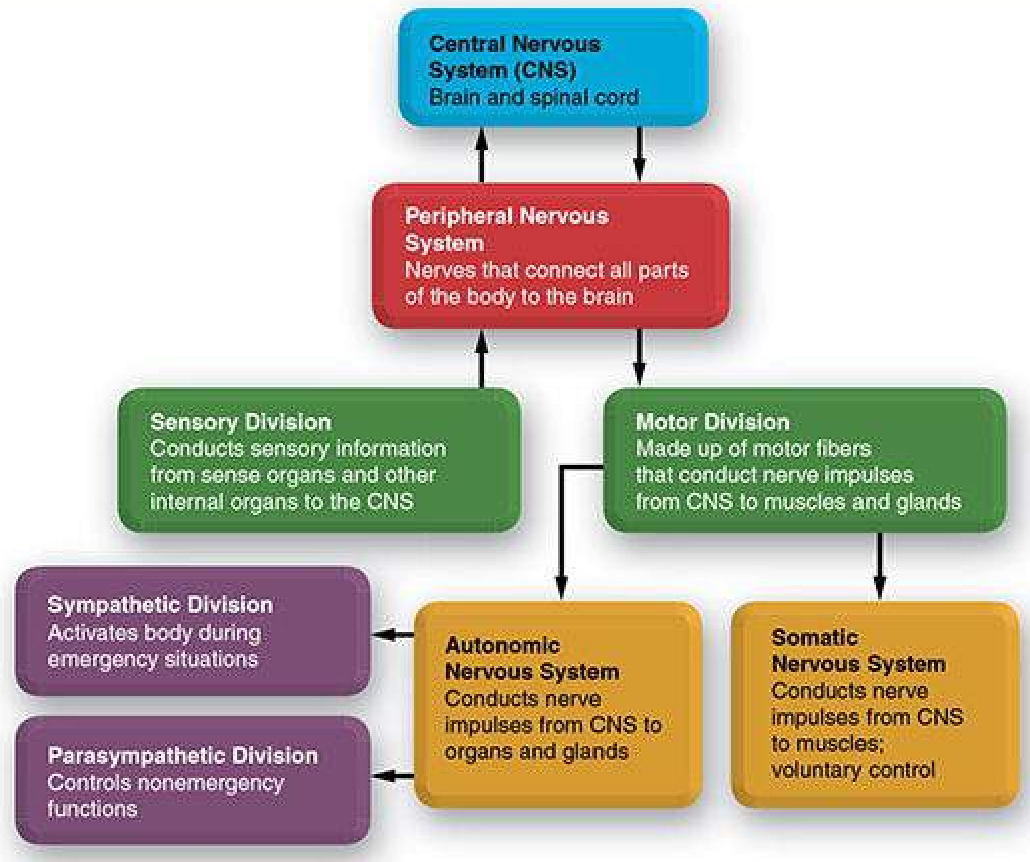


Figure 6-33 The basic configuration of the nervous system.

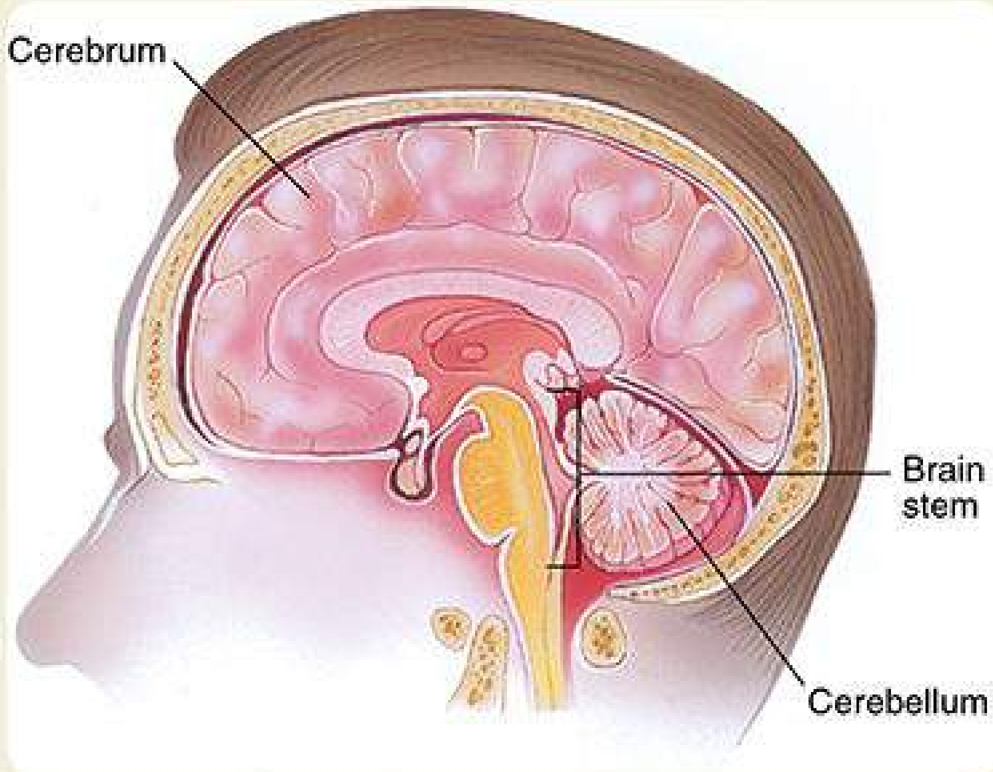


Figure 6-34 The brain lies well protected within the skull. Its major subdivisions are the cerebrum, the cerebellum, and the brain stem.

The **brain stem** is so called because the brain appears to be sitting on this portion of the CNS as a plant sits on its stem. The brain stem is the most primitive part of the CNS. It lies deep within the cranium and is the best-protected part of the CNS. The brain stem is the controlling center for virtually all body functions that are absolutely necessary for life. Cells in this part of the brain control cardiac, respiratory, and other basic body functions such as the regulation of consciousness. As you are reading this book, your **reticular activating system** in the midbrain is keeping you awake. The brain stem comprises three areas: the **midbrain**, the **pons**, and the **medulla oblongata**.

The brain has many other anatomic areas, all of which have specific and important functions. The brain receives a vast amount of information from the environment, sorts it all out, and directs the body to respond appropriately. Many of the responses involve voluntary muscle action; others are automatic and involuntary. Table 6-10 summarizes the major portions of the nervous system and their functions.

Cerebrospinal Fluid. Recall that CSF filters out impurities and toxins; it also absorbs shocks. When forces are applied to the head, CSF allows the brain to shift in the skull without tearing. If a trauma patient has CSF leaking from the ears or nose, this is considered a significant finding, indicating a skull fracture.

Table 6-10 Structures of the Nervous System and General Functions

System	Major Structure	Subdivision	General Function
Central nervous system	Brain	Occipital lobe Parietal lobe Temporal lobe	Vision and storage of visual memories Sense of touch and texture; storage of those memories Hearing, smell, and language; storage of sound and odor memories
		Frontal lobe	Voluntary muscle control and storage of those memories
		Prefrontal area	Judgment and predicting consequences of actions, abstract intellectual functions
		Limbic system	Basic emotions, basic reflexes (chewing, swallowing, etc)
		Diencephalon (thalamus)	Relay center; filters important signals from routine signals
		Diencephalon (hypothalamus)	Emotions, temperature control, interface with endocrine system (hormone control)
	Brain stem	Midbrain	Level of consciousness, reticular activating system, muscle tone, and posture
		Pons	Respiratory patterning and depth
		Medulla oblongata	Heart rate, blood pressure, respiratory rate
	Spinal cord		Reflexes, relays information to and from body
Peripheral nervous system	Cranial nerves		Brain stem to head and neck; special peripheral nerves that connect directly to body parts
	Peripheral nerves		Brain to spinal cord to body part; receive stimulus from body, send commands to body

Circulation in the Head. The brain requires a constant flow of oxygenated blood to support brain function. Blood is supplied to the head through the carotid arteries, which can be palpated on either side of the neck. Deoxygenated blood drains from the head via the internal and external jugular veins.

Spinal Cord

The spinal cord is an extension of the brain stem Figure 6-35. Like the brain, the spinal cord contains nerve cell bodies, but the major portion of the spinal cord is made up of nerve fibers that extend from the cells of the brain. These nerve fibers transmit information to and from the brain. All fibers join together just below the brain stem to form the spinal cord. At the level of the neck, the nerves cross; this is why issues on the left side of the brain relate to the right side of the body, and vice versa. The spinal cord exits through the foramen magnum. It is encased within the spinal canal down to the level of the second lumbar vertebra. The spinal canal is created by an opening through the vertebrae, stacked one on another. Each vertebra surrounds the cord, and together the vertebrae form the bony spinal canal.

The primary function of the spinal cord is to transmit messages between the brain and the body. These messages are passed along the nerve fibers as electrical impulses, just as messages are passed along a telephone cable. The nerve fibers are arranged in specific bundles within the spinal cord to carry the messages from one specific area of the body to the brain and back.

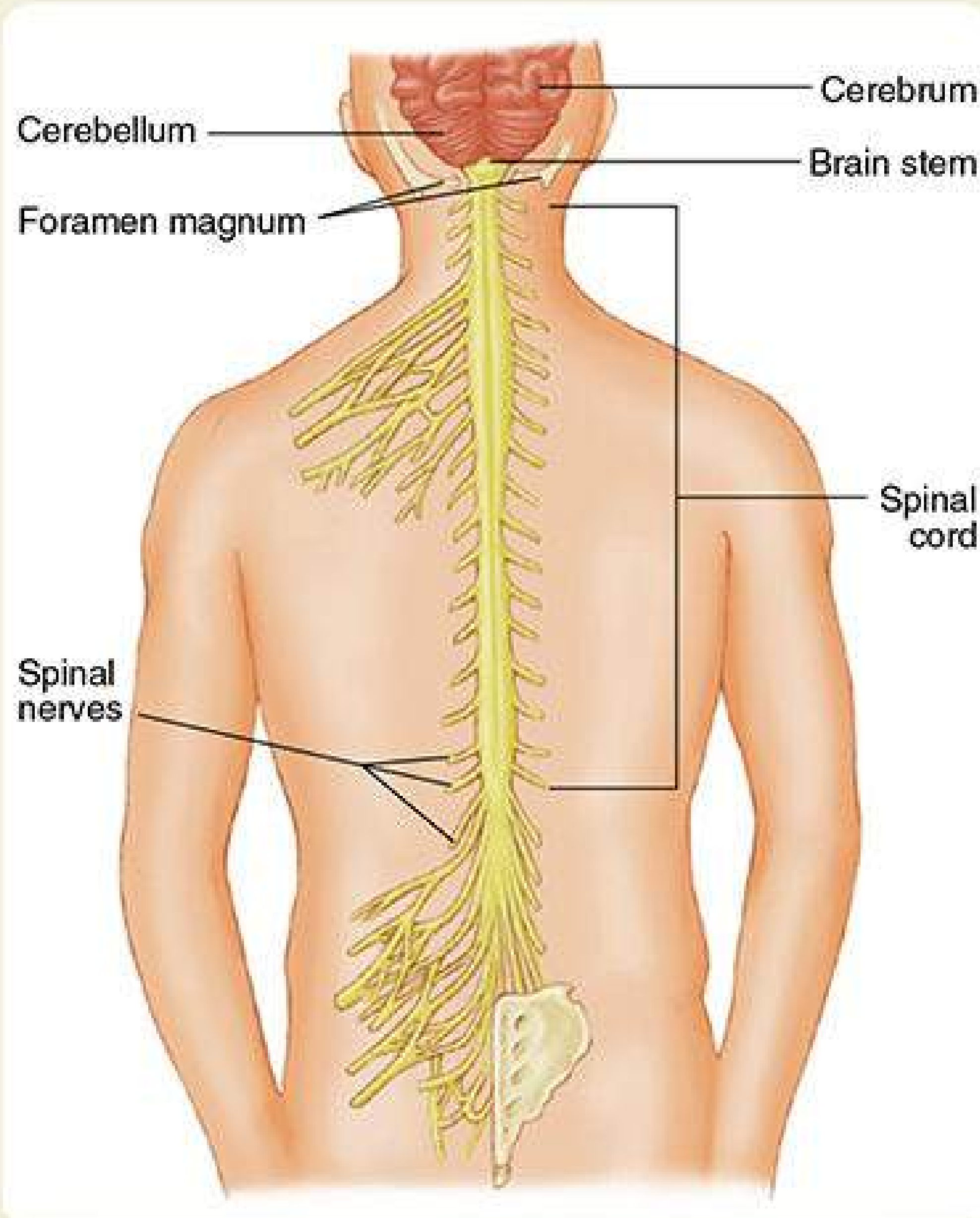


Figure 6-35 The spinal cord is a continuation of the brain stem. It exits the skull at the foramen magnum and extends down to the level of the second lumbar vertebra.

▶ The Peripheral Nervous System

Recall that the PNS is divided into the somatic nervous system and the autonomic nervous system. The autonomic nervous system, in turn, is split into two areas. The sympathetic nervous system is responsible for the fight-or-flight response, enabling you to fight if you find yourself in a dangerous situation or to run away. This fight-or-flight reaction generally increases the activity within your body so that your muscles are able to perform more effectively. An increased heart and respiratory rate, pupil dilation, and increased use of glucose all provide you with the resources to defend yourself or flee the scene.

The **parasympathetic nervous system**, the other half of the autonomic nervous system, generally slows down the body. When you are eating, your blood supply needs to move to your stomach and intestines so the food you eat can be processed. The parasympathetic nervous system slows your body's heart rate and respirations and allows your food to be properly digested.

There are two types of nerves within the peripheral nervous system: sensory nerves and motor nerves.

YOU are the Provider — PART 4

You prepare the patient for transport. He remains conscious and alert, but is still experiencing severe pain. Shortly after loading him into the ambulance and departing the scene, you perform a reassessment.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert
Respirations	24 breaths/min; adequate depth
Pulse	112 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	138/88 mm Hg
Spo_2	97% (on oxygen)

You allow the patient to assume a position of comfort, which seems to help with his pain. With an estimated time of arrival at the hospital of 10 minutes, you call in your radio report.

5. How does knowledge of anatomy, physiology, and medical terminology facilitate communication with other health care professionals?

Sensory Nerves

Sensory nerves of the body are complex. There are many types of sensory cells in the nervous system. Sensory cells are located in the eyes, ears, skin, muscles, joints, lungs, and other organs of the body. When a sensory cell is stimulated, it transmits its own special message to the brain. There are special sensory nerves to detect heat, cold, position, motion, pressure, pain, balance, light, taste, and smell, as well as other sensations. Specialized nerve endings are adapted for each cell so it perceives only one type of sensation and transmits only that message.

The sensory impulses constantly provide information to the brain about what the different parts of the body are doing in relation to your surroundings. Thus, the brain is continuously made aware of its surroundings. For example, the cranial nerves supply sensations directly to the brain. Visual sensations (what you see) reach the brain directly by way of the optic nerve (the second cranial nerve) in each eye. The nerve endings for the optic nerve lie in the retina of the eye. The nerve endings are stimulated by light, and the impulses are carried along the nerve that passes through a hole in the back of the eye socket and carries impulses to the occipital portion of the brain.

When sensory *nerve* endings in the extremities are stimulated, the impulses are transmitted along a peripheral nerve to the spinal cord. The cell body of the peripheral nerve lies in the spinal cord. The impulse is then transmitted from that cell body to another nerve ending in the spinal cord and from there up the spinal cord to the sensory area in the parietal lobe of the brain, where the sensory information can be interpreted and acted on by the brain.

As another example, an irritating stimulus to the sensory nerve, such as heat, transmits from the sensory nerve along the connecting nerve directly to the motor nerve and stimulates it. The muscle responds promptly, withdrawing the limb from the irritating stimulus even before this information can be transmitted to the brain. Technically, you do not "feel" the heat of the fire before you move your hand away. The withdrawal reflex is in place to limit damage to the body.

Motor Nerves

Each muscle in the body has its own motor nerve. Whereas sensory nerves carry information *to* the brain, **motor nerves** carry information *from* the brain to the muscles of the body. The cell body for each motor nerve lies in the spinal cord, and a fiber from the cell body extends as part of the peripheral nerve to its specific muscle. Electrical impulses that are produced by the cell body in the spinal cord are transmitted along the motor nerve to the muscle and cause it to contract. The cell body in the spinal cord is stimulated by an impulse produced in the motor strip of the cerebral cortex. This impulse is transmitted along the spinal cord to the cell body of the motor nerve.

The Integumentary System (Skin): Anatomy

The skin is divided into two parts: the superficial epidermis, which is composed of several layers of cells, and the deeper dermis, which contains the specialized skin structures. Below the skin lies the **subcutaneous tissue** layer **Figure 6-36**. The cells of the epidermis are sealed to form a watertight protective covering for the body.

The **epidermis** is the most superficial layer of the skin and varies in thickness in different areas of the body. On the soles of the feet, the back, and the **scalp**, it is quite thick, but in some areas of the body, the epidermis is only two or three cell layers thick. The epidermis is actually composed of several layers of cells. These layers can be separated into two regions. At the base of the epidermis is the **germinal layer**, which continuously produces new cells that gradually rise to the surface. On the way to the surface, these cells die and enter the **stratum corneal layer**. This is the dead layer of skin. Whereas the germinal layer has a blood supply, the stratum corneal layer does not. The journey from the germinal layer to the surface takes about 4 weeks. The outermost cells of the epidermis are constantly rubbed away and replaced by new cells produced by the germinal layer. The germinal layer also contains cells that produce pigment granules. These granules help to produce skin color.

Below the germinal layer is the **dermis**. Within the dermis lie many of the special structures of the skin: sweat glands, sebaceous (oil) glands, hair follicles, blood vessels, and specialized nerve endings.

Sweat glands produce sweat for cooling the body. The sweat is discharged onto the surface of the skin through small pores, or ducts, that pass through the epidermis. The sebaceous glands produce sebum, the oily material that seals the surface epidermal cells. The **sebaceous glands** lie next to hair follicles and secrete sebum along the hair follicle to the skin surface. In addition to providing waterproofing for the skin, sebum keeps the skin soft so it does not crack.

Hair follicles are the small organs that produce hair. The hair grows from the follicle along a shaft until it reaches the epidermal surface. A sebaceous gland is located along the hair shaft. Connected to the hair is a small muscle. The muscle pulls the hair into an erect position when you are cold or frightened. Hair goes through stages of growth and rest. Each hair follicle on the scalp grows for about 3 years and then rests for about 1 to 2 years.

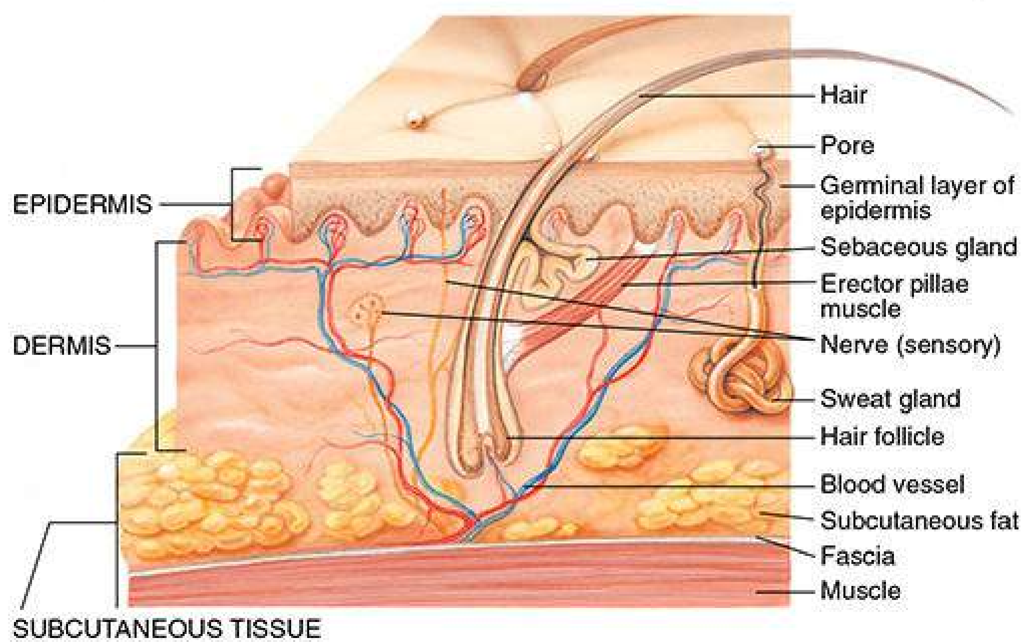


Figure 6-36 The skin has two distinct layers: the epidermis and the dermis. Below the skin is a layer of subcutaneous tissue.

Blood vessels provide nutrients and oxygen to the skin. The blood vessels lie in the dermis. Small branches extend up to the germinal layer. A complex array of nerve endings also lies in the dermis. These specialized nerve endings are sensitive to environmental stimuli; they respond to these stimuli and send impulses along the nerves to the brain.

Beneath the skin, immediately under the dermis and attached to it, lies the subcutaneous tissue. The subcutaneous tissue is composed largely of fat. The fat serves as an insulator for the body and as a reservoir to store energy. The amount of subcutaneous tissue varies greatly from individual to individual. Beneath the subcutaneous tissue lie the muscles and the skeleton. The subcutaneous layer helps to anchor the skin to the structures below. As you age, the loss of the subcutaneous layer causes the skin to have limited support, forming wrinkles in the skin.

The skin covers the entire external surface of the body. The various orifices (openings to the body)—including the mouth, nose, anus, and vagina—are not covered by skin. Orifices are lined with mucous membranes. **Mucous membranes** are quite similar to skin in that they provide a protective barrier against bacterial invasion. Mucous membranes differ from skin in that they secrete **mucus**, a watery substance that lubricates the openings. Thus, mucous membranes are moist, whereas the skin is dry. A mucous membrane lines the entire gastrointestinal tract from the mouth to the anus.

The Integumentary System (Skin): Physiology

The skin, the largest single organ in the body, serves three major functions: to protect the body in the environment, to regulate the temperature of the body, and to transmit information from the environment to the brain.

The protective functions of the skin are numerous. Water makes up a large portion of the body. This water contains a delicate balance of chemical substances in solution. The skin is watertight and serves to keep this balanced internal solution intact. The skin also protects the body from the invasion of infectious organisms: bacteria, viruses, and fungi. These organisms are everywhere and are routinely found lying on the skin surface. However, they never penetrate the skin unless it is broken by injury; thus, the skin provides a constant protection against outside invaders.

The major organ for regulation of body temperature is the skin. Blood vessels in the skin constrict when the body is in a cold environment and dilate when the body is in a warm environment. In a cold environment, constriction of the blood vessels shunts the blood away from the skin to decrease the amount of heat radiated from the body surface. When the outside environment is hot, the vessels in the skin dilate, the skin becomes flushed or red, and heat radiates from the body surface.

Also, in a hot environment, sweat is secreted to the skin surface from the sweat glands. Evaporation of the sweat requires energy. This energy, as body heat, is taken from the body during the evaporation process, which causes the body temperature to fall. Sweating alone will not reduce body temperature; evaporation of the sweat must also occur.

Information from the environment is carried to the brain through a rich supply of sensory nerves that originate in the skin. Nerve endings that lie in the skin are adapted to perceive and transmit information about heat, cold, external pressure, pain, and the position of the body in space. The skin thus recognizes any changes in the environment. The skin also reacts to pressure, pain, and pleasurable stimuli.

The Digestive System: Anatomy

The digestive system, also called the gastrointestinal system, is composed of the gastrointestinal tract (stomach and intestines), mouth, salivary glands, pharynx, esophagus, liver, gallbladder, pancreas, rectum, and anus. The function of this system is **digestion**: the processing of food that nourishes the individual cells of the body. The organs of this system are found within the abdomen.

The Abdomen

The **abdomen** is the second major body cavity; it contains the major organs of digestion and excretion. The diaphragm separates the thorax from the abdominal cavity. Anteriorly and posteriorly, thick muscular abdominal walls create the boundaries of this space. Inferiorly, the abdomen is separated from the pelvis by an imaginary plane that extends from the pubic symphysis through the sacrum Figure 6-37. Some organs lie in the abdomen and the pelvis, depending on the posture of the patient.

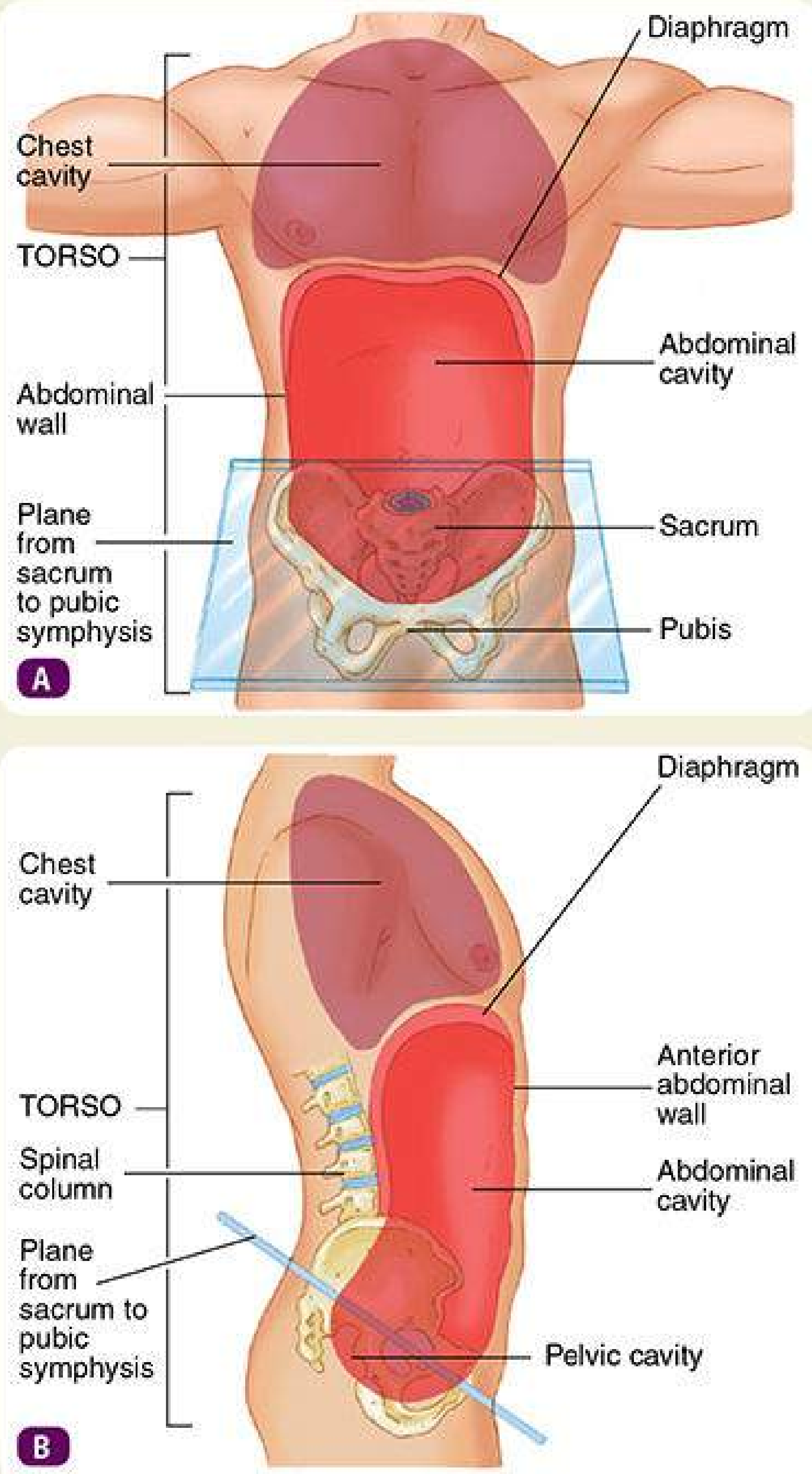


Figure 6-37 The boundaries of the abdomen are the anterior and posterior abdominal cavity walls, the diaphragm, and an imaginary plane from the pubic symphysis to the sacrum. The region below the plane is called the pelvic cavity. **A.** Anterior view. **B.** Lateral view.

The simplest and most common method of describing the portions of the abdomen is by quadrants, the four equal areas formed by two imaginary lines that intersect at right angles at the umbilicus. On the anterior abdominal wall, the quadrants thus formed are the right upper, right lower, left upper, and left lower **Figure 6-38**. “Right quadrant” and “left quadrant” refer to the patient’s right and left. Pain or injury in a given quadrant usually arises from or involves the organs that lie in that quadrant. This simple means of designation will allow you to identify injured or diseased organs that require emergency attention.

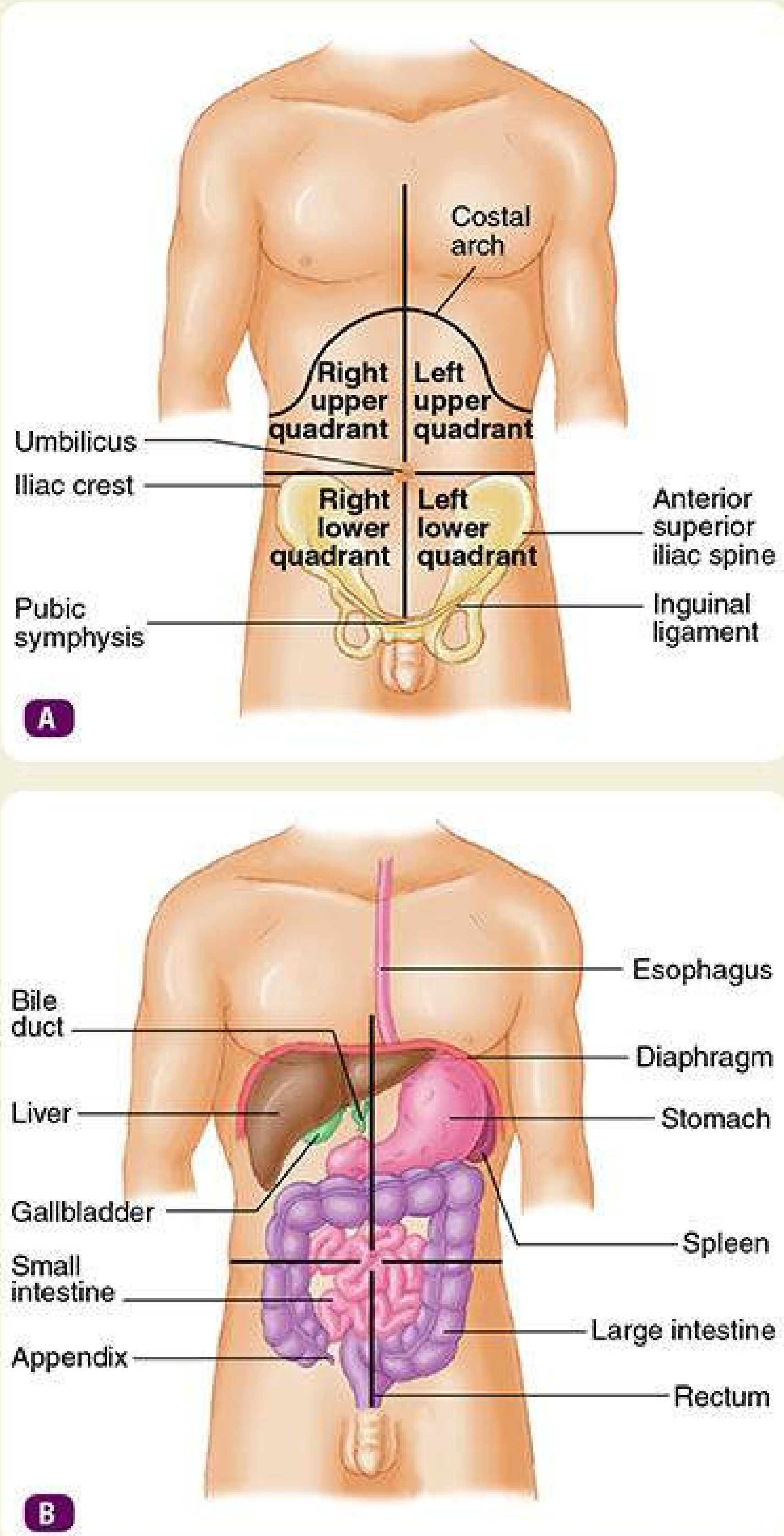


Figure 6-38 **A.** In the abdomen, quadrants are the easiest system for identifying areas. Major bony landmarks are also shown. **B.** Several of the organs in the abdomen lie in more than one quadrant.

Organs and Vascular Structures

In the right upper quadrant (RUQ), the major organs are the liver, the gallbladder, and a portion of the colon. Most of the liver lies in this quadrant, almost entirely under the protection of the 8th to 12th ribs. The liver fills the entire anteroposterior depth of the abdomen in this quadrant. Therefore, injuries in this area are frequently associated with injuries of the liver.

In the left upper quadrant (LUQ), the major organs are the stomach, the spleen, and a portion of the colon. The spleen is almost entirely under the protection of the left rib cage, whereas the stomach may sag well down into the left lower quadrant when full. The spleen lies in the lateral and posterior portion of this quadrant, under the diaphragm and immediately in front of the 9th to 11th ribs. The spleen is frequently injured, especially when these ribs are fractured.

The right lower quadrant (RLQ) contains two portions of the large intestine: the **cecum**, the first portion into which the small intestine (ileum) opens, and the ascending colon. The **appendix** is a small, tubular structure that is attached to the lower border of the cecum. In the left lower quadrant (LLQ) lie the descending and the sigmoid portions of the colon.

Several organs lie in more than one quadrant. The small intestine, for instance, occupies the central part of the abdomen around the umbilicus, and parts of it lie in all four quadrants. The pancreas lies just behind the abdominal cavity on the posterior abdominal wall in both upper quadrants. The large intestine also traverses the abdomen, beginning in the RLQ and ending in the LLQ as it passes through all four quadrants. The urinary bladder lies just behind the pubic symphysis in the middle of the abdomen and, therefore, lies in both lower quadrants and also in the pelvis.

The kidneys and pancreas are called **retroperitoneal** organs because they lie behind the abdominal cavity **Figure 6-39**. They are above the level of the umbilicus, extending from the 11th rib to the 3rd lumbar vertebra on each side. The kidneys are approximately 5 inches (13 cm) long and lie just anterior to the costovertebral angle.

Mouth

The mouth consists of the lips, cheeks, gums, teeth, and tongue. A mucous membrane lines the mouth. The roof of the mouth is formed by the hard and soft palates. The hard palate is a bony plate lying anteriorly; the soft palate is a fold of mucous membrane and muscle that extends posteriorly from the hard palate into the throat. The soft palate is designed to hold food that is being chewed within the mouth and to help initiate swallowing.

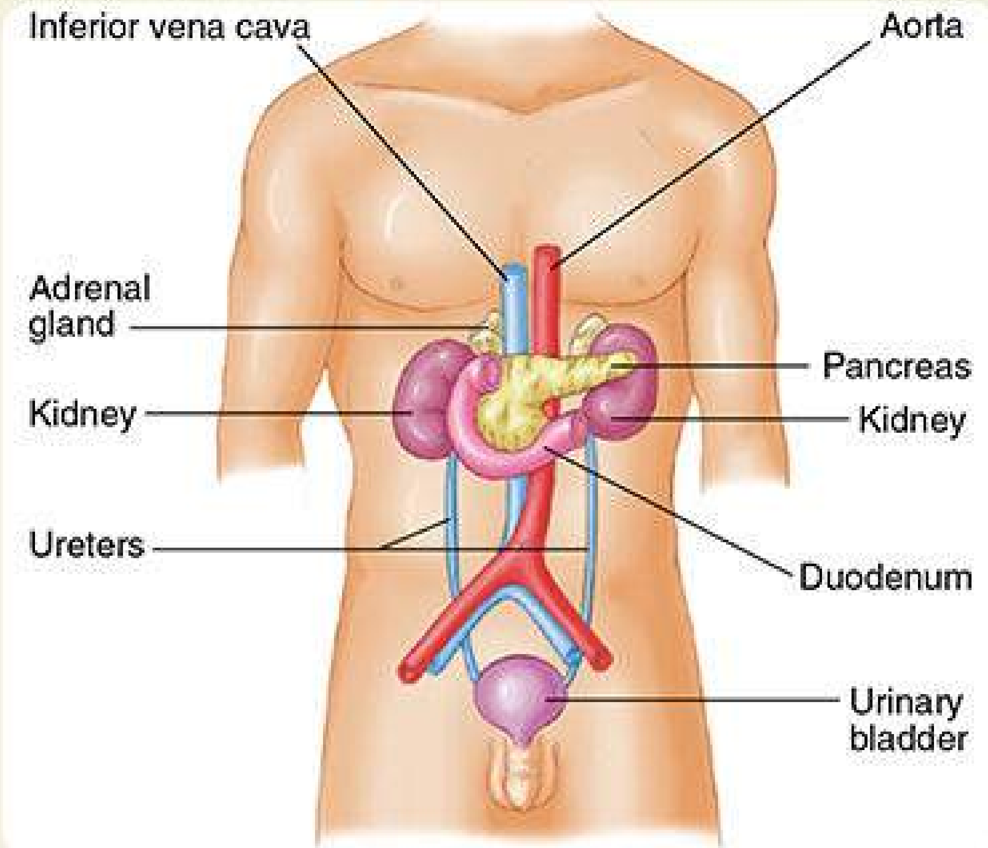


Figure 6-39 The major organs of the retroperitoneal space lie behind the abdominal cavity, above the level of the umbilicus, and extend from the 11th rib to the 3rd lumbar vertebra. The bladder, inferior vena cava, and aorta also lie in this space.

Salivary Glands

There are two sets of salivary glands, one set on each side of the mouth under the tongue, and the other set in front of each ear. They produce nearly 1.5 L of saliva daily. Saliva is approximately 98% water. The remaining 2% is composed of mucus, salts, and organic compounds. Saliva serves as a binder for the chewed food that is being swallowed and as a lubricant within the mouth. Saliva also contains certain digestive enzymes.

▶ Oropharynx

The oropharynx is a tubular structure that extends vertically from the back of the mouth to the esophagus and trachea. An automatic movement of the pharynx during swallowing lifts the larynx to permit the epiglottis to close over it so that liquids and solids are moved into the esophagus and away from the trachea.

▶ Esophagus

The esophagus is a collapsible tube about 10 inches (25 cm) long that extends from the end of the pharynx to the stomach and lies just anterior to the spinal column in the chest. Contractions of the muscle in the wall of the esophagus propel food through it to the stomach. Liquids pass with very little assistance.

Stomach

The stomach is a hollow organ located in the left upper quadrant of the abdominal cavity, largely protected by the lower left ribs. Muscular contractions in the wall of the stomach and gastric juice, which contains a lot of mucus, convert ingested food to a thoroughly mixed semisolid mass, called **chyme**. The stomach produces approximately 1.5 L of gastric juice daily for this process. The primary function of the stomach is to receive food in large quantities intermittently, store it, and provide for its movement into the small bowel in regular, small amounts. In 1 to 3 hours, the semisolid food mass derived from one meal is propelled by muscular contraction into the duodenum, the first part of the small intestine.

Pancreas

The **pancreas**, a flat, solid organ, lies below and behind the liver and stomach and behind the peritoneum. It is firmly fixed in position, deep within the abdomen, and is not easily damaged. It contains two kinds of glands, and the two portions of the pancreas are intertwined. One portion is exocrine, and it secretes nearly 2 L of pancreatic juice daily. This juice contains many enzymes that aid in the digestion of fat, starch, and protein. Pancreatic juice flows directly into the duodenum through the pancreatic ducts. The other portion of the gland—the islets of Langerhans—is endocrine. These are where insulin and glucagon (hormones) are produced. Insulin and glucagon regulate the amount of glucose in the blood.

Liver

The **liver** is a large, solid organ that takes up most of the area immediately beneath the diaphragm in the right upper quadrant and also extends into the left upper quadrant. It is the largest solid organ in the abdomen and has several functions. Poisonous substances produced by digestion are brought to the liver and rendered harmless. Factors that are necessary for blood clotting and for the production of normal plasma are formed here. Between 0.5 and 1 L of bile is made by the liver daily to assist in the normal digestion of fat. The liver is the primary organ for the storage of sugar or starch for immediate use by the body for energy. It also produces many of the factors that aid in the proper regulation of immune responses. Anatomically, the liver is a large mass of blood vessels and cells, packed tightly together. It is fragile and, because of its size, relatively easily injured. Blood flow in the liver is high, because all of the blood that is pumped to the gastrointestinal tract passes into the liver, through the portal vein, before it returns to the heart. In addition, the liver has a generous arterial blood supply of its own. Ordinarily, approximately 25% of the cardiac output of blood (1.5 L) passes through the liver each minute.

Bile Ducts

The liver is connected to the intestine by the **bile ducts**. The **gallbladder** is a small pouch extending from the bile ducts that serves as a reservoir and concentrating organ for bile produced in the liver. Together, the bile ducts and the gallbladder form the biliary system. The gallbladder discharges stored and concentrated bile into the duodenum through the common bile duct. The presence of food in the duodenum triggers a contraction of the gallbladder to empty it. The gallbladder usually contains about 60 to 90 mL of bile.

Small Intestine

The **small intestine** is the major hollow organ of the abdomen. The cells lining the small intestine produce enzymes and mucus to aid in digestion. Enzymes from the pancreas and the small intestine carry out the final processes of digestion. More than 90% of the products of digestion (amino acids, fatty acids, and simple sugars), together with water, ingested vitamins, and minerals, are absorbed across the wall of the lower end of the small intestine into veins to be transported to the liver. The small intestine is composed of the duodenum, the jejunum, and the ileum. The duodenum, which is about 12 inches (30 cm) long, is the part of the small intestine that receives food from the stomach. Here, food is mixed with secretions from the pancreas and liver for further digestion. Bile, produced by the liver and stored in the gallbladder, is emptied as needed into the duodenum. Bile is green-black, but through changes during digestion, it gives feces its typical brown color. Its major function is in the digestion of fat. The jejunum and ileum together measure more than 20 feet (6 m) on average to make up the rest of the small intestine.

Large Intestine

The **large intestine**, another major hollow organ, consists of the cecum, the colon, and the rectum. About 5 feet (1.5 m) long, it encircles the outer border of the abdomen around the small bowel. The major function of the colon, the portion of the large intestine that extends from the cecum to the rectum, is to absorb the final 5% to 10% of digested food and water from the intestine to form solid stool, which is stored in the rectum and passed out of the body through the anus.

Appendix

Recall that the appendix is a tube that opens into the cecum (the first part of the large intestine) in the right lower quadrant of the abdomen. It is 3 to 4 inches (8 to 10 cm) long and may easily become obstructed and, as a result, inflamed and infected. Appendicitis, which is the term for this inflammation, is one of the major causes of severe abdominal distress.

Rectum

The lowermost end of the colon is the **rectum**. It is a large, hollow organ that is adapted to store quantities of feces until it is expelled. At its terminal end is the anus, a 2-inch (5-cm) canal lined with skin. The rectum and anus are supplied with a complex series of circular muscles called sphincters that control, voluntarily and automatically, the escape of liquids, gases, and solids from the digestive tract. Table 6-11 provides a summary of the organs and functions of the digestive system.

Table 6-11 Digestive Organs and Functions

Organ/ Structure	Function
Mouth	Mechanically breaks down food; begins chemical breakdown with saliva
Esophagus	Moves food from the mouth to the stomach; muscular and vascular structure
Stomach	Performs mechanical and chemical breakdown of food: food in, chyme out
Small intestine: duodenum, jejunum, and ileum	Major site for chemical breakdown of food; major absorption of water, fats, proteins, carbohydrates, and vitamins
Large intestine	Water absorption; formation of feces; bacterial digestion of food
Anus/ rectum	Last portion of large intestine; sphincter to control release of feces
Liver	Production of bile; assists with carbohydrate, protein, and fat metabolism of nutrients within the bloodstream; manufactures proteins for immune regulation and clotting; detoxification of blood; elimination of waste
Pancreas	Exocrine: enzymes for protein, carbohydrate, and fat breakdown within the duodenum Endocrine: insulin and glucagon
Gallbladder	Storage of bile

The Digestive System: Physiology

Digestion of food, from the moment it is taken into the mouth until essential compounds are extracted and delivered by the circulatory system to nourish all of the cells in the body, is a complicated chemical process. In succession, different secretions, primarily **enzymes**, are added to the food by the salivary glands, the stomach, the liver, the pancreas, and the small intestine to convert the food into basic sugars, fatty acids, and amino acids. These basic products of digestion are carried across the wall of the intestine and transported through the portal vein to the liver. In the liver, the products are processed further and stored or transported to the heart through veins draining the liver. The heart then pumps the blood with these nutrients throughout the arteries to the capillaries, where the nutrients pass through the capillary walls to nourish the body's individual cells.

In normal routine activity, without any food or fluid ingestion at all, between 8 and 10 L of fluid is secreted daily into the gastrointestinal tract. This fluid comes from the salivary glands, stomach, liver, pancreas, and small intestine. In a healthy adult, about 7% of the body weight is delivered as fluid daily to the gastrointestinal tract. If significant vomiting or diarrhea occurs for more than 2 or 3 days, the person will experience a substantial loss of body composition and become severely ill.

The Lymphatic System: Anatomy and Physiology

The lymphatic system is composed of the spleen, lymph nodes, lymph, lymph vessels, thymus gland, and other components and supports the circulatory system and the immune system. Unlike the circulatory system, the lymphatic system has no pump and relies on muscle contractions and movements of the body for lymph to flow.

Lymph is a thin, straw-colored fluid that carries oxygen, nutrients, and hormones to the cells and waste products of metabolism away from the cells and back into the capillaries so that they may be excreted. Lymph vessels closely parallel the veins, forming a network throughout the body that serves as an auxiliary to the circulatory system. **Lymph nodes** are located in various places along the lymph vessels in the body. These tiny, oval-shaped structures filter lymph.

Together with the circulatory system, the lymphatic system helps to rid the body of toxins and other harmful materials.

The Endocrine System: Anatomy and Physiology

The brain controls the body through the nervous system, using electrical impulses, and the endocrine system, using hormones. The **endocrine system** is a complex message and control system that integrates many body functions. Endocrine glands release their hormones directly into the bloodstream **Figure 6-40**. Epinephrine, norepinephrine, and insulin are examples of hormones. Each endocrine gland produces one or more hormones. Each hormone has a specific effect on some organ, tissue, or process **Table 6-12**. The brain controls the release of hormones by the endocrine glands. **Hormones** can have a stimulating or an inhibiting effect on the body's organs and systems. For example, when you are frightened, your brain stimulates the adrenal gland through a hormone to release epinephrine and norepinephrine. This increases your blood pressure and heart rate. The resulting increase in blood pressure and heart rate decreases the amount of hormone released by the adrenal gland. The brain then reduces the amount of stimulation to the **adrenal glands**. Thus, a new steady state is achieved at heightened levels of alertness. This cycle is known as a feedback loop, and it helps keep the body's systems and functions in balance **Figure 6-41**.

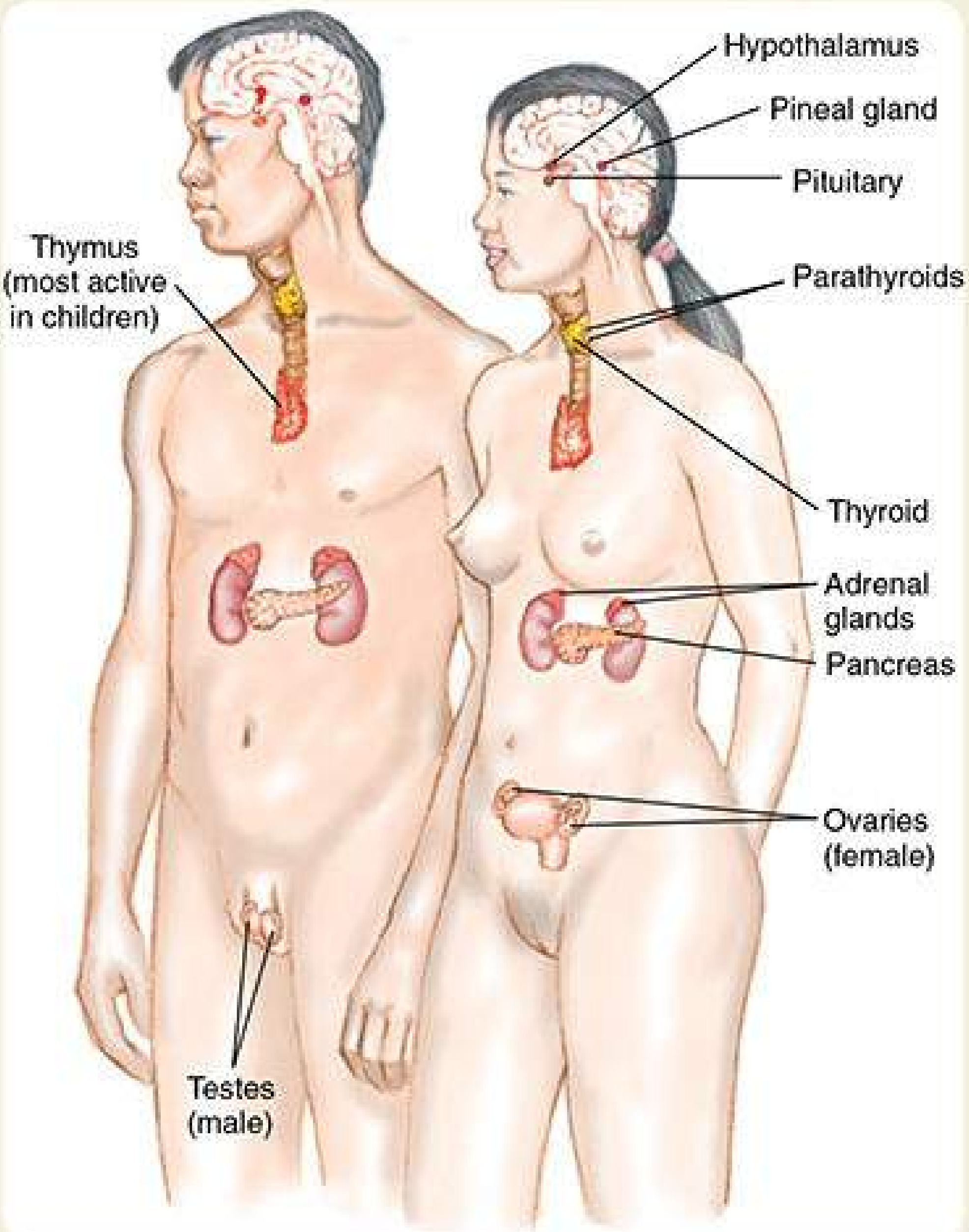


Figure 6-40 The endocrine system controls the production and release of hormones in the body.

Table 6-12 Endocrine Glands

Gland	Location	Function	Hormones Produced
Adrenal	Above the kidneys	Stress response, fight-or-flight reaction	Epinephrine, norepinephrine, cortisol, and others
Ovaries	Female pelvis (two glands)	Regulate sexual function, characteristics, and reproduction	Estrogen and others
Pancreas	Retroperitoneal space	Regulates glucose metabolism and other functions	Insulin, glucagon, and others
Parathyroid	Neck (behind and beside the thyroid) (three to five glands)	Regulates serum calcium	Parathyroid hormone
Pituitary	Base of skull	Regulates all other endocrine glands	Multiple, controls other endocrine glands
Testes	Male scrotum (two glands)	Regulate sexual function, characteristics, and reproduction	Testosterone and others
Thyroid	Neck (over the larynx)	Regulates metabolism	Thyroxine and others

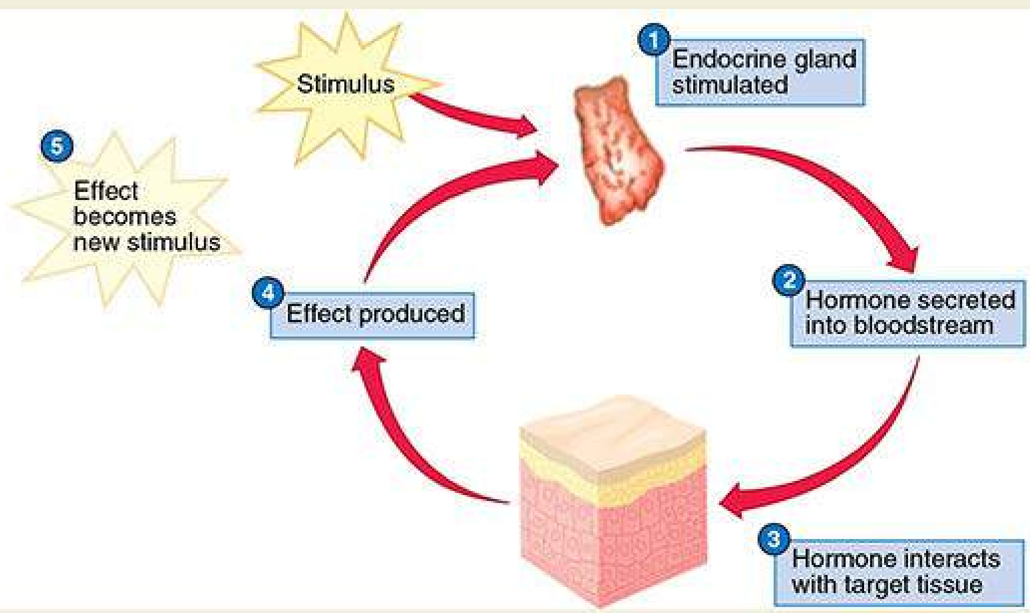


Figure 6-41 The endocrine system is tightly controlled with primary and secondary feedback loops to keep body systems in balance.

Excesses or deficiencies in hormone levels cause various diseases. With endocrine diseases, specific body functions are increased, decreased, or absent. Diabetes mellitus is a common condition. Because production of the hormone insulin is deficient, the body is unable to use glucose normally. Glucose is the primary fuel of the body. Insulin is responsible for rapidly moving glucose into cells; without insulin, glucose moves slowly. This creates a series of complications as the body struggles to find a more readily available fuel for its cells. People with diabetes begin to burn fats and proteins to create the glucose that cells are craving. Interestingly, the end result is higher and higher blood glucose levels as glucose accumulates, unable to be moved efficiently into the cells. Chapter 19, *Endocrine and Hematologic Emergencies*, discusses how high blood glucose levels affect the body.

The Urinary System: Anatomy and Physiology

The **urinary system** controls the discharge of certain waste materials filtered from the blood by the kidneys. In the urinary system, the kidneys are solid organs; the ureters, bladder, and urethra are hollow organs **Figure 6-42**. The main functions of the urinary system are: (1) to control fluid balance in the body, (2) to filter and eliminate wastes, and (3) to control pH balance.

The body has two **kidneys** that lie on the posterior muscular wall of the abdomen behind the peritoneum in the retroperitoneal space. These organs rid the blood of toxic waste products and control its balance of water and salt. Blood flow in the kidneys is high. Nearly 20% of the output of blood from the heart passes through the kidneys each minute. Large vessels attach the kidneys directly to the aorta and the inferior vena cava. Waste products and water are constantly filtered from the blood to form urine. The kidneys continuously concentrate this filtered urine by reabsorbing the water as it passes through a system of specialized tubes within them. The tubes finally unite to form the **renal pelvis**, a cone-shaped area that collects urine from the kidneys and funnels it through the ureter into the bladder. Normally, each kidney drains its urine into one ureter through which the urine passes to the bladder.

A **ureter** passes from the renal pelvis of each kidney along the surface of the posterior abdominal wall behind the peritoneum to drain into the urinary bladder. The ureters are small (0.2 inches [0.5 cm] in diameter), hollow, muscular tubes. **Peristalsis**, a wavelike contraction of smooth muscle, occurs in these tubes to move the urine to the bladder.

The **urinary bladder** is located immediately behind the pubic symphysis in the pelvic cavity and is composed of smooth muscle with a specialized lining membrane. The two ureters enter posteriorly at its base on either side. The bladder empties to the outside of the body through the **urethra**. In the man, the urethra passes from the anterior base of the bladder through the penis. In the woman, the urethra opens in front of the vagina. A healthy adult forms 1.5 to 2 L of urine every day. This waste is extracted and concentrated from the 1,500 L of blood that circulates through the kidneys daily.

YOU are the Provider — PART 5

Shortly before arriving at the hospital, you reassess the patient. He remains conscious and alert and tells you that his pain is less severe than before. After transferring patient care to the attending physician, you later learn that the patient had an inflamed gallbladder, which was surgically removed.

Recording Time: 20 Minutes	
Level of consciousness	Conscious and alert
Respirations	20 breaths/min; adequate depth
Pulse	90 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	132/80 mm Hg
Spo_2	99% (on oxygen)

6. Should your documentation of an EMS call differ from your verbal communication with other health care professionals? Why or why not?

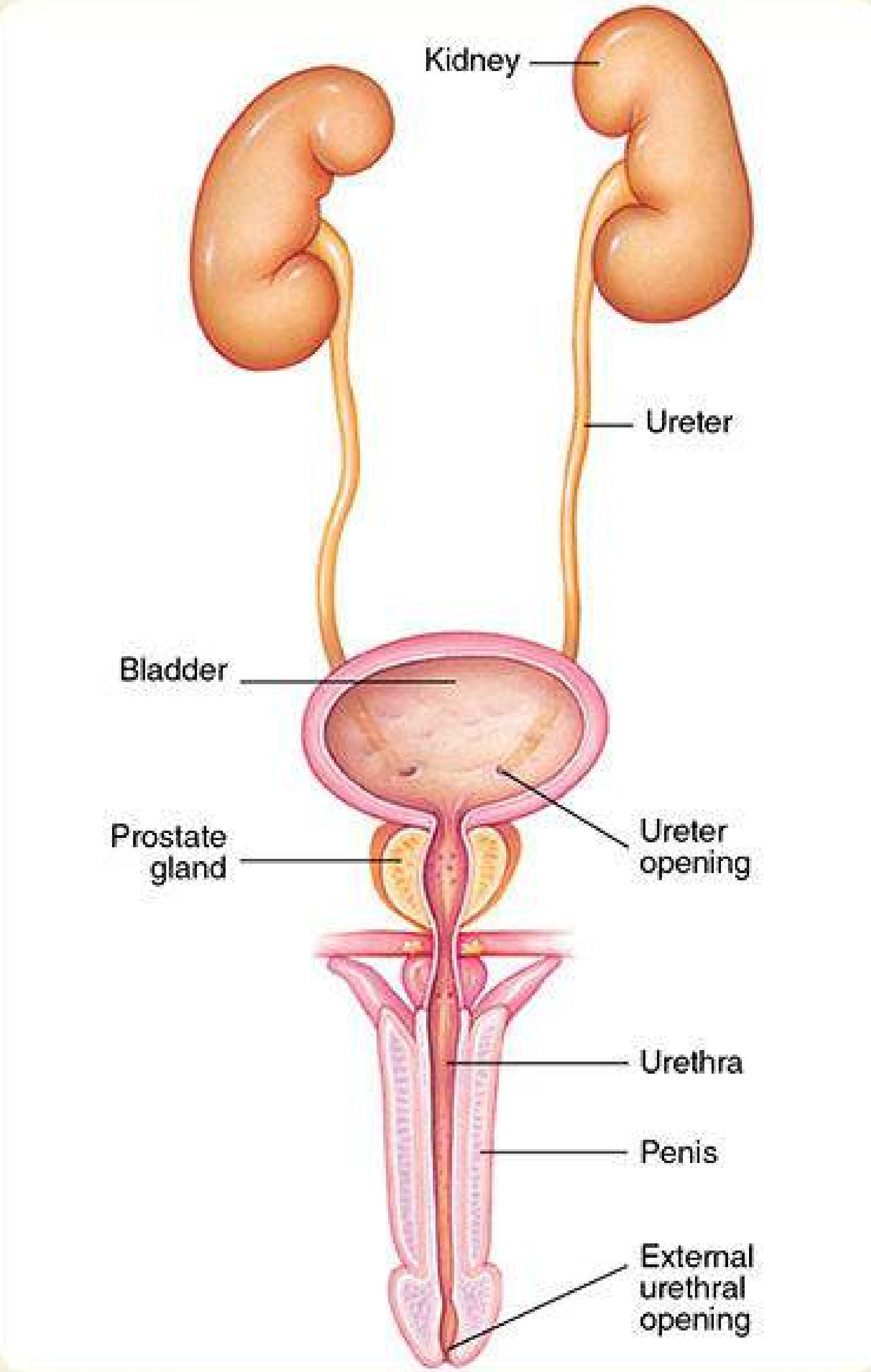


Figure 6-42 The urinary system lies in the retroperitoneal (behind the peritoneum) space behind the organs of the digestive system. The urinary system in men and women includes the kidneys, ureters, bladder, and urethra. This diagram shows the male urinary system.

The Genital System: Anatomy and Physiology

The **genital system** controls the reproductive processes by which life is created. The male genitalia, except for the **prostate gland** and the **seminal vesicles**, lie outside the pelvic cavity. The female genitalia, with the exception of the clitoris and labia, are contained entirely within the pelvis. The male and female reproductive organs have certain similarities and, of course, basic differences. They produce sperm and egg cells and reproductive hormones and play a significant role in sexual intercourse and reproduction.

The Male Reproductive System and Organs

The male reproductive system consists of the testicles, epididymis, vasa deferentia, prostate gland, seminal vesicles, and penis **Figure 6-43**. Each **testicle** contains specialized cells and ducts; some of these produce male hormones, and others develop sperm. The hormones are absorbed directly into the bloodstream from the testicles. The sperm are immature and are moved from the testicles to the epididymis so they can develop. During ejaculation, the sperm are carried through **vasa deferentia** (or vas deferens) to the urethra. Finally, the sperm are deposited by the penis.

The function of the reproductive system is to reproduce. Sperm are able to join with an egg to begin the process of life. In addition to reproduction, this system is also responsible for the production of sex hormones. Many of the physical characteristics of men, such as increased muscle mass, body hair, and deep voice, are attributed to the powerful effects of the hormones released by the testes. Finally, the penis, though part of the reproductive system, is also part of the urinary system. Any damage or infection to the penis can cause problems within the urinary bladder and/or the kidneys.

The Female Reproductive System and Organs

The female reproductive organs include the ovaries, fallopian tubes, uterus, cervix, and vagina **Figure 6-44**. The **ovaries**, like the testicles, produce sex hormones and specialized cells for reproduction. The female sex hormones are absorbed directly into the bloodstream. A specialized ovum, or egg cell, matures and is released regularly during the adult woman's reproductive years. The ovaries release a mature egg approximately every 28 days. This egg travels through the fallopian tubes where fertilization normally occurs. The fallopian tubes exit into the uterus.

The **fallopian tubes** connect with the uterus and carry the ovum into the cavity of this organ. The uterus is pear-shaped and hollow, with muscular walls. The narrow opening from the uterus to the vagina is the cervix. The **vagina** (birth canal) is a muscular, distensible tube that connects the uterus with the vulva (the external female genitalia). The vagina receives the penis during sexual intercourse, when **semen** is deposited in it. The sperm in the semen may pass into the uterus and fertilize an egg, causing pregnancy. Should the pregnancy come to completion at about 40 weeks, the neonate will pass through the vagina and be born. The vagina also channels the menstrual flow from the uterus out of the body.

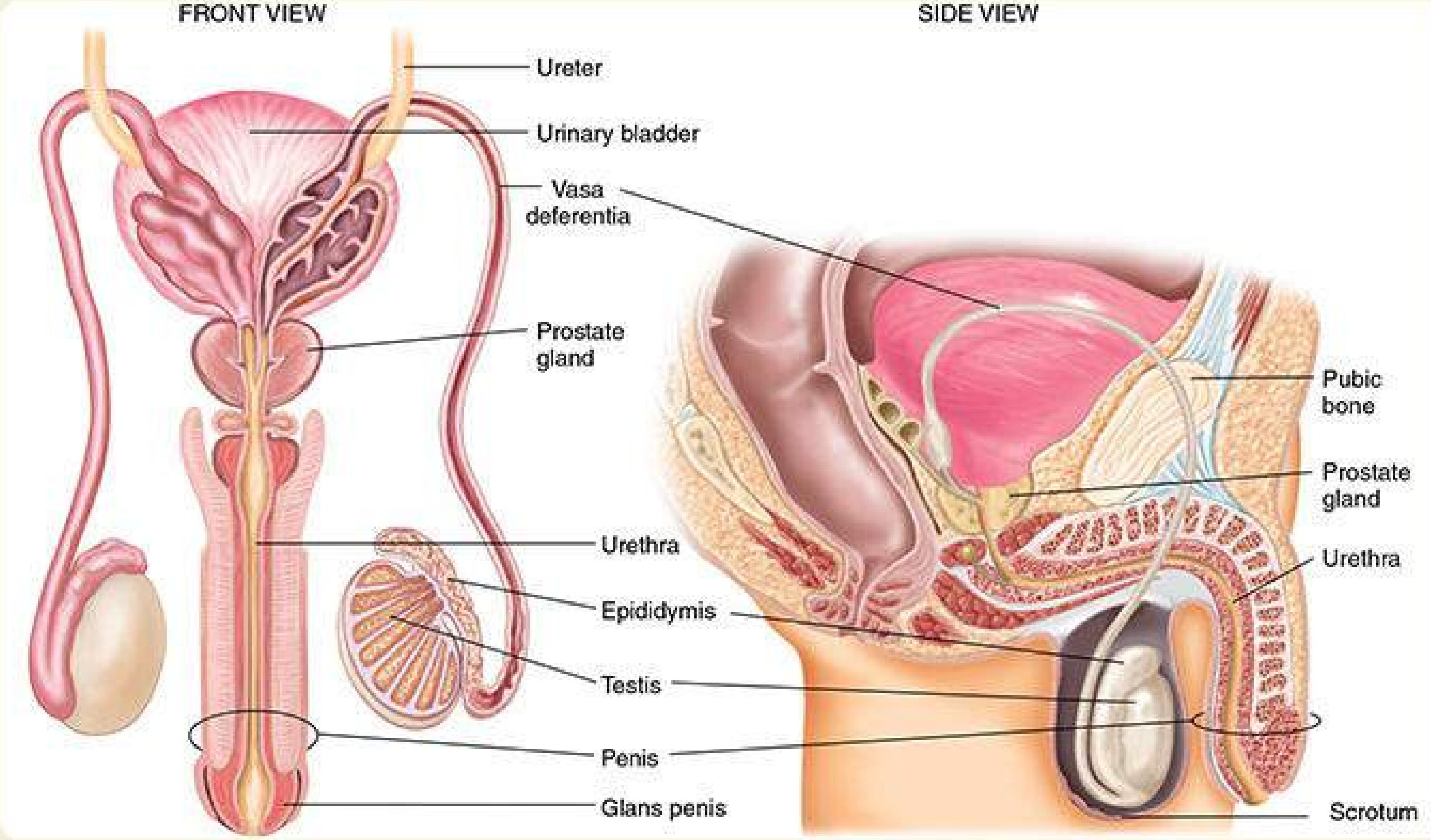


Figure 6-43 The male reproductive system consists of the testicles, epididymis, vasa deferentia, prostate gland, seminal vesicles, and penis.

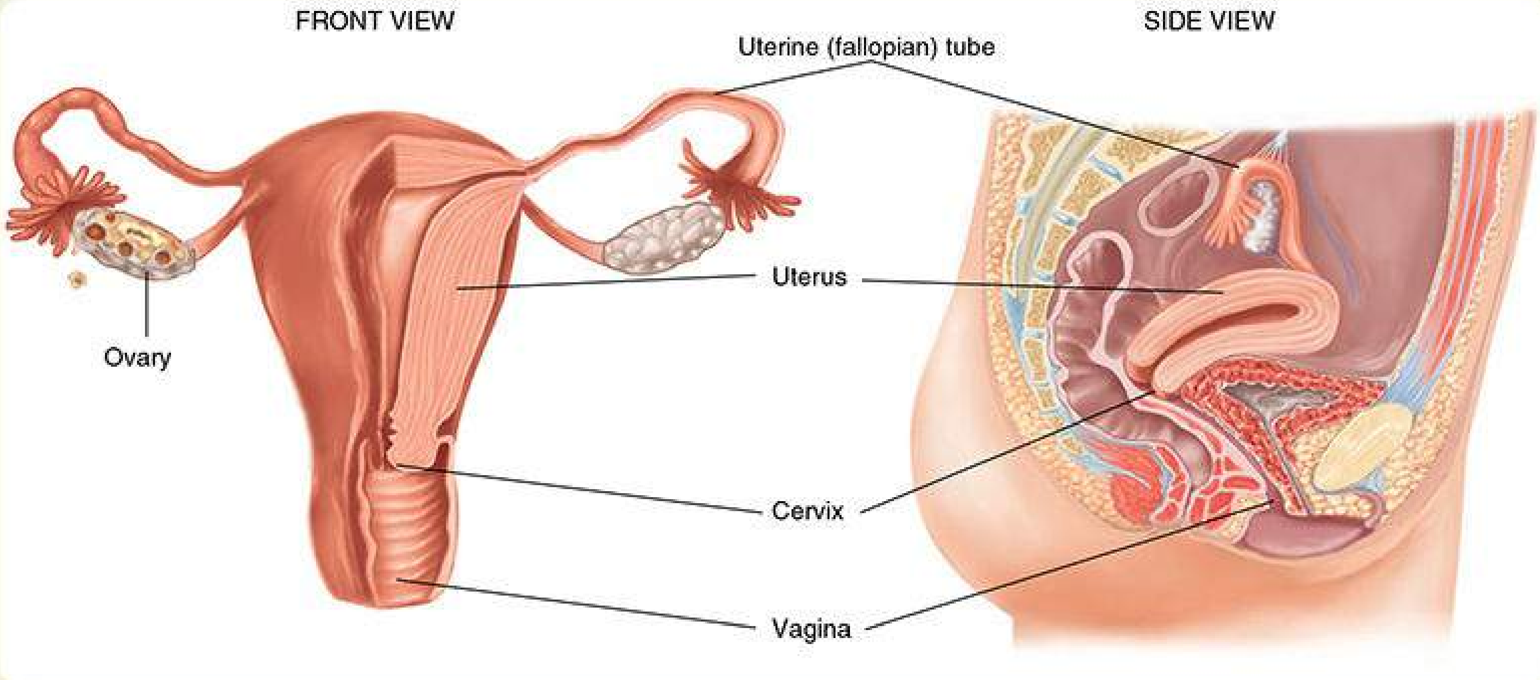


Figure 6-44 The female reproductive system consists of the ovaries, fallopian tubes, uterus, cervix, and vagina.

The functions of the female reproductive system are similar to those of the male reproductive system: reproduction and hormone balance. Urination occurs through the urethra, which in women is not interconnected to the reproductive tract. In men, the urethra is interconnected.

Life Support Chain

You have learned that all functions of the human body depend on a continuous, adequate supply of oxygen to the cells. Cells are the foundation of the human body. Billions of cells compose the human body. Some cells make hair, other cells are involved in storing memory, and others help to move your eyes as you read this page. Cells with a common job grow close to each other and form tissues. Groups of tissues that perform similar or interrelated jobs form organs. A series of organs with similar jobs make up the body systems discussed in this chapter.

The body's cells, tissues, and organs, regardless of their function, all require oxygen, nutrients, and the removal of wastes to perform their job. Oxygen is brought to the cells through the respiratory and circulatory systems. Nutrients are made available to the body after you eat. The digestive system takes the food you eat and breaks it down into, among other things, glucose. The circulatory system is the carrier of these supplies and wastes through the process of perfusion. If interference occurs in this delivery system, cells will become damaged or die.

Cells use oxygen to take available nutrients and turn them into chemical energy through the biochemical process of **metabolism (cellular respiration)**. **Adenosine triphosphate (ATP)** is involved in energy metabolism and is used to store energy. Cells prefer to operate using oxygen because it provides the cells with 15 times as much ATP as when they operate without oxygen. The process that uses oxygen is called aerobic (meaning with air) metabolism. When you perform an activity over a long period of time, such as running a marathon, your body is using anaerobic metabolism. The waste products of **aerobic metabolism** are carbon dioxide and water. Some cells have become so specialized that they are unable to survive without constant supplies of oxygen; for example, the brain and heart. Without oxygen, brain cells will begin to die within 4 to 6 minutes.

Most cells in the body are able to continue to function, even without oxygen. This anaerobic (without air) state allows cells to operate despite a lack of available oxygen. When illness or injury occurs, the body needs to shift available resources to areas in need while ensuring that critical areas, such as the brain and heart, have an uninterrupted supply of resources. Any time that available oxygen is limited to portions of the body, cells will switch to **anaerobic metabolism**. When you perform a short-term, high-intensity activity such as lifting weights, your body is using anaerobic metabolism. In this state, very limited amounts of energy are able to be released so the body must quickly correct the oxygen deficiency or risk cellular death. The most well-known by-product of anaerobic metabolism is lactic acid, which is the material that causes muscle burning during anaerobic exercise. **Lactic acid** is converted back to a useful energy source once oxygen is available. Anaerobic metabolism can be supported in most cells for only 1 to 3 minutes.

Words of Wisdom

Remember

- When cells function with oxygen, they use aerobic metabolism.
  - They generate large amounts of ATP (cellular energy) and produce wastes of carbon dioxide and water.
- When cells function without oxygen, they use anaerobic metabolism.
  - They generate small amounts of ATP (cellular energy) and produce waste of lactic acid.

All of this movement of material—oxygen, waste, nutrients—how does it happen? The main force moving these elements is diffusion. Recall that when you breathe, oxygen moves from an area of higher concentration to one of lower concentration.

Cells are surrounded by fluid that allows for easy movement of nutrients and wastes. A physical property of this fluid that is a critical factor to cell survival is pH, which is the measure of acidity or alkalinity in a solution. Solutions that are high in pH (>7.0) are considered alkaline. A common example is soap. Solutions that are low in pH (<7.0) are considered acidic. Sulfuric acid in automotive batteries is one example. A solution that is neither acidic nor alkaline is considered neutral (pH 7.0). The body's cells want to exist in a near-neutral environment.

Your body spends a large amount of energy working to maintain a normal pH (normal human pH is 7.35 to 7.45). The waste products of cells are often acidic, such as carbon dioxide. Carbon dioxide is transported by combining with water to create carbonic acid, which is more soluble in the plasma. The plasma also contains sodium bicarbonate, which is alkaline and helps to buffer or neutralize the acidic waste products of cells.

The blood and lungs interact continuously to help to maintain the pH level in the body by controlling the level of carbon dioxide, and therefore the level of carbonic acid, in the blood. If the blood becomes acidic, the respiratory centers in the brain stem will increase breathing to blow off more carbon dioxide. If too much carbon dioxide is blown off, then the body can become too alkaline, which is what happens during hyperventilation.

Pathophysiology

Pathophysiology is the study of how normal physiologic processes are affected by disease. Many diseases can occur in patients and will result in calls to EMS. Some examples are diabetes (a disease of the pancreas), pneumonia (a disease of the lungs), and stroke (resulting from disease of the brain). Pathophysiologic changes that occur with specific diseases and trauma are discussed in the chapters of Section 6, *Medical* and Section 7, *Trauma*.

Respiratory compromise and shock are two common emergencies that you will likely encounter in your work as an EMT. This section provides an overview of respiratory compromise, shock, and alteration of cell metabolism as background for how the body responds to disease or injury.

Respiratory Compromise

Respiratory compromise is the inability of the body to move gas effectively, which can result in a decreased level of oxygen in the body (hypoxia), an elevated level of carbon dioxide in the body (hypercarbia), or both. Recall the two concepts of breathing: ventilation and respiration. Ventilation is the movement of air between the lungs and environment, while respiration is the process of gas exchange. Respiratory compromise results when one of these functions is impaired.

Factors That Impair Ventilation

The ability to move gas back and forth can be impaired in a variety of ways. A blocked airway is one example. If a person chokes on what he or she is eating, this will partially or completely block the movement of air through the trachea. The airway can also be blocked by foreign bodies (eg, toys, or broken teeth), swelling in the airway, trauma to the mouth or neck, and swallowing blood or vomitus. The most common airway obstruction is blockage by the tongue. When a person is unconscious, the tongue relaxes and sags posteriorly in the mouth. The patient cannot "swallow his tongue," but the relaxed tongue blocks the opening to the trachea. Fortunately, the airway can be easily opened with manual techniques that will be discussed in later chapters.

Impairment of the muscles of breathing will impair the movement of gas. Neuromuscular diseases, such as cerebral palsy, can interfere with the ability of the brain to send signals to the diaphragm. Trauma can injure the phrenic nerve (the nerve that signals the diaphragm to contract and initiate inspiration) or damage the brain stem. If a patient's level of consciousness is too low, ventilatory problems can occur. This means that any condition that results in a loss of consciousness can have a direct effect on ventilation. For example, a soccer player who is unconscious after being struck in the head during a match may have impaired ventilation.

Ventilation can also be impaired when the airway is obstructed physiologically; for example, during an asthma attack. Early in an asthma attack, hyperventilation results in a decrease in the amount of carbon dioxide in the blood. As the patient fatigues, the level of carbon dioxide increases. Contraction of muscles surrounding the lower airways prevents effective ventilation.

Ventilation can also be impaired by numerous other factors including drug overdose (which depresses the central nervous system), trauma to the chest wall, and allergic reactions. These are discussed in their respective chapters in greater detail.

Factors That Impair Respiration

Impairment of respiration (movement of gas at the cellular level) can also cause respiratory compromise.

A change in the atmosphere can interfere with a person's ability to breathe. The air you breathe is 21% oxygen, and the air you exhale is 16% oxygen. This means there is only a 5% margin of safety for oxygen concentration in the air you breathe. In certain situations—for example, in a fire—oxygen is displaced by another gas. When there is insufficient oxygen in the air, insufficient oxygen is inhaled. That means there is less oxygen in the alveoli to diffuse into the blood that passes by the lungs. If the cells of the body do not have enough oxygen delivered to them, they will not be able to function normally.

Respiration can also be impaired at high altitudes. At high altitudes, gas pressures change. The low atmospheric pressure of oxygen at high altitudes can impair oxygen movement into the blood.

Words of Wisdom

There are two ways to express the amount of oxygen in the air: as a straight percentage or as a fraction of the inspired oxygen (FIO_2). FIO_2 is expressed as the decimal equivalent of the percentage of oxygen being delivered. Therefore, since oxygen makes up 21% of ambient room air, the FIO_2 of ambient room air is 0.21. The oxygen from a nonrebreathing mask at 15 L/min is approximately 90%, therefore the FIO_2 of the air from a nonrebreathing mask at 15 L/min is approximately 0.9.

Another way respiration can become compromised occurs when movement of the gas across the cell membrane is impaired. If the patient has fluid in the alveoli, this fluid may prevent or hinder gas exchange. In pneumonia, mucus and pus form a barrier, preventing gas from accessing the alveoli. If the interstitial space (space between the cells in the lungs) is filled with fluid, this edema increases the distance from the capillary to the air in the alveoli. Because of the increased distance, it will take longer for the gas to move from inside the alveoli to inside the capillary. If one of the blood vessels bringing blood to the lungs is clogged, this will also affect the amount of gas that diffuses into and out of the blood.

Ventilation/Perfusion Mismatch

One way to understand respiratory compromise is the ventilation/perfusion ratio. This measurement, also called the **$\dot{V}/\dot{Q}$ ratio**, describes how much gas is being moved effectively (ventilation) through the lungs and how much blood is flowing around the alveoli where gas exchange (perfusion) occurs. A mismatch occurs when one of those two variables is abnormal.

For example, in a patient with pulmonary embolism, a blood clot breaks off from a large vein and creates a sudden clog in one of the branches of the pulmonary arteries, preventing blood flow to the alveoli in the lung. Part of the circulating blood does not receive air, and, therefore, gas is not exchanged. Therefore, the "Q" portion of the $\dot{V}/\dot{Q}$ ratio is abnormal.

Another example is pulmonary edema, in which gas is unable to move effectively through the alveoli into the lung. Due to fluid (edema) buildup in the lungs, blood passing through the lung does not get air exchange because there is no ventilation occurring in that portion of the lung. Therefore the "V" portion of the $\dot{V}/\dot{Q}$ ratio is impacted.

When either the "V" or the "Q" is impacted, respiratory compromise can occur.

Effects of Respiratory Compromise on the Body

Regardless of the cause of impaired ventilation or respiration, the overall effect of respiratory compromise is the same.

- Oxygen levels throughout the body fall and carbon dioxide levels rise.
- The brain detects an increase in carbon dioxide levels.

- The body increases its respiratory rate in an attempt to return the carbon dioxide levels to normal.
- If increased respiration does not occur or is not effective in returning the carbon dioxide levels to normal, the blood will become more acidic.
- Similarly, blood oxygen levels will begin to fall. This will cause the brain to issue further commands to breathe.

Decreased oxygen levels will force cells to move from aerobic metabolism to anaerobic metabolism. Remember, the heart and brain cells cannot survive without a constant supply of oxygen and will die in minutes. Anaerobic metabolism generates a fraction of the needed energy, and cellular functions will be impaired. Recall that a by-product of anaerobic metabolism is lactic acid. If too much of this acid is created, the pH of the blood will drop further. If the pH becomes too low, cells will die.

If respiratory compromise is mild and gradual, the body can adapt. Anaerobic metabolism that is severe or lasts more than 1 to 3 minutes can overwhelm the body's ability to adapt; if left untreated, it can exhaust the body's energy supplies and the patient may die Table 6-13.

Shock

Recall that shock (hypoperfusion) is a condition in which organs and tissue receive an inadequate flow of blood and oxygen, or perfusion. It can occur due to inadequacy of the central circulation (insufficient blood volume, or a heart that does not pump effectively) or of the peripheral circulation (inability of the body to control the size of the blood vessels).

Oxygen delivery is directly related to the concentration of blood cells within the blood (hemoglobin concentration), the amount of oxygen being carried by the blood (oxygen saturation), and the pumping ability of the heart (cardiac output). Impairment in any one of these three areas will lead to impaired oxygen delivery and shock.

Table 6-13 Summary of Respiratory Compromise

Category	Problem	Effect
Ventilation	Damage to the regulatory centers of the brain Inability to exhale effectively Inability to inhale effectively Injury to chest Obstruction of the airway Overdose/toxic exposure Loss of consciousness Weakened respiratory muscles	Erratic breathing pattern and rate Carbon dioxide builds up in blood Oxygen levels in the blood decrease Breathing depth decreases Decreased or absent movement of air Decreased level of consciousness leading to decreased breathing rate and depth Breathing depth decreases Breathing depth decreases
Respiration	Fluid within the alveoli (pulmonary edema) Mucus or infectious wastes Impaired blood flow to the lungs (pulmonary embolism)	Prevents gas from entering the alveoli Prevent gas from entering the alveoli Affects blood flow to lung tissue where gas exchange occurs
Oxygenation	Decreased oxygen in the air breathed Increased carbon dioxide in the air breathed Toxins in the air breathed	Affects diffusion of gas Affects diffusion of gas Affect ability of oxygen to be carried effectively in blood

Impaired oxygen delivery causes cellular hypoxia (decreased amount of oxygen delivered to the cells), which in turn leads to anaerobic metabolism, lactic acid production, and organ dysfunction.

Shock is categorized into several types depending on the cause. These types are defined in Table 6-14 and discussed in more detail in Chapter 12, *Shock*.

Effects of Shock on the Body

The effects of inadequate perfusion on the body are similar to those of respiratory compromise. The level of oxygen supplied to the tissues falls. This causes the cells to engage in anaerobic metabolism, which results in increased lactic acid production.

A severe metabolic acidosis ensues, leading to increased levels of carbon dioxide within the blood. Patients who can compensate increase their breathing rate and depth, thereby increasing their minute volume.

Baroreceptors detect the decreased blood pressure and initiate the release of epinephrine and norepinephrine. The heart rate will increase, the heart will beat more forcefully, and the blood vessels will constrict. The body's goal is to maintain blood pressure to the areas of the body that are unable to survive without oxygen: the brain and the heart.

Another compensatory mechanism, particularly with hypovolemic shock, is the movement of fluid outside of the cells and outside of the blood vessels (interstitial fluid) into the capillaries. This helps refill the blood vessels and restore some fluid volume so the heart has enough liquid to pump. However, in other forms of shock such as septic and anaphylactic shock, the capillaries leak, and volume from the blood vessels (intravascular volume) moves into the interstitial space. This loss of vascular fluid means there is less blood returning to the heart to pump.

Ultimately the effect of all types of shock is decreased availability of fuel for the cells and impairment of cellular metabolism. Once a certain level of tissue hypoperfusion is reached, cell damage proceeds in a similar manner regardless of the underlying cause of the shock.

Alteration of Cellular Metabolism

Impairment of cellular metabolism results in the inability to properly use oxygen and glucose at the cellular level.

As discussed, when there is inadequate oxygen, cells will create energy through anaerobic metabolism. Anaerobic metabolism serves as a temporary backup system to allow cells to function at low energy levels for a short time. Most cells are able to use alternative fuel supplies to help bridge the gap until perfusion is restored. For example, when a person is engaged in strenuous exercise, the demand for glucose by the muscles exceeds the available supply. The body begins to burn fats and turns them into glucose to meet this need.

Table 6-14 Types of Shock

Type	Description	Examples of Causes
Hypovolemic	Shock resulting from lack of blood volume. Circulating blood volume is inadequate to deliver sufficient oxygen and nutrients to the body	▪ Trauma (blood loss results in inability to transport oxygen and nutrients) ▪ Severe vomiting/diarrhea (substantial loss of water can lead to decreased circulating blood volume; there is less blood to transport oxygen and nutrients)
Cardiogenic	Shock associated with impaired heart function; compromised heart function prevents wastes and nutrients from moving around the body effectively	▪ Weakened heart muscles as a result of myocardial infarction (heart attack) or other conditions ▪ Very fast or very slow heart rate (can prevent blood from moving effectively, blood pressure drops, and perfusion is diminished)
Obstructive	Shock resulting from blocked blood flow back to or through the heart	▪ Severe lung collapse (tension pneumothorax) (pushes on the vena cava, preventing it from returning blood to the heart) ▪ Accumulation of fluid in the sac surrounding the heart (prevents heart from filling) ▪ Large blood clot in pulmonary artery (pulmonary embolus) (can prevent right ventricle from pumping blood out of the heart into the lungs)
Anaphylactic	Shock resulting from severe allergic reaction	▪ Severe allergic reaction (blood vessels dilate, blood pressure drops, and perfusion decreases)
Septic	Shock resulting from severe infection; blood vessels dilate and decreased blood pressure results; leads to dysfunction in multiple organ systems and death	▪ Severe infection (blood vessels dilate, blood pressure drops, and perfusion decreases)
Neurogenic	Shock resulting from injury to the nervous system; for example, spinal cord injury may result in dilation of vessels (vasodilation) below the level of the injury	▪ High spinal cord injury (blood vessels dilate, blood pressure drops, and perfusion decreases)

However, anaerobic metabolism has some important drawbacks. Recall that the use of fats as an alternative fuel supply results in a buildup of lactic acid. This ultimately can result in metabolic acidosis. The process of anaerobic metabolism requires more energy than when using glucose for fuel. Therefore, there are more wastes to be removed, and the body must work harder. Other conditions resulting from anaerobic metabolism include decreased ability for the blood to effectively carry oxygen to the cells and overall decreased functioning of oxygen within the cell.

Although most cells are able to use alternative fuels, brain cells cannot. They rely on a constant supply of glucose to function. When perfusion is impaired, there is less glucose for cells to use. If the supply of available glucose is dramatically decreased, brain cells will quickly become damaged or die.

Cellular injury may, up to a point, be repairable if normal tissue perfusion is restored. When irreversible injury occurs, however, no treatment will help. Cell death is followed by necrosis, a process in which the cell breaks down. The cell membrane becomes abnormally permeable, leading to an influx of electrolytes and fluids. The cell and its components (organelles) swell and are ultimately destroyed, resulting in cell death.

Therefore, when perfusion is ineffective, it needs to be restored so that cells can return to a state of aerobic metabolism and life can continue. Many interventions you perform as an EMT will be aimed at improving conditions that can result in impaired perfusion.

YOU are the Provider — SUMMARY

1. How will knowledge of anatomy and physiology help you provide appropriate patient care?

Knowledge of anatomy and physiology is important for anyone who provides patient care—emergency or otherwise. When a patient reports pain to any part of the body, your knowledge of human anatomy will help you form a logical field impression—that is, what you believe to be the primary problem—regarding which organ or organs may be affected. Your knowledge of physiology will help you predict the negative effects the patient may experience based on the organ or organs affected. From this information, an appropriate treatment plan can be formulated and implemented.

Although you are not expected to diagnose a patient's condition, a strong fundamental knowledge of anatomy, physiology, and medical terminology will help you communicate the correct information to the emergency department physician or nurse.

2. On the sole basis of the patient's chief complaint, which organ or organs should you suspect is/are the cause of his condition?

The major organs in the right upper quadrant (RUQ) are the liver, gallbladder, and a portion of the large intestine (colon). Although your initial thoughts should focus on dysfunction of one or more of these organs, the patient's true problem may exist elsewhere in his abdomen and the pain just happens to be manifesting in his RUQ. Although your objectives are to recognize that the patient has an acute abdominal problem and to find and treat life-threatening conditions, you will need to ask additional questions to clarify his complaint. His answers to your questions will help you formulate a field impression.

3. What additional questions should you ask to gather more information about his chief complaint?

After determining why the patient called 9-1-1, ask the patient to elaborate on the complaint; this is called the history of present illness. The OPQRST mnemonic is a useful tool for this purpose.

The patient has already told you that his pain began suddenly 20 minutes ago, so the "O" and "T" in the OPQRST have been established. Ask him if anything makes his pain better or worse; patients with abdominal pain often draw their knees into their abdomen to take pressure off the abdominal muscles, which may provide them slight relief of their pain. Ask the patient if the pain stays in the RUQ of his abdomen or moves/ travels somewhere else; determine if he has referred pain by asking if he hurts anywhere else in addition to his RUQ. Assess the severity of his pain by using the 0 to 10 scale, with 0 being no pain and 10 being the worst pain ever experienced. Pain severity should be assessed frequently, especially after any interventions have been performed. Although chronic pain can indicate a serious underlying problem, you should be especially concerned that his pain began acutely.

Other questions to ask the patient should focus on common symptoms associated with abdominal pain, such as nausea and/or vomiting, diarrhea, and urinary difficulty, among others. When possible, try not to ask leading questions (ie, "Are you nauseated?"); instead, simply ask him if he has any other symptoms.

4. What additional symptoms would you expect the patient to experience based on the function of the gallbladder?

The gallbladder contracts only when food enters the duodenum; patients with inflammation of the gallbladder (cholecystitis) typically have pain in the right upper quadrant within an hour or so after eating a meal. In many cases, the patient also reports referred pain to the right shoulder. Other symptoms of gallbladder disease include nausea, vomiting, and heartburn.

Most cases of cholecystitis occur when gallstones form and block the outlet of the gallbladder. In some cases, the gallstones spontaneously pass; however, if they do not, the patient experiences pain of varying intensity.

5. How does knowledge of anatomy, physiology, and medical terminology facilitate communication with other health care professionals?

As part of the health care team, everything you do should benefit the patient. An integral part of patient care is effective communication with other health care professionals. Your ability to speak the language of medicine will minimize communication barriers between you and other members of the health care team and therefore will directly benefit your patient.

Whether you are calling in your radio report from the ambulance or giving a verbal report at the hospital, the use of appropriate medical terminology ensures that the information you pass along is relevant and accurate.

Review human anatomy and physiology and medical terminology on a regular basis. Although the structure and function of the body and the terms used to describe it do not change, your ability to recall the information can deteriorate over time.

6. Should your documentation of an EMS call differ from your verbal communication with other health care professionals? Why or why not?

No. Your verbal communication and the patient care report (PCR) should reflect the same relevant and accurate information. When possible, use proper medical terminology when documenting the patient’s complaint, history of present illness, medical history, and any treatment provided in the prehospital setting. If you are unsure of the correct medical term to accurately describe a particular aspect of the patient’s complaint or physical examination, use plain English. The PCR is read by the personnel who assume patient care from you and may have a direct impact on future care that the patient receives. It also becomes part of the patient’s permanent medical record. The use of proper medical terminology, coupled with an accurate depiction of the care you provided, will facilitate continuity of the patient’s care.

EMS Patient Care Report (PCR)

Date: 6-10-16	**Incident No.:** 050109	**Nature of Call:** Abdominal pain		**Location:** 322 Azalea Trail	
Dispatched: 1740	**En Route:** 1741	**At Scene:** 1747	**Transport:** 1759	**At Hospital:** 1809	**In Service:** 1817

Patient Information

Age: 60 **Sex:** M **Weight (in kg [lb]):** 84 kg (185 lb)	**Allergies:** Sulfa, Codeine, Contrast dye **Medications:** Zyrtec, Pepcid **Past Medical History:** Gallbladder problems **Chief Complaint:** Abdominal pain

Vital Signs

Time: 1749	**BP:** 142/82	**Pulse:** 110	**Respirations:** 24	**Spo_2:** 98%
Time: 1759	**BP:** 138/88	**Pulse:** 112	**Respirations:** 24	**Spo_2:** 97%
Time: 1808	**BP:** 132/80	**Pulse:** 90	**Respirations:** 20	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC** **NRM** **BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Position of comfort

Narrative

9-1-1 dispatch for a male patient with abdominal pain. On arrival at the scene, found the patient, a 60-year-old man, lying on his side on the floor of his bedroom with his knees drawn up into his abdomen. He was conscious and alert; his airway was patent, and his breathing was adequate. Patient stated the pain (8 on a 0 to 10 scale) began suddenly approximately 20 minutes earlier. His past medical history is significant for gallbladder problems; no other medical history reported. Applied oxygen at 15 L/min via nonrebreathing mask and obtained vital signs. Further assessment of patient's abdomen revealed that it was soft; however, it was point tender to palpation of the RUQ. Patient denied chest pain, shortness of breath, nausea or vomiting, and any other symptoms. He further denied radiating and referred pain. Placed patient onto the stretcher, allowed him to assume a position of comfort, loaded him into the ambulance, and began transport to the hospital. En route, continued to monitor patient's condition, which remained unchanged. Vital signs reassessed and noted above. Shortly before arrival at the hospital, reassessment of the patient revealed that his vital signs remained stable and that his pain had decreased in severity. Transferred care of patient to receiving hospital without incident and gave verbal report to charge nurse. Departed the hospital and returned to service.**End of report**

Prep Kit

Ready for Review

- To properly care for your patients, you must have a thorough understanding of human anatomy and physiology so you can assess your patients' condition and communicate with hospital personnel and other health care providers.
- You must be able to identify superficial landmarks of the body and know what lies underneath the skin so that you can perform an accurate patient assessment.
- The skeleton gives the body its recognizable human form through a collection of bones, ligaments, tendons, and cartilage.
- The skeletal system provides protection for fragile organs, allows for movement, and gives the body its shape.
- The contraction and relaxation of the musculoskeletal system gives the body its ability to move.
- The respiratory system consists of all the structures of the body that contribute to the process of breathing. It includes the nose, mouth, throat, larynx, trachea, bronchi, and bronchioles.
- The function of the respiratory system is to provide the body with oxygen and eliminate carbon dioxide.
- The circulatory system is a complex arrangement of connected tubes, including the arteries, arterioles, capillaries, venules, and veins.
- The nervous system is perhaps the most complex organ system within the human body. It consists of the brain, spinal cord, and nerves.
- The skin is divided into two parts: the superficial epidermis, which is composed of several layers of cells, and the deeper dermis, which contains the specialized skin structures.
- The skin, the largest single organ in the body, serves three major functions: to protect the body in the environment, to regulate the temperature of the body, and to transmit information from the environment to the brain.
- The digestive system is composed of the gastrointestinal tract (stomach and intestines), mouth, salivary glands, pharynx, esophagus, liver, gallbladder, pancreas, rectum, and anus.
- Digestion of food, from the moment it is taken into the mouth until essential compounds are extracted and delivered by the circulatory system to nourish all of the cells in the body, is a complicated chemical process.
- The lymphatic system is composed of the spleen, lymph nodes, lymph, lymph vessels, thymus gland, and other components. It supports the circulatory system and the immune system, and relies on muscle contractions and movements of the body for lymph to flow.
- The endocrine system is a complex message and control system that integrates many body functions.
- The urinary system controls the discharge of certain waste materials filtered from the blood by the kidneys.
- The genital system controls the reproductive processes by which life is created.
- Solutions that are high in pH (>7.0) are considered alkaline. Solutions that are low in pH (<7.0) are considered acidic. A solution that is neither acidic nor alkaline is considered neutral (pH 7.0).
- Pathophysiology is the study of how normal physiologic processes are affected by disease.
- Respiratory compromise is the inability of the body to move gas effectively. Respiratory compromise results when either ventilation or respiration is impaired.
- Shock is a condition in which organs and tissue receive an inadequate flow of blood and oxygen, or perfusion. Impaired oxygen delivery causes cellular hypoxia, which in turn leads to anaerobic metabolism, lactic acid production, and organ dysfunction.
- Impairment of cellular metabolism results in the inability to properly use oxygen and glucose at the cellular level. When irreversible cellular injury occurs, no treatment will help. Therefore, when perfusion is ineffective, it needs to be restored quickly.

Vital Vocabulary

abdomen The body cavity that contains the major organs of digestion and excretion. It is located below the diaphragm and above the pelvis.

acetabulum The depression on the lateral pelvis where its three component bones join, in which the femoral head fits snugly.

Adam's apple A firm prominence of cartilage that forms the upper part of the larynx. It is more prominent in men than in women. Also called the thyroid cartilage.

adenosine triphosphate (ATP) The nucleotide involved in energy metabolism; used to store energy.

adrenal glands Endocrine glands located on top of the kidneys that release adrenaline when stimulated by the sympathetic nervous system.

adrenergic Pertaining to nerves that release the neurotransmitter norepinephrine, or noradrenaline (such as adrenergic nerves, adrenergic response); also pertains to the receptors acted on by norepinephrine.

aerobic metabolism Metabolism that can proceed only in the presence of oxygen.

agonal gasps Abnormal breathing pattern characterized by slow, gasping breaths, sometimes seen in patients in cardiac arrest.

alpha-adrenergic receptors Portions of the nervous system that, when stimulated, can cause constriction of blood vessels.

alveoli The air sacs of the lungs in which the exchange of oxygen and carbon dioxide takes place.

anaerobic metabolism The metabolism that takes place in the absence of oxygen; the main by-product is lactic acid.

anatomic position The position of reference in which the patient stands facing forward, arms at the side, with the palms of the hands forward.

aorta The main artery leaving the left side of the heart and carrying freshly oxygenated blood to the body.

appendicular skeleton The portion of the skeletal system that comprises the arms, legs, pelvis, and shoulder girdle.

appendix A small, tubular structure that is attached to the lower border of the cecum in the lower right quadrant of the abdomen.

arterioles The smallest branches of arteries leading to the vast network of capillaries.

articular cartilage A pearly layer of specialized cartilage covering the articular surfaces (contact surfaces on the ends) of bones in synovial joints.

atrium One of the two upper chambers of the heart.

autonomic nervous system The part of the nervous system that regulates functions, such as digestion and sweating, that are not controlled voluntarily.

axial skeleton The part of the skeleton comprising the skull, spinal column, and rib cage.

ball-and-socket joint A joint that allows internal and external rotation, as well as bending.

beta-adrenergic receptors Portions of the nervous system that, when stimulated, can cause an increase in the force of contraction of the heart, an increased heart rate, and bronchial dilation.

biceps The large muscle that covers the front of the humerus.

bile ducts The ducts that convey bile between the liver and the intestine.

blood pressure (BP) The pressure that the blood exerts against the walls of the arteries as it passes through them.

brachial artery The major vessel in the upper extremities that supplies blood to the arm.

brain The controlling organ of the body and center of consciousness; functions include perception, control of reactions to the environment, emotional responses, and judgment.

brain stem The area of the brain between the spinal cord and cerebrum, surrounded by the cerebellum; controls functions that are necessary for life, such as respiration.

capillary vessels The tiny blood vessels between the arterioles and venules that permit transfer of oxygen, carbon dioxide, nutrients, and waste between body tissues and the blood.

cardiac muscle The heart muscle.

cardiac output (CO) A measure of the volume of blood circulated by the heart in 1 minute, calculated by multiplying the stroke volume by the heart rate.

carotid artery The major artery that supplies blood to the head and brain.

cartilage The smooth connective tissue that forms the support structure of the skeletal system and provides cushioning between bones; also forms the nasal septum and portions of the outer ear.

cecum The first part of the large intestine, into which the ileum opens.

central nervous system (CNS) The brain and spinal cord.

cerebellum One of the three major subdivisions of the brain, sometimes called the little brain; coordinates the various activities of the brain, particularly fine body movements.

cerebrospinal fluid (CSF) Fluid produced in the ventricles of the brain that flows in the subarachnoid space and bathes the meninges.

cerebrum The largest part of the three subdivisions of the brain, sometimes called the gray matter; made up of several lobes that control movement, hearing, balance, speech, visual perception, emotions, and personality.

cervical spine The portion of the spinal column consisting of the first seven vertebrae that lie in the neck.

chordae tendineae Thin bands of fibrous tissue that attach to the valves in the heart and prevent them from inverting.

chyme The substance that leaves the stomach. It is a combination of all of the eaten foods with added stomach acids.

circulatory system The complex arrangement of connected tubes, including the arteries, arterioles, capillaries, venules, and veins, that moves blood, oxygen, nutrients, carbon dioxide, and cellular waste throughout the body.

clavicle The collar bone; it is lateral to the sternum and anterior to the scapula.

coccyx The last three or four vertebrae of the spine; the tail bone.

coronal plane An imaginary plane where the body is divided into front and back parts.

cranium The area of the head above the ears and eyes; the skull. The cranium contains the brain.

cricoid cartilage A firm ridge of cartilage that forms the lower part of the larynx.

cricothyroid membrane A thin sheet of fascia that connects the thyroid and cricoid cartilages that make up the larynx.

dead space Any portion of the airway that does contain air and cannot participate in gas exchange, such as the trachea and bronchi.

dermis The inner layer of the skin, containing hair follicles, sweat glands, nerve endings, and blood vessels.

diaphragm A muscular dome that forms the undersurface of the thorax, separating the chest from the abdominal cavity. Contraction of this (and the chest wall muscles) brings air into the lungs. Relaxation allows air to be expelled from the lungs.

diastole The relaxation, or period of relaxation, of the heart, especially of the ventricles.

diffusion Movement of a gas from an area of higher concentration to an area of lower concentration.

digestion The processing of food that nourishes the individual cells of the body.

dorsalis pedis artery The artery on the anterior surface of the foot between the first and second metatarsals.

endocrine system The complex message and control system that integrates many body functions, including the release of hormones.

enzymes Substances designed to speed up the rate of specific biochemical reactions.

epidermis The outer layer of skin, which is made up of cells that are sealed together to form a watertight protective covering for the body.

epiglottis A thin, leaf-shaped valve that allows air to pass into the trachea but prevents food and liquid from entering.

epinephrine A hormone produced by the adrenal medulla that has a vital role in the function of the sympathetic nervous system.

esophagus A collapsible tube that extends from the pharynx to the stomach; muscle contractions propel food and liquids through it to the stomach.

expiratory reserve volume The amount of air that can be exhaled following a normal exhalation; average volume is about 1,200 mL in the average adult man.

extension The straightening of a joint.

fallopian tubes Long, slender tubes that extend from the uterus to the region of the ovary on the same side and through which the ovum passes from the ovary to the uterus.

femoral artery The major artery of the thigh, a continuation of the external iliac artery. It supplies blood to the lower abdominal wall, external genitalia, and legs. It can be palpated in the groin area.

femoral head The proximal end of the femur, articulating with the acetabulum to form the hip joint.

femur The *thighbone*; the longest and one of the strongest bones in the body.

flexion The bending of a joint.

foramen magnum A large opening at the base of the skull through which the brain connects to the spinal cord.

frontal bone The portion of the cranium that forms the forehead.

gallbladder A sac on the undersurface of the liver that collects bile from the liver and discharges it into the duodenum through the common bile duct.

genital system The reproductive system in men and women.

germinal layer The deepest layer of the epidermis where new skin cells are formed.

greater trochanter A bony prominence on the proximal lateral side of the thigh, just below the hip joint.

hair follicles The small organs that produce hair.

heart A hollow muscular organ that pumps blood throughout the body.

heart rate (HR) The number of heartbeats during a specific time (usually 1 minute).

hinge joints Joints that can bend and straighten but cannot rotate; they restrict motion to one plane.

hormones Substances formed in specialized organs or glands and carried to another organ or group of cells in the same organism; they regulate many body functions, including metabolism, growth, and body temperature.

humerus The supporting bone of the upper arm.

hydrostatic pressure The pressure of water against the walls of its container.

hypoxic drive A "backup system" to control respiration; senses drops in the oxygen level in the blood.

ilium One of three bones that fuse to form the pelvic ring.

inferior vena cava One of the two largest veins in the body; carries blood from the lower extremities and the pelvic and the abdominal organs to the heart.

inspiratory reserve volume The amount of air that can be inhaled after a normal inhalation; the amount of air that can be inhaled in addition to the normal tidal volume.

interstitial space The space in between the cells.

involuntary muscle The muscle over which a person has no conscious control. It is found in many automatic regulating systems of the body.

ischium One of three bones that fuse to form the pelvic ring.

joint (articulation) The place where two bones come into contact.

joint capsule The fibrous sac that encloses a joint.

kidneys Two retroperitoneal organs that excrete the end products of metabolism as urine and regulate the body's salt and water content.

labored breathing The use of muscles of the chest, back, and abdomen to assist in expanding the chest; occurs when air movement is impaired.

lactic acid A metabolic by-product of the breakdown of glucose that accumulates when metabolism proceeds in the absence of oxygen (anaerobic metabolism).

large intestine The portion of the digestive tube that encircles the abdomen around the small bowel, consisting of the cecum, the colon, and the rectum. It helps regulate water balance and eliminate solid waste.

lesser trochanter The projection on the medial/ superior portion of the femur.

ligament A band of fibrous tissue that connects bones to bones. It supports and strengthens a joint.

liver A large, solid organ that lies in the right upper quadrant immediately below the diaphragm; it produces bile, stores glucose for immediate use by the body, and produces many substances that help regulate immune responses.

lumbar spine The lower part of the back, formed by the lowest five nonfused vertebrae; also called the dorsal spine.

lymph A thin, straw-colored fluid that carries oxygen, nutrients, and hormones to the cells and carries waste products of metabolism away from the cells and back into the capillaries so that they may be excreted.

lymph nodes Tiny, oval-shaped structures located in various places along the lymph vessels that filter lymph.

mandible The bone of the lower jaw.

manubrium The upper quarter of the sternum.

maxillae The upper jawbones that assist in the formation of the orbit, the nasal cavity, and the palate and hold the upper teeth.

medulla oblongata Nerve tissue that is continuous inferiorly with the spinal cord; serves as a conduction pathway for ascending and descending nerve tracts; coordinates heart rate, blood vessel diameter, breathing, swallowing, vomiting, coughing, and sneezing.

metabolism (cellular respiration) The biochemical processes that result in production of energy from nutrients within cells.

midbrain The part of the brain that is responsible for helping to regulate the level of consciousness.

midsagittal plane (midline) An imaginary vertical line drawn from the middle of the forehead through the nose and the umbilicus (navel) to the floor, dividing the body into equal left and right halves.

minute volume The volume of air that moves in and out of the lungs per minute; calculated by multiplying the tidal volume and respiratory rate; also called minute ventilation.

motor nerves Nerves that carry information from the central nervous system to the muscles of the body.

mucous membranes The lining of body cavities and passages that communicate directly or indirectly with the environment outside the body.

mucus The watery secretion of the mucous membranes that lubricates the body openings.

musculoskeletal system The bones and voluntary muscles of the body.

myocardium The heart muscle.

nasopharynx The part of the pharynx that lies above the level of the roof of the mouth, or palate.

nervous system The system that controls virtually all activities of the body, both voluntary and involuntary.

norepinephrine A neurotransmitter and drug sometimes used in the treatment of shock; produces vasoconstriction through its alpha-stimulator properties.

occiput The most posterior portion of the cranium.

oncotic pressure The pressure of water to move, typically into the capillary, as the result of the presence of plasma proteins.

orbit The eye socket, made up of the maxilla and zygoma.

oropharynx A tubular structure that extends vertically from the back of the mouth to the esophagus and trachea.

ovaries Female glands that produces sex hormones and ova (eggs).

pancreas A flat, solid organ that lies below the liver and the stomach; it is a major source of digestive enzymes and produces the hormone insulin.

parasympathetic nervous system A subdivision of the autonomic nervous system, involved in control of involuntary functions, mediated largely by the vagus nerve through the chemical acetylcholine.

parietal bones The bones that lie between the temporal and occipital regions of the cranium.

patella The knee cap; a specialized bone that lies within the tendon of the quadriceps muscle.

pathophysiology The study of how normal physiologic processes are affected by disease.

perfusion The circulation of oxygenated blood within an organ or tissue in adequate amounts to meet the cells' current needs.

peripheral nervous system (PNS) The part of the nervous system that consists of 31 pairs of spinal nerves and 12 pairs of cranial nerves; these may be sensory nerves, motor nerves, or connecting nerves.

peristalsis The wavelike contraction of smooth muscle by which the ureters or other tubular organs propel their contents.

plasma A sticky, yellow fluid that carries the blood cells and nutrients and transports cellular waste material to the organs of excretion.

platelets Tiny, disc-shaped elements that are much smaller than the cells; they are essential in the initial formation of a blood clot, the mechanism that stops bleeding.

pleura The serous membranes covering the lungs and lining the thorax, completely enclosing a potential space known as the pleural space.

pleural space The potential space between the parietal pleura and the visceral pleura; described as "potential" because under normal conditions, the space does not exist.

pons An organ that lies below the midbrain and above the medulla and contains numerous important nerve fibers, including those for sleep, respiration, and the medullary respiratory center.

posterior tibial artery The artery just behind the medial malleolus; supplies blood to the foot.

prostate gland A small gland that surrounds the male urethra where it emerges from the urinary bladder; it secretes a fluid that is part of the ejaculatory fluid.

pubic symphysis A hard, bony, and cartilaginous prominence found at the midline in the lowermost portion of the abdomen where the two halves of the pelvic ring are joined by cartilage at a joint with minimal motion.

pubis One of three bones that fuse to form the pelvic ring.

pulmonary artery The major artery leading from the right ventricle of the heart to the lungs; carries oxygen-poor blood.

pulmonary circulation The flow of blood from the right ventricle through the pulmonary arteries and all of their branches and capillaries in the lungs and back to the left atrium through the venules and pulmonary veins; also called the lesser circulation.

pulmonary veins The four veins that return oxygenated blood from the lungs to the left atrium of the heart.

pulse The wave of pressure created as the heart contracts and forces blood out the left ventricle and into the major arteries.

radial artery The major artery in the forearm; it is palpable at the wrist on the thumb side.

radius The bone on the thumb side of the forearm.

rectum The lowermost end of the colon.

red blood cells Cells that carry oxygen to the body's tissues; also called erythrocytes.

renal pelvis A cone-shaped area that collects urine from the kidneys and funnels it through the ureter into the bladder.

residual volume The air that remains in the lungs after maximal expiration.

respiration The inhaling and exhaling of air; the physiologic process that exchanges carbon dioxide from fresh air.

respiratory compromise The inability of the body to move gas effectively.

respiratory system All the structures of the body that contribute to the process of breathing, consisting of the upper and lower airways and their component parts.

reticular activating system Located in the upper brain stem; responsible for maintenance of consciousness, specifically one's level of arousal.

retroperitoneal Behind the abdominal cavity.

sacroiliac joint The connection point between the pelvis and the vertebral column.

sacrum One of three bones (sacrum and two pelvic bones) that make up the pelvic ring; consists of five fused sacral vertebrae.

sagittal (lateral) plane An imaginary line where the body is divided into left and right parts.

salivary glands The glands that produce saliva to keep the mouth and pharynx moist.

scalp The thick skin covering the cranium, which usually bears hair.

scapula The shoulder blade.

sebaceous glands Glands that produce an oily substance called sebum, which discharges along the shafts of the hairs.

semen Fluid ejaculated from the penis and containing sperm.

seminal vesicles Storage sacs for sperm and seminal fluid, which empty into the urethra at the prostate.

sensory nerves The nerves that carry sensations such as touch, taste, smell, heat, cold, and pain from the body to the central nervous system.

shock An abnormal state associated with inadequate oxygen and nutrient delivery to the cells of the body, also known as hypoperfusion.

shoulder girdle The proximal portion of the upper extremities, made up of the clavicle, the scapula, and the humerus.

skeletal muscle Muscle that is attached to bones and usually crosses at least one joint; striated, or voluntary, muscle.

skeleton The framework that gives the body its recognizable form; also designed to allow motion of the body and protection of vital organs.

small intestine The portion of the digestive tube between the stomach and the cecum, consisting of the duodenum, jejunum, and ileum.

smooth muscle Involuntary muscle; it constitutes the bulk of the gastrointestinal tract and is present in nearly every organ to regulate automatic activity.

somatic nervous system The part of the nervous system that regulates activities over which there is voluntary control.

sphincters Muscles arranged in circles that are able to decrease the diameter of tubes. Examples are found within the rectum, bladder, and blood vessels.

sphygmomanometer A device used to measure blood pressure.

spinal cord An extension of the brain, composed of virtually all the nerves carrying messages between the brain and the rest of the body. It lies inside of and is protected by the spinal canal.

sternum The breast bone.

stratum corneal layer The outermost or dead layer of the skin.

stroke volume (SV) The volume of blood pumped forward with each ventricular contraction.

subcutaneous tissue Tissue, largely fat, that lies directly under the dermis and serves as an insulator of the body.

superior vena cava One of the two largest veins in the body; carries blood from the upper extremities, head, neck, and chest into the heart.

sweat glands The glands that secrete sweat, located in the dermal layer of the skin.

symphysis A type of joint that has grown together to form a very stable connection.

synovial fluid The small amount of liquid within a joint used as lubrication.

synovial membrane The lining of a joint that secretes synovial fluid into the joint space.

systemic circulation The portion of the circulatory system outside of the heart and lungs.

systemic vascular resistance (SVR) The resistance that blood must overcome to be able to move within the blood vessels; related to the amount of dilation or constriction in the blood vessel.

systole The contraction, or period of contraction, of the heart, especially that of the ventricles.

temporal bones The lateral bones on each side of the cranium; the temples.

tendons The fibrous connective tissue that attaches muscle to bone.

testicle A male genital gland that contains specialized cells that produce hormones and sperm.

thoracic cage The chest or rib cage.

thoracic spine The 12 vertebrae that lie between the cervical vertebrae and the lumbar vertebrae. One pair of ribs is attached to each of these vertebrae.

thorax The chest cavity that contains the heart, lungs, esophagus, and great vessels.

thyroid cartilage A firm prominence of cartilage that forms the upper part of the larynx; the Adam’s apple.

tibia The shinbone; the larger of the two bones of the lower leg.

tidal volume The amount of air moved in and out of the lungs in one relaxed breath; about 500 mL for an adult.

topographic anatomy The superficial landmarks of the body that serve as guides to the structures that lie beneath them.

trachea The windpipe; the main trunk for air passing to and from the lungs.

transverse (axial) plane An imaginary line where the body is divided into top and bottom parts.

triceps The muscle in the back of the upper arm.

tunica media The middle and thickest layer of tissue of a blood vessel wall, composed of elastic tissue and smooth muscle cells that allow the vessel to expand or contract in response to changes in blood pressure and tissue demand.

ulna The inner bone of the forearm, on the side opposite the thumb.

ureter A small, hollow tube that carries urine from the kidneys to the bladder.

urethra The canal that conveys urine from the bladder to outside the body.

urinary bladder A sac behind the pubic symphysis made of smooth muscle that collects and stores urine.

urinary system The organs that control the discharge of certain waste materials filtered from the blood and excreted as urine.

vagina A muscular, distensible tube that connects the uterus with the vulva (the external female genitalia); also called the birth canal.

vasa deferentia The spermatic duct of the testicles; also called vas deferens.

ventilation The movement of air between the lungs and the environment.

ventricle One of two lower chambers of the heart.

vertebrae The 33 bones that make up the spinal column.

voluntary muscle Muscle that is under direct voluntary control of the brain and can be contracted or relaxed at will; skeletal, or striated, muscle.

V/Q ratio A measurement that examines how much gas is being moved effectively and how much blood is flowing around the alveoli where gas exchange (perfusion) occurs.

white blood cells Blood cells that have a role in the body’s immune defense mechanisms against infection; also called leukocytes.

xiphoid process The narrow, cartilaginous lower tip of the sternum.

zygomas The quadrangular bones of the cheek, articulating with the frontal bone, the maxillae, the zygomatic processes of the temporal bone, and the great wings of the sphenoid bone.

Assessment *in Action*

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You are dispatched to an unresponsive person at an automotive garage. On arrival, you find a middle-aged man lying on the ground by a tire rack.

1. You observe the patient as you approach. He is lying face-up. As you look at the front side of his body, which plane of the body are you observing?

   A. Coronal
   B. Midsagittal
   C. Sagittal
   D. Transverse

2. After opening the patient's airway and confirming spontaneous respirations, you check for a pulse on his neck just lateral to the trachea. What artery are you palpating?

   A. Radial
   B. Carotid
   C. Femoral
   D. Brachial

3. You determine the patient has a strong pulse and perform a rapid assessment. While assessing the lower extremities, you observe marked swelling in the right thigh. What bone is in this location?

   A. Fibula
   B. Tibia
   C. Femur
   D. Patella

4. Which of the following substances is the main element that the bone cells use to create a hard and resilient structure?

   A. Sodium
   B. Potassium

C. Magnesium
D. Calcium

5. You perform an assessment while en route to the hospital. You note bruising and instability of the right cheekbone. What is the proper name for this bone?

   A. Zygoma
   B. Maxilla
   C. Sphenoid
   D. Mandible

6. The larger bone of the forearm at the wrist is the:

   A. humerus.
   B. ulna.
   C. radius.
   D. clavicle.

7. The forearm makes up part of the elbow. The elbow is an example of what type of joint?

   A. Hinge
   B. Ball-and-socket
   C. Saddle
   D. Immovable

8. Explain what occurs in the body as a result of respiratory compromise.

9. On the basis of your assessment findings, you suspect that your patient may have sustained a closed head injury. What structure of the brain is responsible for the level of consciousness and maintenance of vital signs?

10. Just before arriving at the hospital, you take your final set of vital signs. The patient's initial pulse rate was 89 beats/min and now it is 116 beats/min. What part of the nervous system is responsible for this increase, and how does it work?

CHAPTER 7

Life Span Development

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National EMS Education Standard Competencies

Preparatory

Applies fundamental knowledge of the emergency medical services (EMS) system, safety/well-being of the emergency medical technician (EMT), medical/legal, and ethical issues to the provision of emergency care.

Life Span Development

Applies fundamental knowledge of life span development to patient assessment and management.

Knowledge Objectives

1. Know the terms used to designate the following stages of life: infants, toddlers and preschoolers, school-age children, adolescents (teenagers), early adults, middle adults, and older adults. (pp 241–251)
2. Describe the major physical and psychosocial characteristics of an infant's life. (pp 241–244)
3. Describe the major physical and psychosocial characteristics of a toddler and preschooler's life. (pp 245–247)
4. Describe the major physical and psychosocial characteristics of a school-age child's life. (p 247)
5. Describe the major physical and psychosocial characteristics of an adolescent's life. (pp 247–249)
6. Describe the major physical and psychosocial characteristics of an early adult's life. (pp 249–250)
7. Describe the major physical and psychosocial characteristics of a middle adult's life. (pp 250–251)
8. Describe the major physical and psychosocial characteristics of an older adult's life. (pp 251–255)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

As living organisms, humans develop throughout their lives. The period from birth to death—the life span—is marked by constant change. Newborns and infants are completely dependent on others for every aspect of their care, while toddlers and preschoolers learn to move from gross motor activities (eg, kicking and crawling) to fine motor activities (eg, holding toys and writing). School-age children begin to learn various types of reasoning from more environmental and social interactions, and adolescents struggle to create their own identity and image as they start to transition out of childhood. Adulthood is marked by three stages, early, middle, and older, and ranges from age 19 to death. Each stage brings its rewards and challenges. As an EMT, you must be aware of the obvious and not so obvious changes a person undergoes physically and mentally at various stages of life and understand how these changes may alter your approach to patient care.

Neonates (Birth to 1 Month) and Infants (1 Month to 1 Year)

As any parent can attest, **infants** (ages 1 month to 1 year) develop at a surprising rate Figure 7-1. **Neonates** (from birth to 1 month) are covered in detail in Chapter 33, *Obstetrics and Neonatal Care*. The leading cause of death for this age group is congenital abnormalities, according to the Centers for Disease Control and Prevention (CDC).

Figure 7-1 An infant.

Physical Changes

Vital Signs

As a general rule the younger the person, the faster the pulse rate and respirations. At birth, a pulse rate of 90 to 180 beats/min and a respiratory rate of 30 to 60 breaths/min are considered normal. Within the first half hour after birth, a neonate's pulse rate often drops to 120 beats/min and the respiratory rate falls between 30 to 40 breaths/min. By age 1 year, the respiratory rate slows to 20 to 30 breaths/ min. Tidal volume in neonates starts at 6 to 8 mL/kg. By the end of the first year, the volume increases to 10 to 15 mL/kg. Table 7-1 lists the normal ranges of vital signs for various age groups.

YOU are the Provider — PART 1

You and your partner are outside washing the ambulance when a man in his 50s drives up to the front of the ambulance bay door. He requests that you check his vital signs, which your EMS system offers as part of its community outreach program. As your partner is retrieving the blood pressure cuff and stethoscope from the ambulance, the man tells you he is light-headed and needs to sit down. The time is 1310 hours according to the dispatch operator, who acknowledges that you have a walk-in patient.

1. How does a patient's age affect your assessment?
2. What are some physical differences between middle adults and older adults?

Blood pressure directly corresponds to the patient's weight, so it typically increases with age. At birth, the average systolic blood pressure of a neonate is 50 to 70 mm Hg. By 1 year of age, it ranges between 70 and 95 mm Hg.

Weight

A neonate usually weighs 6 to 8 lb (3 to 3.5 kg) at birth. Remarkably, the head accounts for 25% of a neonate's body weight. In the first week after birth, neonates usually have a 5% to 10% loss of their birth weight due to fluid loss. By week 2, the neonate begins to gain weight. From here on, infants grow at a rate of about 1 oz (30 g) per day, doubling their weight by 4 to 6 months and tripling it by the end of the first year.

Special Populations

Infants often land head first when they fall because their heads account for 25% of their total body weight. Also, most infants cannot stretch out their arms in time to cushion or slow their fall. Keep this point in mind when considering spinal stabilization on an infant.

Cardiovascular System

Prior to birth, fetal circulation occurs through the placenta. During the birthing process, hormones and pressure changes help the neonate make the transition from fetal circulation to independent circulation. See Chapter 33, *Obstetrics and Neonatal Care*, for more information about fetal circulation.

Pulmonary System

Prior to a neonate's first breath, the lungs have never been inflated. A neonate's first breath is therefore forceful—it has to be!

Neonates are primarily "nose breathers." Infants younger than 6 months are particularly prone to nasal congestion, which can cause viral upper respiratory infections. If you respond to a call for a baby choking, make sure the nasal passages are clear and unobstructed by mucus.

The rib cage of an infant is less rigid and the ribs sit horizontally. This explains the diaphragmatic breathing ("belly breathing") in infants.

An infant's airway is different from an adult's airway. The infant's tongue is larger in proportion to the oral cavity, and the airway is proportionally shorter and narrower. As a result, airway obstruction is more common in infants than in adults or older children.

Table 7-1 Vital Signs at Various Ages

Age	Pulse Rate (beats/min)	Respirations (breaths/min)	Systolic Blood Pressure (mm Hg)	Temperature (°F)
Neonate (0 to 1 month)	90 to 180	30 to 60	50 to 70	98 to 100 (37 to 38°C)
Infant (1 month to 1 year)	100 to 160	25 to 50	70 to 95	96.8 to 99.6 (36 to 37.5°C)
Toddler (1 to 3 years)	90 to 150	20 to 30	80 to 100	96.8 to 99.6 (36 to 37.5°C)
Preschool age (3 to 6 years)	80 to 140	20 to 25	80 to 100	98.6 (37°C)
School age (6 to 12 years)	70 to 120	15 to 20	80 to 110	98.6 (37°C)
Adolescent (12 to 18 years)	60 to 100	12 to 20	90 to 110	98.6 (37°C)
Early adult (19 to 40 years)	60 to 100	12 to 20	90 to 140	98.6 (37°C)
Middle adult (41 to 60 years)	60 to 100	12 to 20	90 to 140	98.6 (37°C)
Older adult (61 and older)	60 to 100	12 to 20	90 to 140	98.6 (37°C)

When providing bag-valve mask ventilations to an infant, you need to be aware that an infant's lungs are fragile. Ventilations that are too forceful can result in trauma from pressure, or **barotrauma**. Due to the large size of the infant's occiput and the increased flexibility of the trachea, the airway can easily be inadvertently blocked by incorrect positioning, either over-extension or over-flexion. Infants have very little reserves available to assist with breathing. The muscles they use to breathe are immature. They can manage normal breathing requirements easily but can become fatigued when stressed. The number of alveoli in the infant's lungs is relatively low. Fortunately, the amount of oxygen that the infant needs is also relatively low. As the infant grows and moves more, the need for greater amounts of oxygen triggers a growth in the number of alveoli. However, in very small infants, respiratory problems can quickly turn life threatening. Infants who struggle to breathe can quickly tire and become overheated and even dehydrated.

Special Populations

When you are counting respirations in an infant, count the number of times the abdomen rises instead of concentrating solely on the chest rise.

Nervous System

Although the infant's nervous system is developed at birth, its evolution continues after birth. For example, the neonate lacks the ability to isolate a particular response to sensation. When neonates are born, they tend to move their extremities together. They do not have independent arm or leg movements until many weeks later.

A neonate is born with certain reflexes. The **Moro reflex** (startle reflex) happens when a neonate is caught off guard by something or someone; the neonate opens his or her arms wide, spreads the fingers, and seems to grab at things. A **palmar grasp** occurs when an object is placed into the neonate's palm. The **rooting reflex** takes place when something touches a neonate's cheek; the neonate will instinctively turn his or her head toward the touch. In conjunction with the **sucking reflex**, which occurs when a neonate's lips are stroked, these reflexes are often evident when feeding.

A neonate's **fontanelles** allow the head to be molded—for example, when the neonate passes through the birth canal **Figure 7-2**. The fontanelles are the area or space between the bones that eventually fuse to form the skull. The posterior fontanelle normally fuses by the third month of life. The anterior fontanelle fuses between 9 and 18 months of age. On assessment, if either of the fontanelles is depressed, the infant is most likely dehydrated.

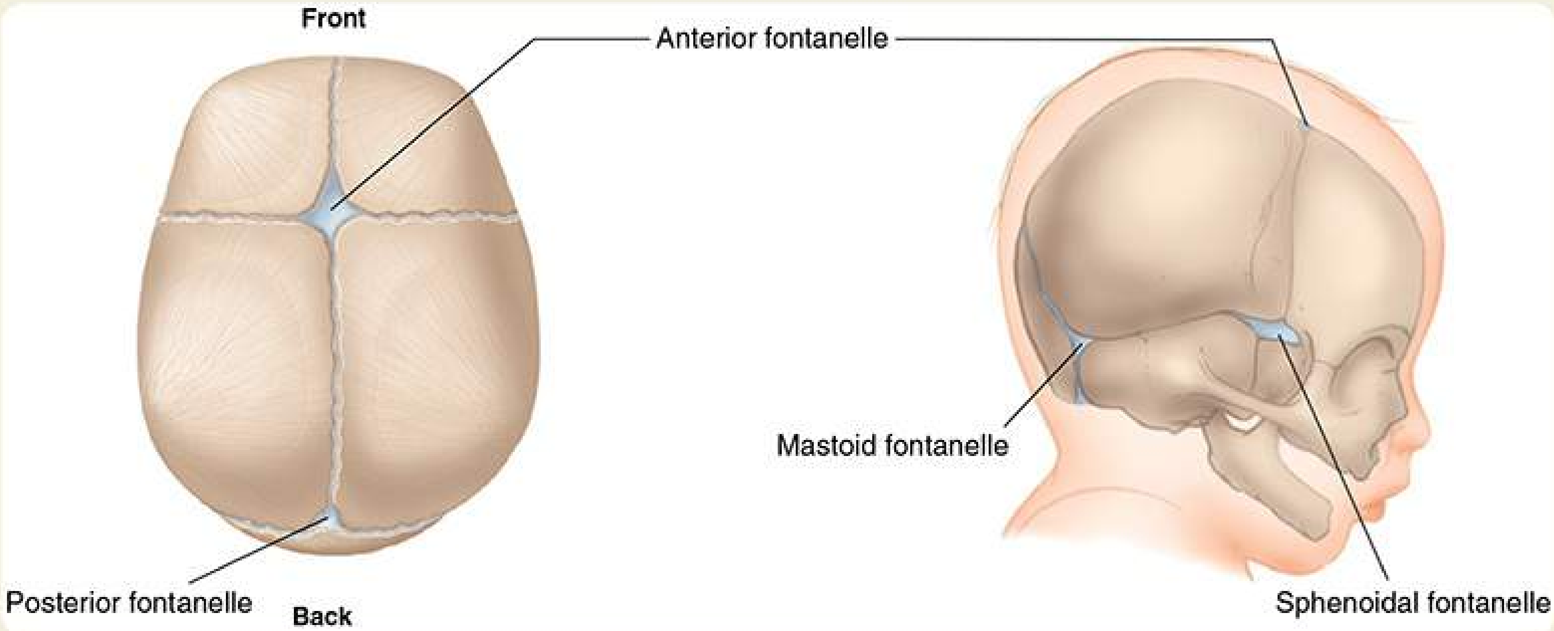

Figure 7-2 Fontanelles.

A bulging fontanelle is indicative of increased intracranial pressure.

At birth, the neonate is not able to do much without assistance. He or she cannot turn over or even focus his or her eyes beyond a very short distance. Sleep patterns begin to develop. But by 2 months of age, the infant is able to track objects with his or her eyes and should recognize familiar faces. At 6 months of age, the infant is able to sit upright and begins to make cooing and babbling sounds. By 12 months of age, the infant can walk with assistance and even knows his or her name.

Immune System

While in the womb, fetuses collect antibodies from the maternal blood. During the first year of life, infants maintain some of their mother's immunities, so they have naturally acquired passive immunities. Infants can also receive antibodies via breastfeeding, which strengthen their immune system.

Special Populations

Another development that occurs during infancy includes the emergence of "baby" teeth. Teething (ie, teeth breaking through the gums) can be painful and accompanied by a low-grade fever.

Psychosocial Changes

An infant's psychosocial development begins at birth and continues to evolve as the infant interacts with, and reacts to, the environment. Table 7-2 outlines typical ages at which major psychosocial changes are noticed.

In most infants, the primary method of communicating distress is through crying. Parents can often tell what is upsetting their child simply by listening to the tone of the child's crying—that is, they know the difference between tears for anger, frustration, pain, fear, hunger, discomfort, and sleepiness. Infants occasionally make another distinct cry—an alarming distressed cry. This cry may be heard when an unexpected event occurs, causing a situational crisis for the infant.

Infants develop relationships with their parents or caregivers at different rates. *Bonding*, or the formation of a close, personal relationship, is usually based on a secure attachment. A *secure attachment* occurs when an infant understands that parents or caregivers will respond to their needs. This realization encourages a child to reach out and explore, knowing their parents will provide a "safety net."

Table 7-2 Noticeable Characteristics at Various Ages

Age	Characteristic
2 months	Recognizes familiar faces; tracks objects with the eyes
3 months	Brings objects to the mouth; smiles and frowns
4 months	Reaches out to people; drools
5 months	Sleeps throughout the night; recognizes family members from strangers
6 months	Teething begins; sits upright; speaks one-syllable words
7 months	Afraid of strangers; mood swings
8 months	Responds to "no"; can sit alone; plays peek-a-boo
9 months	Pulls up to stand; places objects in mouth to explore them
10 months	Responds to his or her name; crawls efficiently
11 months	Starts to walk without help; frustrated with restrictions
12 months	Knows his or her name; walks

Another type of attachment, referred to as *anxious-avoidant attachment*, is observed in infants who are repeatedly rejected. In this attachment style, children show little emotional response to their parents or caregivers and treat them as they would strangers. These children often develop an isolated lifestyle where they do not have to depend on the support and care of others.

Separation anxiety is common in older infants. This normal reaction peaks between 10 and 18 months and involves clingy behavior and fear of unfamiliar places and people. It is normal for older infants to protest by crying. As infants become accustomed to their homes and families, they begin to need the security of a predictable environment. If the infant's environment is too unpredictable, the infant may despair and become withdrawn, which leads to trust issues.

Trust and mistrust refers to a stage of development from birth to about 18 months of age that involves an infant's needs being met by his or her parents or caregivers. When caregivers and parents provide consistent care in an organized, routine environment, the infant gains trust in them. If the infant does not perceive the environment as secure, a sense of mistrust will develop **Figure 7-3**.

Figure 7-3 Infants develop a sense of mistrust if they perceive their parents or caregivers will not provide an organized, predictable environment.

Special Populations

When caring for patients who are very young, keep their routine the same by keeping family and familiar items nearby.

Toddlers (1 to 3 Years) and Preschoolers (3 to 6 Years)

Physical Changes

In **toddlers** (ages 1 to 3 years), the pulse rate is normally 90 to 150 beats/min and the respiratory rate is 20 to 30 breaths/min, slower than the corresponding vital signs in infants, whereas the systolic blood pressure is higher (80 to 100 mm Hg). The average body temperature of children this age is 96.8°F (36°C) to 99.6°F (38°C), usually leveling off at 98.6°F (37°C) by school age **Figure 7-4**.

In **preschoolers** (ages 3 to 6 years), the pulse rate is 80 to 140 beats/min and the respiratory rate is 20 to 25 breaths/min. The systolic blood pressure is 80 to 100 mm Hg. Weight gain should level off by this time **Figure 7-5**.

A toddler's cardiovascular system is not dramatically different from an adult's system. A toddler's lungs continue to develop more terminal bronchioles and alveoli. Although toddlers and preschoolers have more lung tissue, they do not have well-developed lung musculature. This anomaly prevents them from sustaining deep or rapid respirations for an extended period of time.

The loss of passive immunity is possibly the most obvious development at this stage of human life. Viral infections (colds) often develop that may manifest as gastrointestinal distress or upper respiratory tract infections. As toddlers spend more time around playmates and classmates, they acquire immunity as their bodies are exposed to various viruses and germs.

YOU are the Provider — PART 2

After sitting the man down in a chair inside your station, he tells you he has been stressed lately, although he does not know why, and he has had several episodes of light-headedness over the past few days. He denies having chest pain, shortness of breath, or any other symptoms. As you are assessing the patient, your partner prepares to take his vital signs.

Recording Time: 0 Minutes	
Appearance	Calm
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions or foreign bodies
Breathing	Normal rate; adequate depth
Circulation	Radial pulses, strong and regular; skin is pink, warm, and dry

3. What are some common psychosocial concerns experienced by middle adults?

Figure 7-4 A toddler.

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Neuromuscular growth also makes considerable progress at this age. Toddlers and preschoolers spend a great deal of time exploring how to use their expansive nervous system and the muscles it controls by walking, running, jumping, and playing catch **Figure 7-6**. Watching the changes in how children play from age 1 to 6 years demonstrates how they move from gross motor activities (grabbing an object with the full palm) to fine motor activities (picking up a crayon). By the end of this stage, preschoolers will have a brain that weighs 90% of its final adult weight. In addition, all of this playing places stress on the muscles and bones. As a result, muscle mass increases as does bone density.

This stage also includes the continued development of the renal system and of elimination patterns (ie, toilet training). Physiologically, toddlers have the neuromuscular control capable of bladder control by 12 to 15 months of age. However, the child may not be psychologically ready until 18 to 30 months of age. The average age for toddlers to complete toilet training is 28 months of age. In addition, parents and toddlers are fascinated with sensory development—for example, tickling. According to the CDC, the leading cause of death for this age group is unintentional injuries (accidents).

Figure 7-5 A preschooler.

Psychosocial Changes

Parents are often excited for this period of development. Toddlers or preschoolers are learning to speak and express themselves, thereby taking a major step toward independence. At the same time, toddlers are very attached to their parents and feel safe with them. Separation anxiety peaks between 10 and 18 months of age.

At 36 months of age, in most toddlers, basic language is mastered. By the age of 3 or 4 years, most children can use and understand full sentences. As they progress through this stage, they will go from using language to communicate what they want, to using language creatively and playfully.

This is also the time when toddlers begin to interact with other children and start to play games. Playing games teaches control, following of rules, and even competitiveness. Significant learning and development takes place by the child watching his or her peers during group outings, such as “play dates” with other children. By 18 to 24 months, toddlers begin to understand cause and effect. Of course, behavior observed on television and the Internet can also be learned, which is why some parents limit their children’s viewing choices or the amount of time they devote to these activities. During this phase of development, children also learn to recognize gender differences by observing their role models.

Figure 7-6 A toddler learns to walk, one of the major milestones in life.

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School-Age Children (6 to 12 Years)

Physical Changes

From ages 6 to 12 years, a school-age child's vital signs and body gradually approach those observed in adulthood Figure 7-7. The pulse rate is approximately 70 to 120 beats/min, the respiratory rate 15 to 20 breaths/min, and blood pressure is 80 to 110 mm Hg. Obvious physical traits and body function changes become apparent as most children grow about 4 lb (2 kg) and 2.5 inches (6 cm) each year. Permanent teeth also come in during this period, and brain activity in both hemispheres increases. Unintentional injuries are cited by the CDC as the leading cause of death in this age group.

Figure 7-7 A school-age child.

Psychosocial Changes

School-age children are engaged in a lot of psychosocial growth. Parents generally do not devote as much time to their children during this phase. Nevertheless, it is at this critical time in human development that children learn various types of reasoning. In **preconventional reasoning**, children act almost purely to avoid punishment and to get what they want. In **conventional reasoning**, they look for approval from their peers and society. In **postconventional reasoning**, children make decisions guided by their conscience.

During this stage, children begin to develop their self-concept and self-esteem. *Self-concept* is our perception of ourselves; *self-esteem* is how we feel about ourselves and how we "fit in" with our peers.

Adolescents (12 to 18 Years)

Physical Changes

In **adolescents** (ages 12 to 18 years), vital signs begin to level off within the adult ranges, with a systolic blood pressure generally between 90 and 110 mm Hg, a pulse rate between 60 and 100 beats/min, and respirations in the range of 12 to 20 breaths/min **Figure 7-8**.

Adolescence is the time of life when humans experience a 2- to 3-year growth spurt (ie, an increase in muscle and bone growth) and body changes. Growth begins with hands and feet, then moves to the long bones of the extremities, and finishes with growth of the torso. Boys typically experience this growth spurt later in life than girls. Girls usually finish their growth spurt by 16 years of age and boys by 18 years of age. Boys, however, are generally taller than girls when this period of growth has finished. Muscle mass and bone density are nearly at adult levels.

One change during adolescence is the maturation of the human reproductive system. Secondary sexual development begins, along with enlargement of the external reproductive organs. Pubic hair and axillary hair begin to appear. Voices start to change in range and depth. In girls, the breasts and thighs increase in size as adipose (fat) tissue is deposited there. Menstruation begins during this time. *Menarche*, the first menstrual bleeding, occurs during this time; however, it is not uncommon to begin menstruation prior to becoming a teenager.

These changes in the endocrine and reproductive systems provide the platform for reproduction. By the middle of adolescence, boys are able to produce sperm, and in girls, eggs begin to develop. Acne can also occur due to hormonal changes. Unintentional injuries are also the leading cause of death for adolescents according to the CDC.

Figure 7-8 An adolescent.

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YOU are the Provider PART 3

As your partner takes the patient's vital signs, he tells you he and his wife are taking care of his father, who is 82 years old and has Alzheimer disease. He further tells you, although this situation is very stressful for him, he does not want to put his father in a nursing home. He is still light-headed and now reports a headache. After applying oxygen via nasal cannula, you advise him he should be transported to the hospital via EMS, but he tells you he would rather drive himself.

Recording Time: 5 Minutes	
Respirations	14 breaths/min; regular and adequate
Pulse	76 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	174/98 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)

4. Are the patient's vital signs consistent with his age?
5. Why should you transport this patient to the hospital?

Psychosocial Changes

Adolescents and their families often deal with conflict as adolescents try to gain control of their lives from their parents. The need for privacy and personal space from siblings and parents becomes an important issue for adolescents. Self-consciousness also increases. Adolescents may struggle to create their own identity—to define themselves **Figure 7-9**, for example, by dressing in a certain style of clothing that fits their personality. Adolescents use the feedback from their family and peers to help create their adult image. Adolescents are often caught between two worlds. They want to be treated like an adult, yet they want to be cared for like a young child.

Rebellious behavior is common when an adolescent is trying to find his or her own identity. Typically, antisocial behavior and peer pressure tend to peak at around age 14 to 16 years. Smoking, illicit drug use, unprotected sex, and other high-risk behaviors also peak during this period. Adolescents may exhibit self-control through what they eat, which can lead to eating disorders. Although these behaviors can be very troubling to parents, the adolescent is trying to determine if he or she is ready to take control of his or her life. An adolescent's struggle toward independence may have devastating setbacks. Patience and support from family and friends are essential in assisting an adolescent's transition into adulthood.

Adolescents may show greater interest in sexual relations. Many adolescents are fixated on their public image and are terrified of being embarrassed. At this age, a code of personal ethics is developed, based partly on parents' ethics and values and partly on the influence of the adolescent's environment. During this confusing time, adolescents are at a higher risk than other populations for suicide and depression.

Figure 7-9 Adolescents want to fit in and may struggle to create identity.

Special Populations

When you interview adolescents in the presence of their family, they may not tell you the complete truth in an attempt to protect their privacy or image. It is best to ask these patients certain questions in total privacy, where they feel they can answer without constraint.

Early Adults (19 to 40 Years)

Physical Changes

Early adults range in age from 19 to 40 years **Figure 7-10**. Their vital signs do not vary greatly from those seen throughout adulthood. Ideally, the human pulse rate will average around 70 beats/min, the respiratory rate will stay in the range of 12 to 20 breaths/min, and the systolic blood pressure will be approximately between 90 and 140 mm Hg.

From age 19 years to shortly after 25 years, the human body should be functioning at its optimal level. Lifelong habits, whether positive or negative, such as eating preferences, exercise, and tobacco use are solidified. At the beginning of this period, the body is working at peak efficiency, but as early adulthood continues, subtle wear and tear on bones and changes in body tissues and muscles begin.

The disks in the spine begin to settle, and height can sometimes be affected, causing a “shrinking.” Being able to eat anything without gaining weight becomes more difficult. Fatty tissue increases, which leads to weight gain. Muscle strength decreases, and reflexes slow. The leading cause of death in this age group is unintentional injury, according to the CDC.

Psychosocial Changes

Three words best describe the average human’s world during this stage of life: work, family, stress. During this period, adults strive to create a place for themselves in the world, and many do everything they can to "settle down." Along with this natural tendency to settle down often come marriage and family. Despite all of this stress and change, this age group enjoys one of the more stable periods of life.

Figure 7-10 An early adult.

Middle Adults (41 to 60 Years)

Physical Changes

Middle adults are ages 41 to 60 years **Figure 7-11**. The average pulse rate for this age remains at 70 beats/ min, the respiratory rate continues at 12 to 20 breaths/ min, and the blood pressure also remains between 90 and 140 mm Hg. This group is vulnerable to vision and hearing loss. Cardiovascular health also becomes an issue in many middle adults, as does the greater incidence of cancer. In women, menopause—the end of menstruation—begins in the late 40s or early 50s. Middle adults may begin having medical problems or be unaware of conditions such as diabetes and hypertension. Medications or underlying conditions may affect patient response to treatments. Other concerns include an increase in cholesterol levels, a decrease in the efficiency of the heart, and weight control maintenance. However, many of the effects of aging can be diminished with exercise and a healthy diet. The CDC sites unintentional injuries as the leading cause of death in ages 41 to 44 years. For ages 45 to 60, the leading cause of death is cancer.

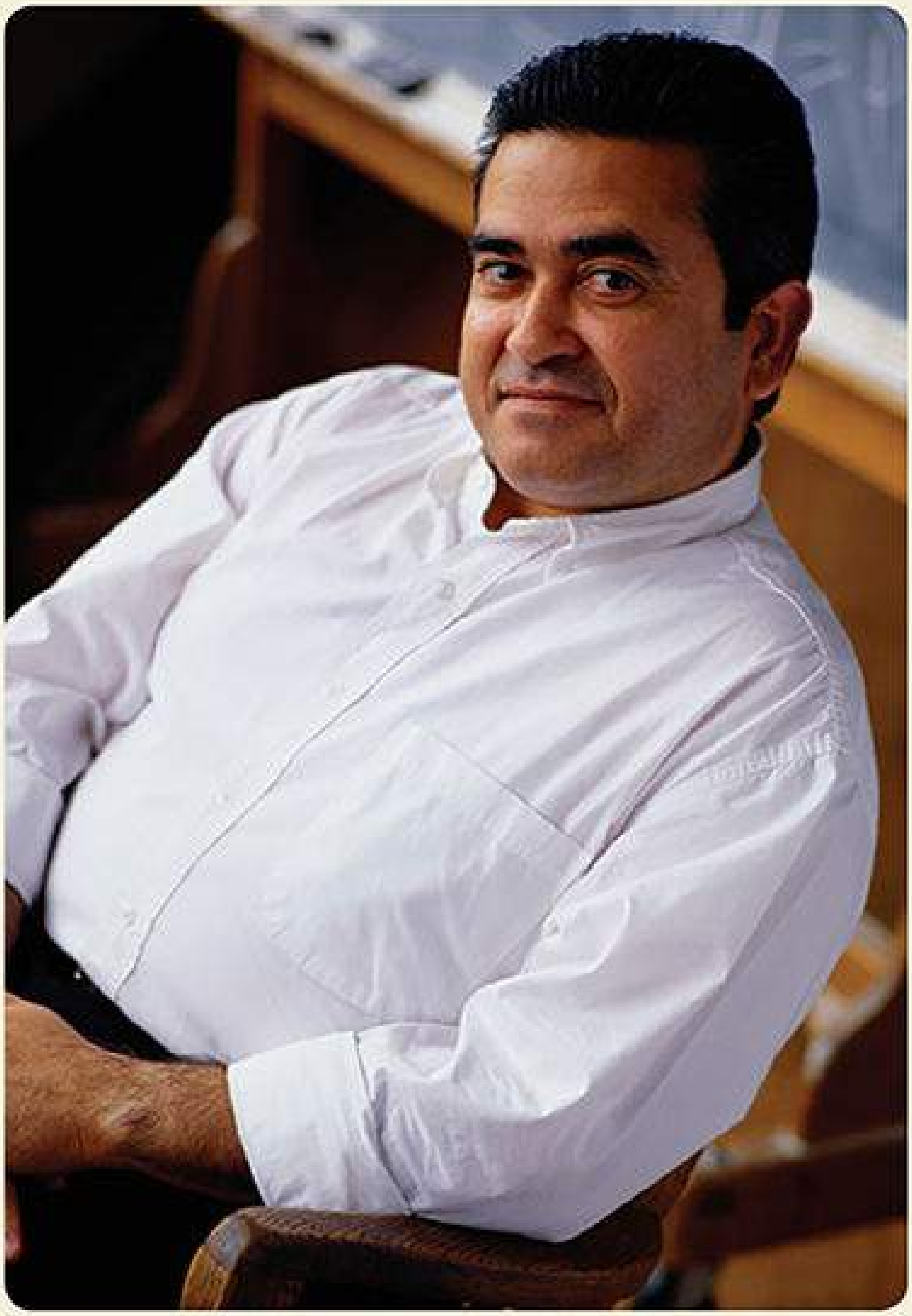

Figure 7-11 A middle adult.

Psychosocial Changes

Middle adults tend to focus on achieving their life's goals, as they approach the halfway point in human life expectancy. After years of nurturing and having children living at home, parents must readjust their lifestyle as children leave home, commonly called the "empty nest" syndrome. Finances may become a worrisome issue, as people prepare for retirement while still managing everyday financial demands. During this time people often view crisis as a challenge to be overcome and not a threat to be avoided. Generally, their health is stable and they have the physical, emotional, and spiritual reserves to handle life's difficulties.

The parents of adults in this age group are getting older and now need care. Most of the older adults in the United States are cared for by family members inside the home. Therefore, a middle adult may need to manage children who are leaving for college while at the same time care for parents who require greater assistance.

Older Adults (61 Years and Older)

Physical Changes

Older adults include those ages 61 and older **Figure 7-12**. **Life expectancy** is constantly changing. In the early 1900s, life expectancy was 47 years. It is now approximately 78 years, with maximum life expectancy estimated at 120 years. How long a person lives is based on many factors. Perhaps surprisingly, the year you were born and the country you live in can affect your life expectancy. These two facts are based on public health advances, changes within diets, attitudes regarding exercise, advances in medical care, access to that medical care, and personal behaviors. Cancer is the leading cause of death in ages 61 to 64 according to the CDC. In ages 65 and older, the leading cause of death is heart disease.

Figure 7-12 An older adult.

© Photodisc.

Special Populations

Be patient when interviewing older patients. Some older patients may have physical, cognitive, and psychologic barriers that may slow or interfere with their ability to communicate effectively.

YOU are the Provider — PART 4

After expressing your concern about the patient's health and advising him that driving himself to the hospital would not be safe, he agrees to be transported via EMS. You place the patient onto the stretcher, load him into the ambulance, and begin transport to a hospital located a short distance away. En route, you reassess his vital signs; assess his blood glucose level, which reads 100 mg/dL; and then call your radio report to the hospital.

Recording Time: 11 Minutes	
Level of consciousness	Conscious and alert
Respirations	14 breaths/min; regular and adequate
Pulse	80 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	180/102 mm Hg
Spo_2	99% (on oxygen)

6. What additional treatment, if any, does this patient require?

Figure 7-13 Older people are often prescribed multiple medications to help them stay active.

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Later in life, the vital signs depend on the patient's overall health, medical conditions, and use of medications. Today's older adults are staying active longer than their ancestors. Thanks to medical advances, they are often able to overcome numerous medical conditions, but may need multiple medications to do so **Figure 7-13**.

Cardiovascular System

Cardiac function declines with age as a result of anatomic and physiologic changes largely related to **atherosclerosis**. In this disorder, which most commonly affects coronary vessels, cholesterol and calcium build up inside the walls of blood vessels, forming plaque. The accumulation of plaque eventually leads to a partial or complete blockage of blood flow. More than 60% of people older than 65 years have atherosclerotic disease. This can lead to decreased blood supply to the organs of the body.

Other age-related changes typically include a decrease in heart rate, a decline in cardiac output (the amount of blood circulated each minute), and the inability to elevate cardiac output to match the demands of the body. This translates into a heart that is less able to respond to exercise or disease. In the event of a life-threatening illness, the body typically needs to increase the heart rate to ensure adequate blood pressure. Because heart muscle may weaken with age, the increase in heart rate can actually cause damage to the heart.

The vascular system also becomes stiff. For example, the diastolic blood pressure increases with age. Compensation for blood pressure changes is hampered because these vessels are less able to dilate and contract. As the blood vessels become stiffer, the heart must work harder to be able to move the blood effectively. These stiff blood vessels increase the workload of the heart.

Aging also affects blood cells. The body's blood cells originate from within the bone marrow. As a person ages, more of the bone marrow is replaced with fatty tissue. The decreased amount of bone marrow results in a decrease in the ability of the bones to manufacture more blood cells when needed. Although this change alone typically does not pose a problem, if an older adult sustains trauma, it will decrease the body's ability to produce new blood cells to replace lost cells. Finally, functional blood volume gradually declines over time.

Respiratory System

In older adults, the size of the airway increases and the surface area of the alveoli decreases. The natural elasticity of the lungs also decreases, forcing people to use the muscles between their ribs, called intercostal muscles, more to breathe. As the elasticity of the lungs decreases, the overall strength of the intercostal muscles and diaphragm also decreases. These factors together make breathing more labor intensive for older adults. You might think a rigid chest would offer more protection, but this rigidity actually makes the chest more fragile. Instead of the chest being able to bend and give if struck, the calcified chest can fracture. However, as with all of the physical changes related to aging, the changes in the respiratory system are often gradual and go unnoticed until a severe, life-threatening condition occurs. The older person will then have less respiratory reserve to use to maintain adequate breathing.

As the patient ages, the structures that protect the upper airway tend to decrease in function. For example, cough and gag reflexes diminish, as does the ability to clear secretions. The cilia that line the airways diminish and the innervation of the structures in the airway provides increasingly less sensation. This results in making it more difficult to maintain the upper airway, resulting in a greater risk of aspiration and airway obstruction.

When a younger patient inhales, the airway maintains its shape, allowing air to enter. As the smooth muscles of the lower airway weaken with age, strong inhalation can make the walls of the airway collapse inward and cause inspiratory wheezing. The collapsing airways result in low flow rates, because less air can move through the smaller airways, and air trapping, because air does not completely exit the alveoli (incomplete expiration). Also within the airways, the cells of the immune system are less functional. As a result of the overall decrease in the metabolic activity of the older body, the white blood cells found within the airways are less aggressive at fighting invading organisms. This leads to an increased risk of lung infections.

By age 75 years, the vital capacity (the volume of air moved during the deepest inspiration and expiration) may amount to only 50% of the vital capacity of a young adult. Factors contributing to this decline include loss of respiratory muscle mass, increased stiffness of the thoracic cage, and decreased surface area available for the exchange of air.

Physiologically, vital capacity decreases and residual volume (the amount of air left in the lungs after expiration of the maximum possible amount of air) increases with age. A lifetime of breathing, especially breathing air with high levels of pollution, causes the accumulation of pollutants in the lungs. As a consequence, stagnant air remains in the alveoli and hampers diffusion of gases. The net effect is that the respiratory system is increasingly less able to handle the stresses of disease. This is why a simple cold, which for a 30-year-old would mean a runny nose and body aches, could mean pneumonia and possible death for an 80-year-old.

Endocrine System

As with the other systems of the body, the function of the endocrine system gradually declines with age. Insulin production begins to drop off and metabolism decreases. As people get older, they tend to slow down their physical activity. Unfortunately, they do not decrease their food intake. When a person gains weight, more insulin is needed to control the body's metabolism and blood glucose (sugar) level. The pancreas may not be able to produce enough insulin for the person's body size, which can lead to diabetes mellitus.

The reproductive systems of both men and women change with age. Men are able to produce sperm long into their 80s but the rigidity of the penis tends to decrease over time. Women have a decrease in the size of the uterus and vagina. Hormone production gradually decreases for both genders as they age. Sexual desire may diminish with age but does not stop.

Digestive System

Changes in gastric and intestinal functions may inhibit nutritional intake and utilization in older adults. For example, taste bud sensitivity to salty and sweet sensations decreases. The sense of smell can also be diminished. A decrease in smell together with a decreased taste response is why older adults may find food bland and flavorless.

Saliva secretion decreases, which reduces the body's ability to process complex carbohydrates. Older people may have loss of teeth that impacts their ability to chew. The ability of the intestines to contract and move food along diminishes with age. This can lead older adults to feel constipated or not hungry. Likewise, gastric acid secretion diminishes. Blood flow may drop by as much as 50%, decreasing the ability of the intestines to extract vitamins and minerals from digested food. Gallstones become increasingly common with age, and anal sphincter changes reduce elasticity and can produce fecal incontinence.

Renal System

In the kidneys, both structural and functional changes occur in older adults. The filtration function of these organs, for example, declines by 50% from age 20 to 90 years. Kidney size decreases by 20% over the same span. This is due in part to the decreased effectiveness of the blood vessels that supply blood to the nephrons. **Nephrons** are sophisticated capillaries that perform filtering in the kidney. One of the portions of the nephron is called the *glomerulus*. The decreased blood supply causes more abnormal glomeruli to be present as a person ages. The number of nephrons also declines between the ages of 30 and 80 years. This loss of renal function means a decrease in the ability to clear waste from the body. It also means a decreased ability to conserve fluids when needed.

Nervous System

Nervous system changes can result in the most debilitating of age-related illnesses. In the central nervous system, the brain weight may shrink 10% to 20% by age 80. Motor and sensory neural networks become slower and less responsive. The metabolic rate in the older brain does not change, however, and oxygen consumption remains constant throughout life. Generally, you have fewer brain cells (neurons) today than you had yesterday. If measured strictly by numbers of brain cells, infants are far more intelligent than any of us.

However, this is not how the brain works. Although it is true older adults have a lower number of brain cells, there is great flexibility in the operation of the brain. Interconnections between brain cells continue as people age. These new connections provide redundancy within the brain, allowing for loss of neurons without loss of knowledge or skill.

One of the consequences of the loss of neurons is a change in the sleep patterns of older adults. Instead of sleeping through the night, they may take a nap during the day and be up late at night. Their sleep cycle may move into a biphasic (two-phased) sleep cycle—sleep from 0100 to 0600 hours and then a nap from 1200 to 1500 hours.

The brain, which is surrounded by the meninges, takes up almost all of the space in the skull. Cerebrospinal fluid protects the brain inside these membranes. In older adults, age-related shrinkage creates a void between the brain and the outermost layer of the meninges, which creates room for the brain to move when stressed **Figure 7-14**. If trauma forcefully moves the brain, the bridging veins can tear and bleed. Blood can empty into this void and may go unnoticed for some time.

Functioning of the peripheral nervous system also slows with age. Sensation becomes diminished and misinterpreted. The ability to know where the body is in space, the kinesthetic sense, can be diminished. Slower reactions cause longer delays between stimulation and motion. Slower reflexes and the decreased kinesthetic sense may contribute to the higher incidence of falls and trauma in older adults. Nerve endings deteriorate, and the ability of the skin to sense the surroundings becomes hindered. Hot, cold, sharp, and wet objects can all create dangerous situations because the body cannot sense them quickly enough.

Sensory Changes

It is often assumed that older people are hard of hearing and have difficulty seeing. There are changes that diminish the effectiveness of the eyes and ears; however, many older adults hear well and have good vision. They may need eyeglasses or hearing aids, but you should not assume that your older patient is deaf and nearly blind. Pupillary reaction and ocular movements become more restricted with age. The pupils are generally smaller in older patients, and the opacity of the eye's lens diminishes visual acuity and makes the pupils sluggish when responding to light. Visual distortions are also common in older people. Thickening of the lens makes it harder for the eye to focus, especially at close range. Peripheral fields of vision become narrower, and a greater sensitivity to glare constricts the visual field.

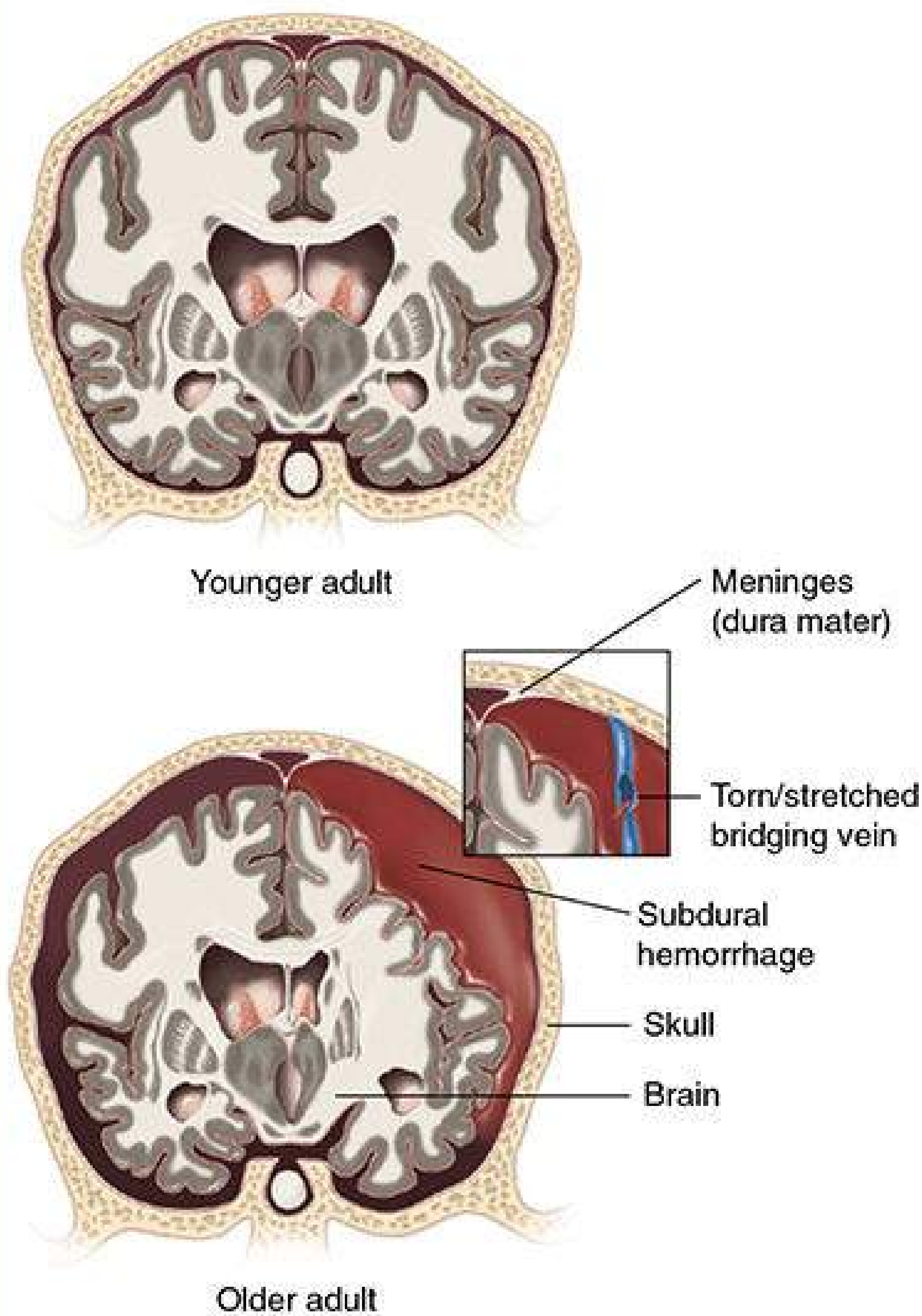

Figure 7-14 Age-related atrophy or shrinkage of the brain results in a space between the brain and its cover, the dura mater. Bleeding into this area can occur because veins are stretched.

Hearing loss is about four times more common than loss of vision in late adulthood. Changes in several hearing-related structures may lead to a loss of high-frequency hearing or even deafness.

Psychosocial Changes

You should value your opportunity to care for older adults as you do any patient. Many older adults have amazing stories and experiences to share, yet we often take them for granted. They share with us a great amount of wisdom, and we need to remind them of their self-worth. Until about 5 years before death, most late-stage adults retain high brain function; however, in the 5 years preceding death, mental function often declines.

As the older adult population continues to grow, you have the responsibility to seek out unique ways to accommodate their needs during their last 20 to 40 years of life. Statistics indicate 95% of older adults live at home. They may have the assistance of family, friends, or home health care, but they are shown to be relatively healthy, active, and independent. The increasing number of older adults in the United States as a result of the baby boom of the 1940s through the 1960s has produced a need for additional assisted-living facilities. These facilities allow older adults to live in campus-based communities with people in their own age group, while enjoying the independence and privacy of their own apartment and the security of nursing care, maintenance, and food preparation, if desired Figure 7-15. Unfortunately, these facilities can be expensive.

Most people need to deal with financial issues throughout their lives. Few things in life cause more worry and stress than money problems. Older adults, in particular, may constantly worry about rising health care costs and are often forced to make decisions such as whether to pay for groceries or their medication. Compared with earlier generations, many families today often take less responsibility for their older family members. Today, more than 50% of all single women in the United States who are 60 years of age or older are living at or below the poverty level. This problem is unresolved.

One of the important issues older adults face is their mortality. The fact is everyone dies; yet, for most of us, this concept is an intellectual exercise with a distant connection to reality. Older adults witness their friends and loved ones, with some of whom they have shared this life journey for half a century or more, die. As a result, older adults are challenged by isolation and depression.

Figure 7-15 A small percentage of older adults live in assisted-living facilities.

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Fortunately, many older adults are happy and actively participate in life. With good financial resources and a good support system of family and friends, adults in their 80s can enjoy life and continue to feel productive.

YOU are the Provider — SUMMARY

1. How does a patient's age affect your assessment?

The fundamental concepts of patient assessment are the same for all age groups. However, factors such as physical development, communication skills, behavior, and vital sign values vary with age. Communication with the patient is an integral part of the patient assessment process—especially the history-taking phase. Depending on the patient's age, communication can be relatively easy or extremely difficult.

Certain medical conditions that are common in one age group are uncommon in others. Determining a patient's risk factors for disease is an important part of the history-taking process and affects your index of suspicion. For example, it is rare—although not impossible—for an otherwise healthy 8-year-old child with chest pain to be experiencing a cardiac problem because children generally have healthy hearts. However, you should be suspicious of a cardiac problem if a 55-year-old patient with a history of high blood pressure—a major risk factor for cardiovascular disease—has the same symptoms.

Understanding which illnesses are common in various age groups will help you formulate a plausible field impression—that is, what you believe is wrong with the patient based on your assessment findings.

2. What are the physical differences between middle adults and older adults?

Middle adults (41 to 60 years of age) have reached the halfway point in human life expectancy. However, provided they are otherwise healthy, their vital signs and physical abilities usually remain consistent with those of early adults. Their average pulse rate is 70 beats/min, their respiratory rate is between 12 and 20 breaths/min, and their systolic blood pressure is between 90 and 140 mm Hg.

The age-related physical changes that occur in older adults (61 years of age and older) are more pronounced than they are in middle adults and affect nearly every organ and organ system in the body.

The vital signs of older adults are largely dependent on their underlying health and are often affected by medications taken. In general, however, age-related vital sign changes include a decrease in heart rate and an increase in diastolic blood pressure. The elasticity of the lungs also decreases, forcing this group to rely more on their intercostal muscles to breathe. In addition, the ribs become more rigid due to calcification, which adds to their breathing difficulty.

Other physical changes that occur during late adulthood include a decrease in metabolism and insulin production, which can lead to diabetes, decreased gastrointestinal function, decreased taste bud sensation, decreased kidney size and filtration (kidney function declines by 50% from age 20 to age 90), nervous system changes (including a 10% to 20% decrease in brain weight by 80 years of age) and sensory and motor nerve deterioration, and vision and hearing loss, among others.

The anatomic and physiologic changes that occur between middle and late adulthood must be taken into consideration during your assessment.

Keep in mind, however, that compared with middle adults, older adults often have fewer classic signs and symptoms of a wide variety of medical conditions.

3. What are some common psychosocial concerns experienced by middle adults?

During middle adulthood, many people's concerns center around finances. This often causes stress and uncertainty.

A unique psychosocial concern in middle adults relates to their children and their parents. As their children move away from home—which forces them to readjust their lifestyle ("empty nest" syndrome)—their own parents are getting older and now need care. Most middle adults prefer to care for their parents in their own home or in their parents' home; however, this often increases the stress and anxiety they are already experiencing from other factors such as finances or retirement.

4. Are the patient's vital signs consistent with his age?

The patient's heart rate and respiratory rate are consistent with his age. However, his blood pressure is not. A typical middle adult's systolic blood pressure ranges between 90 and 140 mm Hg; the diastolic blood pressure usually ranges between 70 and 80 mm Hg.

Ask the patient if he keeps a journal of his vital signs. If he does, ask him what his blood pressure typically reads; clearly, hypertension cannot be diagnosed based on a single blood pressure reading. If he keeps a journal and tells you his current blood pressure is consistent with what it normally reads, ask him if he is under a physician's care or being treated with any medication. If he is not, you should advise him to be evaluated by a physician; he may have hypertension and not be aware of it. Hypertension is often referred to as the "silent killer," and a blood pressure of 174/98 mm Hg is abnormal at any age.

5. Why should you transport this patient to the hospital?

This patient should not drive himself to the hospital. He experienced a syncopal episode, which could indicate a variety of underlying medical conditions—some of them potentially life threatening. The patient is light-headed, reports a headache, and is hypertensive. He should be informed that if he drives himself to the hospital, he could experience another syncopal episode while driving; this would jeopardize not only his own safety but also the safety of other motorists.

Although the patient is of legal age and has the decision making capacity to legally refuse EMS transport, you should make every effort to convince him to agree to EMS transport and advise him that his refusal could potentially result in death.

6. What additional treatment, if any, does this patient require?

Further treatment of this patient should be supportive. Continue to monitor his mental status and ABCs and make him comfortable. Dimming the lights in the back of the ambulance may provide him with some relief from his headache.

Remain alert for any changes in his neurologic status, such as slurred speech, unilateral weakness (weakness to one side of the body), or confusion, and contact the receiving facility if any changes are noted.

EMS Patient Care Report (PCR)

Date: 7-17-16	**Incident No.:** 060109	**Nature of Call:** Vital sign check		**Location:** EMS Station 2	
Dispatched: 1310	**En Route:** 1310	**At Scene:** 1310	**Transport:** 1324	**At Hospital:** 1330	**In Service:** 1339

Patient Information

Age: 50 **Sex:** M **Weight (in kg [lb]):** 86 kg (190 lb)	**Allergies:** No known drug allergies **Medications:** Vitamins **Past Medical History:** None **Chief Complaint:** Light-headedness, fainting, headache

Vital Signs

Time: 1315	**BP:** 174/98	**Pulse:** 76	**Respirations:** 14	**Spo_2:** 98%
Time: 1325	**BP:** 180/102	**Pulse:** 80	**Respirations:** 14	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ 4 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Blood glucose level assessment

Narrative

50-year-old man presented to EMS station 2 for routine vital sign check. Shortly after arrival, the patient stated he felt light-headed and needed to sit down. He stated he has been "stressed" about caring for his ill father, and has experienced several episodes of light-headedness over the past few days. He further stated he experienced a syncopal episode earlier today, but did not know how long he was unconscious. Upon presentation, he was conscious and alert; his airway was patent and his breathing was adequate. He denies any past medical history and stated he only wanted his vital signs checked. He further denies any medication allergies and states he only takes vitamins. Initial vital signs revealed an elevated blood pressure. After vital sign assessment, the patient reported a headache. Applied oxygen at 4 L/min via nasal cannula and reassessed his mental status; he remained conscious and alert. Advised patient that because of his elevated blood pressure, syncopal episode, light-headedness, and headache, EMS transport to the hospital for evaluation by a physician was wise. He stated he preferred to drive himself, because he did not feel transport via ambulance was necessary. Advised patient that driving himself was unsafe because he could experience another syncopal episode while driving. He was further advised that his signs and symptoms could signal a potentially life-threatening condition that only a physician could diagnose. After being informed of these potential consequences, the patient agreed to EMS transport. Placed patient onto the stretcher, loaded him into the ambulance, and began transport. The patient's condition remained unchanged en route. After dimming the lights in the back of the ambulance, he stated his headache improved slightly, but he was still light-headed. Reassessed his vital signs and assessed his blood glucose level, which read 100 mg/dL. Duration of transport was uneventful, and the patient was delivered to the emergency department without incident. After giving verbal report to the charge nurse, Medic 2 returned to service.**End of report**

Prep Kit

Ready for Review

- Each developmental stage is marked by different physical and psychosocial changes and characteristics; infants (1 month to 1 year) develop at a surprising rate.
- The vital signs of toddlers (ages 1 to 3 years) and preschoolers (ages 3 to 6 years) differ somewhat from those of an infant. During this stage, children learn to speak and express themselves.
- From ages 6 to 12 years, the school-age child's vital signs and body gradually approach those observed in adulthood. During this stage, children develop self-esteem.
- The vital signs of adolescents (ages 12 to 18 years) begin to level off within the adult ranges. Adolescents focus on creating their self-image.
- Early adults are people who are age 19 to 40 years. Early adults focus on work and family.
- Middle adults are people who are age 41 to 60 years. Middle adults focus on achieving life goals.
- Older adults are people who are age 61 years and older. Older adults focus on their mortality and the mortality of friends and loved ones.
- Vital signs do not vary greatly throughout adulthood.

Vital Vocabulary

adolescent A young person age 12 to 18 years.

atherosclerosis A disorder in which cholesterol and calcium build up inside the walls of the blood vessels, forming plaque, which eventually leads to a partial or complete blockage of blood flow.

barotrauma Injury caused by pressure to enclosed body surfaces, for example from too much pressure in the lungs.

conventional reasoning A type of reasoning in which a child looks for approval from peers and society.

early adult A young adult age 19 to 40 years.

fontanelles Areas where the neonate's or infant's skull has not fused together; usually disappear at approximately 18 months of age.

infant A young child age 1 month to 1 year.

life expectancy The average number of years a person can be expected to live.

middle adult An adult age 41 to 60 years.

Moro reflex An infant reflex in which, when an infant is caught off guard, the infant opens his or her arms wide, spreads the fingers, and seems to grab at things.

neonate A newborn age birth to 1 month.

nephrons The basic filtering units in the kidneys.

older adult An adult age 61 years or older.

palmar grasp An infant reflex that occurs when something is placed in the infant's palm; the infant grasps the object.

postconventional reasoning A type of reasoning in which a child bases decisions on his or her conscience.

preconventional reasoning A type of reasoning in which a child acts almost purely to avoid punishment to get what he or she wants.

preschooler A child age 3 to 6 years.

rooting reflex An infant reflex that occurs when something touches an infant's cheek, and the infant instinctively turns his or her head toward the touch.

school age A person who is 6 to 12 years of age.

sucking reflex An infant reflex in which the infant starts sucking when his or her lips are stroked.

toddler A young child age 1 to 3 years.

trust and mistrust Refers to a stage of development from birth to approximately 18 months of age, during which infants gain trust of their parents or caregivers if their world is planned, organized, and routine.

Assessment *in Action*

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You are called to an assisted-living facility where a 72-year-old woman has fallen. While en route, you consider the implications of a fall for someone 72 years old.

When you arrive you are greeted in the lobby by one of the nurses. He tells you the patient takes several medications and he found her on the floor in the bathroom.

1. Which of the following is the LEAST likely cause of a fall in a patient of this age?
   - **A.** Hypertension
   - **B.** Hypotension
   - **C.** Balance issues
   - **D.** Muscle weakness
2. Which of the following should be expected when you assess the patient's pupils?
   - **A.** Slower pupillary reaction
   - **B.** Vision deficit
   - **C.** Fixed, dilated pupils
   - **D.** Unequal pupils
3. Which of the following statements is true regarding communication with older adults?

A. You must speak loudly so the patient will hear you.
B. Communication may be difficult since the weight of the brain shrinks up to 40% by age 80.
C. It may take older adult patients more time to respond to your questions.
D. Place yourself directly in front of the patient since peripheral vision narrows as the patient becomes older.

4. Changes in which of the following body systems can result in the most debilitating of age-related illnesses?

A. Nervous
B. Renal
C. Sensory
D. Endocrine

5. Which of the following affects vital signs the most in older adults?

A. Patient's immune system
B. Overall health of the patient
C. Patient's cardiovascular system
D. Patient's diet

6. Who provides the most care for older adults in the United States?

A. Home health nurses
B. Nursing homes
C. Family members
D. An assisted-living facility

7. What influence will the medications the patient takes have on the potential reason for the fall?
8. Describe some of the contributors that affect life expectancy.
9. List at least three psychosocial issues people experience during late adulthood.
10. Why is there an increased need for additional extended care facilities?

CHAPTER

8

Lifting and Moving Patients

Courtesy of Rhonda Hunt.

National EMS Education Standard Competencies

EMS Operations

Knowledge of operational roles and responsibilities to ensure patient, public, and personnel safety.

Knowledge Objectives

1. Explain the need and use of the most common patient-moving equipment, the stretcher and backboard. (pp 261–263)
2. Explain the technical skills and general considerations required of EMTs during patient packaging and patient handling. (p 263)
3. Define the term body mechanics. (p 264)
4. Discuss how following proper patient lifting and moving techniques can help prevent work-related injuries. (pp 263–264)
5. Identify how to avoid common mistakes when lifting and carrying a patient. (pp 265–267)
6. Explain the power grip and sheet or blanket methods for lifting a patient. (pp 267–269)
7. Explain the general considerations required of EMTs to safely move patients without causing the patient further harm and while protecting themselves from injury. (pp 271–274)
8. Explain how to carry patients safely on stairs, including the selection of appropriate equipment to aid in the process. (pp 274–276)
9. Describe specific situations in which an urgent move or rapid extrication may be necessary to move a patient; include how each one is performed. (pp 283–287)
10. Describe specific situations in which a nonurgent move may be necessary to move a patient; include how each one is performed. (pp 288–293)
11. Explain the special considerations and guidelines related to moving and transporting geriatric patients. (pp 293–296)
12. Define the term bariatrics. (p 296)
13. Discuss the guidelines for lifting and moving bariatric patients. (pp 295–297)
14. Explain the need and use for additional patient–moving equipment (specialized); include examples. (pp 296–300)
15. Know the importance of decontaminating equipment in the prevention of disease transmission. (p 300)

16. Describe proper positioning for the following conditions: (p 301)
    - Unresponsive patients without suspected spine injury
    - Patients with chest pain, discomfort, or difficulty breathing
    - Patients with suspected spine injury
    - Pregnant patients with hypotension
    - Patients who are nauseated or vomiting
17. Discuss situations that may require the use of medical restraints on a patient. (pp 301–302)
18. Explain guidelines and safety considerations for the use of medical restraints. (pp 301–302)

Skills Objectives

1. Perform a power lift to lift a patient. (p 266, Skill Drill 8–1)
2. Demonstrate a power grip. (p 267)
3. Demonstrate the body mechanics and principles required for safe reaching and pulling, including the technique used for performing log rolls. (pp 267–269)
4. Perform the diamond carry to move a patient. (p 272, Skill Drill 8–2)
5. Perform the one–handed carry to move a patient. (p 273, Skill Drill 8–3)
6. Perform a patient carry using a stair chair to move a patient down the stairs. (p 275, Skill Drill 8–4)
7. Perform a patient carry to move a patient down the stairs on a backboard. (pp 276–277, Skill Drill 8–5)
8. Demonstrate how to load a stretcher into an ambulance. (pp 276–281, Skill Drill 8–6)
9. Demonstrate how to perform an emergency or urgent move. (pp 281–287)
10. Perform the rapid extrication technique to move a patient from a vehicle. (pp 283–287, Skill Drill 8–7)
11. Perform the direct ground lift to lift a patient. (pp 288–289, Skill Drill 8–8)
12. Perform the extremity lift to move a patient. (pp 290–291, Skill Drill 8–9)
13. Perform the direct carry to move a patient. (pp 291–292, Skill Drill 8–10)
14. Demonstrate how to use the draw sheet method to transfer a patient onto a stretcher. (pp 291–293)
15. Use a scoop stretcher to move a patient. (pp 292–294, Skill Drill 8–11; p 300)
16. Demonstrate the correct use of medical restraints on a patient. (pp 301–302)

Introduction

In the course of a typical call, you will have to move the patient several times to provide emergency medical care and transport. Once you have assessed the patient and provided emergency care, the patient is generally moved onto a backboard or stretcher. At a minimum, you will have to lift and carry the patient to the stretcher, move the stretcher to the ambulance, and load the stretcher into the patient compartment. Upon arrival at the hospital, the patient must be removed from the ambulance, wheeled into the emergency department (ED), and transferred to the ED bed. To avoid injury to the patient, yourself, or your team, you need to learn how to lift and carry a patient properly, using proper body mechanics and a power grip.

To move a patient safely and properly in the various situations that you may encounter in the field, it is necessary to learn how to perform emergency body drags and lifts, rapidly extricate a patient from a vehicle onto the stretcher, assist a patient from a chair or bed onto the stretcher, lift a patient from the floor onto the stretcher, and manually carry a patient up or down stairs. You and your team should know how to place a patient with a suspected spinal injury onto an immobilization device and how to package patients with and without suspected spinal injury. At times, you and your team may need to move a patient who is very heavy or carry a patient on a trail or across rugged terrain. Special techniques for loading and unloading the stretcher and transferring the patient from the stretcher to an examining table or bed in the ED are necessary.

Lifting and carrying are dynamic processes. To avoid unexpected, dangerous shifts in weight and to reduce the risk of injury to yourself, your partner, and the patient, you and your team should practice these techniques often. You must know where each EMT should be positioned and how to give and receive lifting commands so that all parties act simultaneously. You also need to know how to properly use patient-moving devices, such as a wheeled ambulance stretcher, stair chair, backboard, scoop stretcher, folding ambulance stretcher, basket stretcher, flexible stretcher, and any other equipment your service may carry. You must also know which device or combination of devices is appropriate for the current situation. This chapter will cover lifting, carrying, and reaching techniques as well as principles of moving patients, including emergency, urgent, and nonurgent moves, and the use of physical restraints to protect the patient and your team from further harm. In addition, different types of equipment and patient positioning will be discussed in detail.

The Wheeled Ambulance Stretcher

The **wheeled ambulance stretcher** (also called an ambulance stretcher, gurney, or simply the stretcher) is the most commonly used device to move and transport patients. The wheeled ambulance stretcher is a specially designed stretcher that can be rolled along the ground and weighs between 40 and 145 lb (18 and 66 kg), depending on its design and features **Figure 8-1**. Because its weight must be added to that of the patient and any equipment needed for immediate patient care, it is generally not taken up or down stairs or to other locations where the patient must be carried for any significant distance. Moving a patient by rolling, using a stretcher or other wheeled device, is preferred when the situation allows and helps prevent injuries from carrying.

Figure 8-1 The wheeled ambulance stretcher is specially designed to roll along the ground.

Words of Wisdom

Patients are typically transported on the wheeled ambulance stretcher. Only when you must transport two patients in the same ambulance should it be necessary to transport one patient on a folding stretcher or backboard placed on the long squad bench.

The modern stretcher is available in a number of different models, which may include different features. Before going on a call, familiarize yourself with the specific features of the stretcher that your ambulance carries. You must know where to locate the controls to adjust and lock each feature and how each works.

The stretcher has a specific head end and foot end. The stretcher has a strong, rectangular, tubular metal main frame to which all of its other parts are attached. The stretcher should be pulled, pushed, and lifted only by its main frame or handles, which are attached to the main frame specifically for this purpose.

On most models, a second tubular frame made up of three sections is attached within or above the main frame. A metal plate is fastened to each of the three sections between its sides. This plate serves as the platform on which the stretcher mattress and patient are supported. The head section runs from the head end of the stretcher to near the center of the stretcher, where the patient's hips will be. Hinges at the area where the hips will be allow the head end to be elevated and the patient's back to be positioned at any desired angle from flat to fully upright. The head end of the stretcher is designed to be elevated or moved down only when a tilt control is purposely released. At all other times, the back will remain locked at the position in which it was placed. The frame and plates that lie from the hips to the foot end of the stretcher are divided into two hinged sections. These sections may be connected so that the foot end can be drawn in toward the knees, causing the frame and plates to hinge upward under the patient's knees to elevate them as desired. This feature is not found in all models.

A retractable guardrail is attached along the central portion of the main frame of the stretcher at each side and is lowered out of the way when a patient is being loaded onto the stretcher. Once the patient has been properly placed on the stretcher, the handle is drawn up and locked in an elevated position perpendicular to the surface of the stretcher. The patient cannot roll off either side of the stretcher even if a securing strap becomes released. The guardrail at each side can be lowered only if its locking handle is released.

The underside of the main frame of the stretcher is supported on a folding undercarriage that has a smaller, horizontal, rectangular frame and four large rubber casters at its bottom end. The folding undercarriage is designed so that the litter can be adjusted to any height from about 12 inches (30 cm) above the ground, which is the desired height when the stretcher is secured in the ambulance, to 32 to 36 inches (81 to 91 cm) above the ground, which is the desired height when the stretcher is being rolled. Because you are able to lock the stretcher at any height between its lowest height and its fully extended height, it can be locked at the same height as any bed or examining table to allow the patient to be slid from one to the other. This permits you to transfer the patient without the need for any additional lifting. The controls for folding the undercarriage are designed so that the stretcher remains locked at its present height when the controls are not being activated. As an additional safety feature on most stretchers, the main frame must be slightly lifted to remove all weight from the undercarriage before it will fold, even if the control is pulled. Therefore, if the handle is accidentally pulled, the elevated stretcher will not suddenly drop. Controls for elevating and lowering most stretchers are located at the foot end and at one or both sides. You and your partner must use the proper lifting mechanics to lift the wheeled ambulance stretcher.

The mattress on a stretcher must be fluid resistant so that it does not absorb any type of potentially infectious material, including water, blood, or other body fluid.

Patients must always be secured with the straps on the stretcher. In the event of a crash while en route to the hospital, these help prevent the patient from further injury.

Backboards

A **backboard** is a long, flat board made of rigid, rectangular material Figure 8-2. Backboards are also called long backboards, spine boards, trauma boards, or longboards. A backboard is used to carry patients and to immobilize supine patients with suspected hip, pelvic, spinal, and lower extremity injuries or other multiple trauma in accordance with local protocols. Backboards can also be used to move patients out of awkward places.

Backboards are 6 to 7 feet long (approximately 2 m) and are commonly used for patients who are found lying down. Parallel to the sides and ends of the backboard are a number of long holes that are about 0.5 to 1 inch (1 to 2.5 cm) from the outer edge. These holes form handles and handholds so that the board can be easily grasped, lifted, and carried. The handles and adjacent holes also allow the patient to be secured to the board using straps located at each side and end of the backboard.

Figure 8-2 A backboard is used to transfer patients who must be moved in a supine or immobilized position.

For many years, backboards were made of thick marine plywood whose surface was sealed with polyurethane or another marine varnish. Wooden backboards are still used in some places. If your service uses wooden backboards, you must follow infection control procedures before you can reuse them. Where wooden backboards are no longer used, they have generally been stored so that they will be available in the event of a mass-casualty situation. Newer backboards are made of lighter plastic materials that will not absorb blood or other infectious substances.

Moving and Positioning the Patient

Every time you have to move a patient, special care must be taken so that neither you, your team, nor the patient is injured. Patient packaging and handling are technical skills that you will learn and perfect through repeated training and practice. Every year, a significant number of EMTs are injured when they attempt to lift and move patients. Even when you are lifting, moving, or transferring relatively lightweight patients, the need for proper body mechanics should remain paramount. Occasionally injuries occur when proper lifting techniques are utilized; however, using proper body mechanics and maintaining physical fitness greatly reduce the chance of injury.

Moving a patient should normally be done in an orderly, planned, and unhurried manner. This approach will protect you and the patient from further injury and reduce the risk of worsening the patient's condition when he or she is moved. Therefore, practice each technique with your team often so that when you must move a patient, you can perform the move quickly, safely, and efficiently. You must also master the skills necessary for the use of all equipment and understand the advantages and limitations of each device before you use it in the field. After each patient transfer, you and your team should evaluate the appropriateness of the technique that you used, as well as your technical skill in completing the transfer. You must also be sure to maintain your equipment according to the manufacturer's instructions. Using clean, well-maintained equipment is a critical part of providing high-quality patient care.

After delivering the patient to the ED, you and your team must begin preparation for your next call by reviewing the positive points about the transport and discussing changes that would improve the next run. This process of evaluation should help you identify the following:

- Procedures that need more practice
- Equipment that needs to be cleaned or serviced
- Skills that you need to review or acquire

YOU are the Provider PART 1

You are dispatched to a motor vehicle crash with an overturned vehicle. You arrive on scene to find a 4-door sedan lying on the passenger's side in a deep ditch partially filled with water. The vehicle is resting on a concrete pipe and a metal signpost. There are two patients who were unrestrained at the time of the crash. Patient 1 (the driver) is an older man who is unresponsive. You note that his skin is ashen with cyanosis around his lips. He is crumpled in a semi-supine position over the second patient. Only the top of the head of Patient 2 (the passenger) is visible, but she is obviously alert and able to speak with you. She tells you the water inside the vehicle is up to her waist.

1. What immediate challenges do you face?
2. Why is knowledge of body mechanics important when lifting and moving a patient?
3. What other resources are needed?

Most important, a critical review helps you and your team to become more confident and better skilled EMTs.

Body Mechanics

Anatomy Review

The shoulder girdle rests on the rib cage and is supported by the vertebrae that lie inferior to it. The arms are connected to and hang from the shoulder girdle. When a person stands upright, the individual weight-bearing vertebrae are stacked on top of each other and aligned over the sacrum. The sacrum is both the mechanical weight-bearing base of the spinal column and the fused central posterior section of the pelvic girdle. **Body mechanics** is the relationship between the body's anatomical structures and the physical forces associated with lifting, moving and carrying; in other words, the ways in which the body moves to achieve a specific action. Maintaining proper posture and body movement during daily activities is applying the use of body mechanics. Using good body mechanics while lifting and moving patients reduces your risk of injury.

When a person stands upright, the weight of anything being lifted and carried in the hands is reflected onto the shoulder girdle, the spinal column inferior to it, the pelvis, and then the legs **Figure 8-3**. In lifting, if the shoulder girdle is aligned over the pelvis and the hands are held close to the legs, the force that is exerted against the spine occurs in an essentially straight line down the vertebrae in the spinal column. Therefore, with the back properly maintained in an upright position, very little strain occurs against the muscles and ligaments that keep the spinal column in alignment, and significant weight can be lifted and carried without injury to the back **Figure 8-4**. However, you may injure your back if you lift while leaning forward, or even if straight, bent significantly forward at the hips **Figure 8-5**. With the back in either of these positions, the shoulder girdle lies significantly anterior to the pelvis, and the force of lifting is exerted primarily across, rather than down, the spinal column. When this occurs, the weight is supported by the muscles of the back and ligaments that run from the base of the skull to the pelvis, keeping the spinal column in alignment, rather than by each vertebral body and disk resting on those aligned below it. In addition, the upper spine and torso serve as a lever so that the force that is exerted against the muscles and ligaments in the lumbar and sacral regions, as a result of the mechanical advantage produced, is many times that of the combined weight of your upper body and the object you are lifting. Therefore, the first key rule of lifting is to always keep your back in a straight, upright (vertical) position and lift without twisting. Always face the patient and point your feet in the same direction. After lifting the patient, change the direction of your feet as opposed to twisting or turning from the waist.

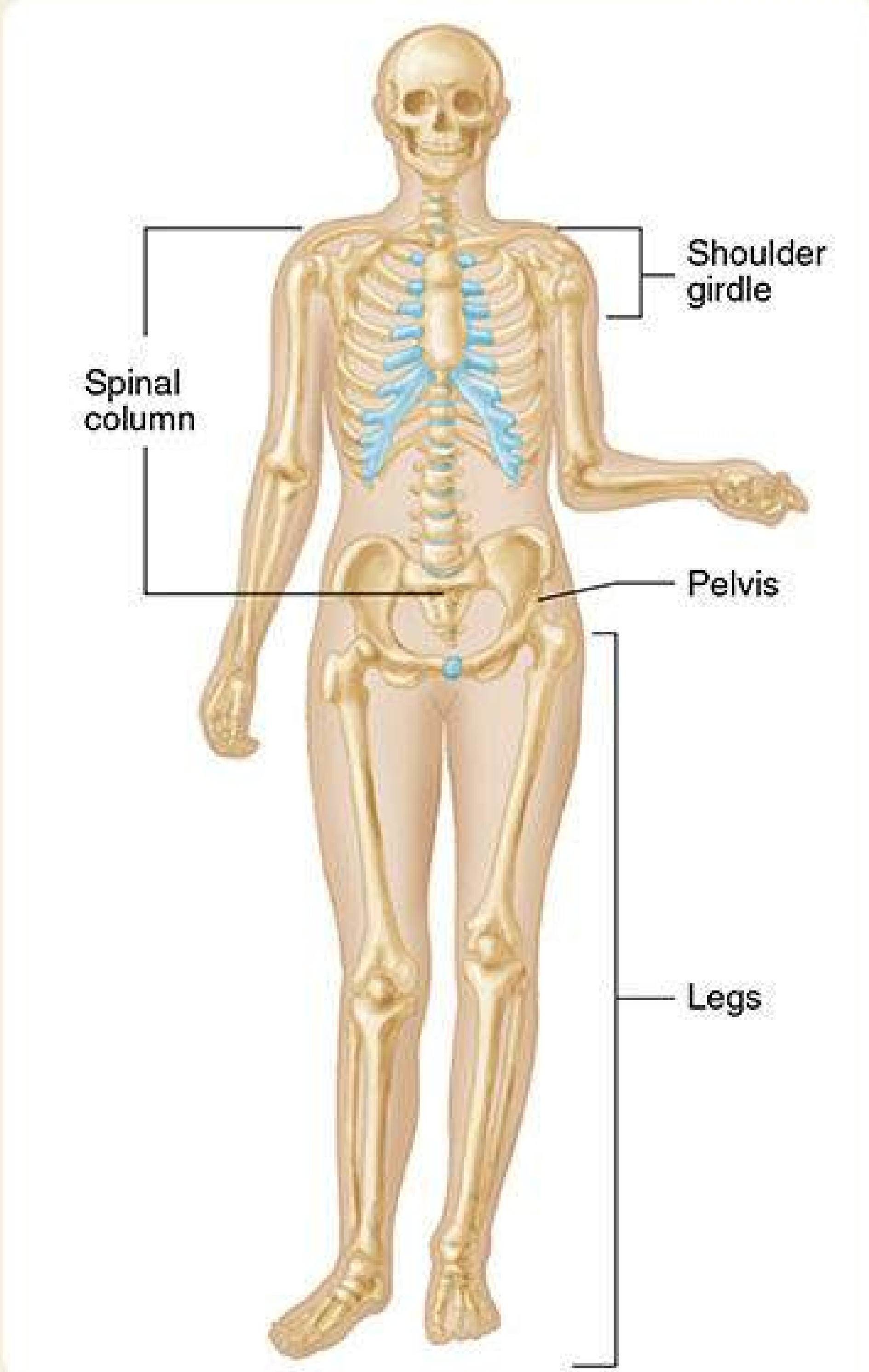

Figure 8-3 When you stand upright, the weight of anything that you lift and carry in your hands is borne by the shoulder girdle, the spinal column, the pelvis, and the legs.

When lifting, spread your legs about 15 inches (38 cm) apart (shoulder width) and place your feet so that your center of gravity is properly balanced between them. Then, with the back held upright, bring your upper body down by bending the legs. Once you have properly grasped the patient or stretcher and made any necessary adjustments in the location of your feet, lift the patient by straightening your legs until you are in a standing position and then curling your arms up to waist height. If you have still not reached the desired height, reposition your legs so they are closer together and repeat the process. Because the leg muscles are regularly exercised by walking, climbing stairs, or running, they are well developed and extremely strong. Therefore, as well as being the safest method, lifting by extending the properly placed flexed legs is also the most powerful way to lift. This method is appropriately called a **power lift**. The power lift position is also useful if you have weak knees or thighs.

Figure 8-4 If your body is properly aligned when you lift, the line of force exerted against the spine occurs in an essentially straight line down the vertebrae. In this way, the vertebrae support the lift.

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Figure 8-5 This photo demonstrates an incorrect method of lifting. You may be injured if you lift with your back curved because the lifting force is exerted primarily across, rather than down, the spinal column. When this occurs, the muscles of the back, not the vertebrae, are supporting the lift.

Words of Wisdom

The stretcher is designed so that the patient's head is slightly higher than the feet. Always position the tallest EMTs at the head of the stretcher when lifting to offset the difference in the height of the stretcher.

One mistake to avoid while performing a lift is lifting a patient or other heavy object with your arms outstretched. Even if your back is held properly upright, adverse forces across the spinal column and leverage against the low back will occur if your hands are significantly anterior to the plane described by the front of the torso (the plane consists of the anterior torso and imaginary lines extended vertically above and below it). Whenever you lift or carry a patient, be sure to hold your arms so that your hands are almost adjacent to the plane described by your anterior torso, and always keep the weight that you are lifting as close to your body as possible.

Another rule to remember when lifting is to avoid placing lateral force across the spine and sideways leverage against the low back. If you lift with only one arm or with the arms extended more to one side than the other, more force will be exerted against one side of the shoulder girdle than the other, causing lateral force to be exerted across the spinal column. To prevent this, keep your arms approximately the same distance apart as when hanging at each side of the body, with the weight distributed equally and properly centered between them. If the weight is not balanced between both arms or properly centered between the shoulders when you are preparing to lift, turn and/or move to the left or right until the weight is properly balanced and centered. To lift safely and produce the maximal power lift, take the following steps **Skill Drill 8-1**:

1. Tighten your back in its normal upright position, and use your abdominal muscles to lock it in a slight curve.
2. Spread your legs apart about 15 inches (38 cm), and bend your legs to lower your torso and arms.
3. With arms extended down each side of the body, grasp the stretcher or backboard with your hands held palm up and just in front of the plane described by the anterior torso and imaginary lines extending vertically from it to the ground.

4. Adjust your orientation and position until the weight is balanced and centered between both arms Step 1.
5. Reposition your feet as necessary so that they are about 15 inches (38 cm) apart with one slightly farther forward and rotated so that you and your center of gravity will be properly balanced between them. Be sure to straddle the object, keep your feet flat, and distribute your weight to the balls of the feet or just behind them. The knees should not bend more than 90 degrees, nor extend past the toes.
6. With the arms extended downward, lift by straightening your legs until you are fully standing. Make sure your back is held upright and that your upper body comes up before your hips Step 2.

Skill Drill 8-1 Performing the Power Lift

Step 1

Lock your back in a slight curve. Spread and bend your legs. Grasp the backboard, palms up and just in front of you. Balance and center the weight between your arms.

Step 2

Position your feet, straddle the object, and distribute your weight evenly. Lift by straightening your legs, keeping your back locked in.

Reverse these steps whenever you are lowering the stretcher. Always remember to avoid bending at the waist and twisting as you stand.

Your safety, as well as that of the other EMTs and the patient, depends on the use of proper lifting techniques and maintaining a proper hold when lifting or carrying a patient. If you do not have proper hold of the stretcher or of the patient in a body lift, you will not be able to bear a proper share of the weight, and there is an increased chance that you can suddenly lose your grasp with one or both hands. If you temporarily lose your grasp, the position and weight distribution of the stretcher will change suddenly, and the other team members must quickly overextend beyond a safe distance to avoid dropping the patient. As a result, sudden excessive force may be placed across each one’s spine, causing low back injury.

You should use the **power grip** to get the maximum force from your hands whenever you are lifting a patient **Figure 8-6**. The arm and hand have their greatest lifting strength when facing palm up. Whenever you grasp a stretcher or backboard, your hands should be at least 10 inches (25 cm) apart. Each hand should be inserted under the handle with the palm facing up and the thumb extended upward. Next, advance the hand until the thumb prevents further insertion and the cylindrical handle lies firmly in the crease of your curved palm. Curl your fingers and thumb tightly over the top of the handle. All your fingers should be at the same angle. To have the proper power grip, make sure that the underside of the handle is fully supported on your curved palm with only the fingers and thumb preventing it from being pulled sideways or upward out of the palm.

Figure 8-6 To perform the power grip, grasp the handle of the stretcher or backboard with your palms up and your thumbs extending up. Make sure your hands are about 10 inches (25 cm) apart and that your fingers are all at the same angle. The underside of the handle should be fully supported by the palms of your hands.

If you must lift the object higher once you have lifted by extending your legs, you will be able to "curl" the object higher by using your biceps to flex the arms while maintaining the power grip and weight supported in the palms.

Never grasp a stretcher or backboard with the hand placed palm down over the handle. When you are lifting with the palm down, the weight is supported by the fingers rather than the palm. This hand orientation places the tips of the fingers and thumb under the handle. If the weight forces them apart, your grasp on the handle will be lost.

When directly lifting a patient, tightly grip the patient in a place and manner that will ensure that you will not lose your grasp on the patient. If at all possible, use a draw sheet or other approved lifting device so you are not pulling directly on the patient's skin (discussed later in the chapter). This is especially important when lifting patients who are either heavy and/or older.

Words of Wisdom

Regardless of patient size or use of proper body mechanics, the potential for injury is present. There are many commercial devices available for lifting and moving patients that help to protect you, including soft stretchers, tarps, and sliding boards. Patients may also be lifted with equipment such as a sling lift, which does not require additional assistance for lifting and moving. With a sling lift, a sling is slid under the patient's body. Loops on the corners of the sling's fabric attach to a hydraulic lift, and the patient is safely hoisted from the bed or chair into position (a method similar to the draw sheet method).

Principles of Safe Reaching and Pulling

The same basic body mechanics and principles apply to moving, lifting, and carrying a patient.

When you use a body drag to move a patient, your back should always be locked in a slight curve created by tightening your abdominal muscles, not curved laterally or bent laterally. It should be held in its normal upright position. Avoid any twisting so that the vertebrae remain in their normal alignment. When you reach overhead, avoid hyperextending your back. When you pull a patient who is on the ground, always kneel to minimize the distance that you will have to lean over **Figure 8-7A**. To keep your reach within the recommended distance, reach forward and grasp the patient so that your elbows are just beyond the anterior torso **Figure 8-7B**. When you pull a patient who is at a different height from you, bend your knees until your hips are just below the height of the plane across which you will be pulling the patient. During pulling, extend your arms no more than about 15 to 20 inches (38 to 50 cm) in front of your torso. Reposition your feet (or knees, if kneeling) so that the force of pull will be balanced equally between both arms and the line of pull will be centered between them **Figure 8-7C**. Pull the patient by slowly flexing your arms. When you can pull no farther because your hands have reached the front of your torso, stop and move back another 15 to 20 inches (38 to 50 cm). Then, when properly positioned, repeat the steps. Alternate between pulling the patient by flexing your arms and then repositioning yourself so that your arms are again extended with your hands about 15 inches (38 cm) in front of your torso. By not moving yourself and the patient simultaneously, you will prevent undesirable jostling of the patient and the chance that sudden force will occur across your spine. You should also try to prevent injury to yourself by avoiding situations that involve strenuous effort lasting more than 1 minute.

If you must drag a patient across a bed, kneel on the bed to avoid reaching beyond the recommended distance. Then follow the steps described previously until the patient is within 15 to 20 inches (38 to 50 cm) of the bed's edge (see Figure 8-7). You can then complete the drag while standing at the side of the bed. Rather than dragging the patient by his or her clothing, use the sheet or blanket under the patient for this purpose. You can roll the bedding under the patient until it is about 6 inches (15 cm) wider than the patient. Pull on the rolled bedding smoothly and evenly to glide the patient to the bedside.

Unless the patient is on a backboard, transfer the patient from the stretcher to a bed in the ED or the patient's hospital room with a body drag. With the stretcher at the same height as the bed or slightly higher and held firmly against the bed's side, you and another EMT should kneel on the hospital bed and, in the manner previously described, drag the patient in increments until he or she is properly centered on the bed. When transferring the patient onto a narrow examining table, rather than kneeling on the table, you can usually drag the patient while standing against the opposite side. A third person may need to take both sides of the head to move the patient safely.

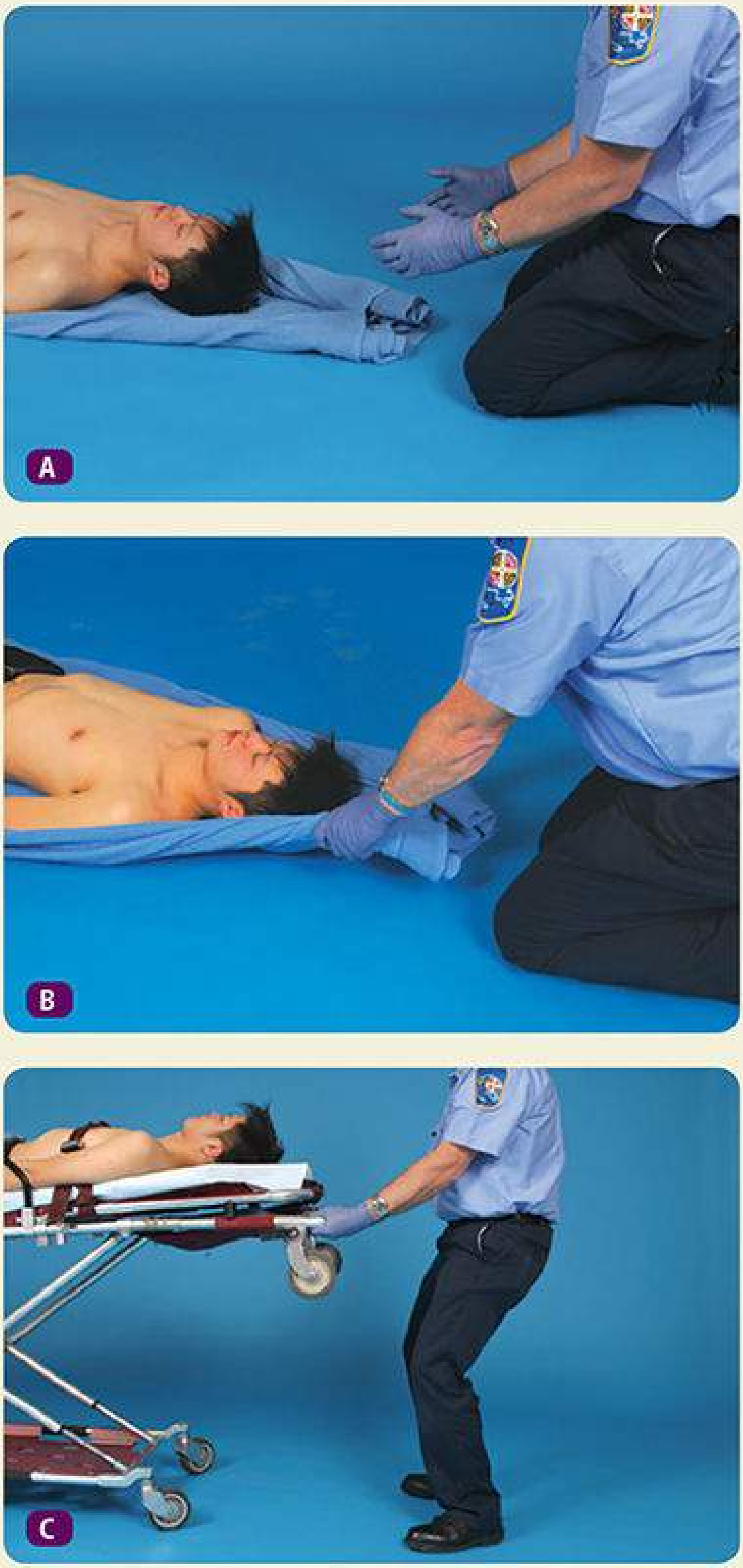

Figure 8-7 Reaching and pulling safely. **A.** Kneel to pull a patient who is on the ground. **B.** When pulling, your elbows should only extend just beyond the anterior torso. **C.** Bend your knees to pull a patient who is at a different height than you are. Position your feet or knees to balance the force of pull.

Sometimes during a body drag, you and another EMT may have to pull the patient with one of you on each side of the patient. You will have to alter the usual pulling technique to prevent pulling sideways and producing adverse lateral leverage against your lower back. Position yourself by kneeling just beyond the patient's shoulder and facing toward his or her groin **Figure 8-8A**. By extending one arm across and in front of your chest, you can grasp the armpit and, with your other arm extended in front and to the side of the patient's torso, the patient's belt. Then, by raising your elbows and flexing your arms, you can pull the patient with the line of force at the minimum angle possible **Figure 8-8B**.

Words of Wisdom

When moving a patient, you may grab his or her belt to assist with the move. However, do not use pockets or belt loops that may tear with the patient's weight.

Figure 8-8 A body drag with an EMT on each side of the patient. **A.** Kneel just beyond the patient's shoulder facing his or her groin. Extend one arm across and in front of your chest, and grasp the armpit. Extend your other arm in front and to the side of the patient's torso, and grasp the patient's belt. **B.** Raise your elbows and flex your arms to pull the patient.

Generally, when log rolling a patient onto his or her side, you will initially have to reach farther than 18 inches (46 cm) **Figure 8-9**. To minimize this distance, kneel as close to the patient's side as possible, leaving only enough room so that your knees will not prevent the patient from being rolled. When you lean forward, keep your back straight and lean solely from the hips. Be sure to use your shoulder muscles to help with the roll. To minimize the amount of time you are extended like this and to support the patient's weight, roll the patient without stopping until the patient is resting on his or her side and braced against your thighs. Pulling toward you allows your legs to prevent the patient from rolling over completely and from rolling beyond the intended distance.

Words of Wisdom

You will often be called upon to lift a patient in tandem with someone you have never worked with before. Pay attention to what each other is doing, and verbalize your actions to decrease the risk of dropping the patient or hurting one another. If you have the chance to practice lifts with a new partner prior to your first call together, do so.

Figure 8-9 When placing a patient onto a backboard, log roll the patient onto his or her side. Kneel as close to the patient's side as possible, leaving only enough room so that your knees will not prevent the patient from being rolled. Lean forward, keeping your back straight and leaning solely from the hips. Use your shoulder muscles to help with the roll.

YOU are the Provider — PART 2

Due to the critical condition of Patient 1, you immediately request paramedic backup. Because of the position of the vehicle and the patients, you determine that the patients are entrapped and that the vehicle is potentially unstable. You ask dispatch to send a rescue unit to assist with stabilizing the vehicle and extricating the victims. The rear driver's side door was wedged open as a result of the crash. You are able to look through and perform a modified primary assessment on the patients while waiting for further assistance.

Patient 1

Recording Time: 0 Minutes	
Appearance	Motionless; ashen skin with cyanosis around the mouth
Level of consciousness	Unresponsive
Airway	Snoring respirations
Breathing	Increased rate; shallow depth
Circulation	Unable to reach patient to feel for pulse; no obvious bleeding

Patient 2

Recording Time: 0 Minutes	
Appearance	Unable to visualize due to patient's position, but she is anxious and reports some pain to her back and right side
Level of consciousness	Alert and oriented
Airway	Open; clear of secretions and foreign bodies
Breathing	Unable to assess, but talking in complete sentences with no sounds of distress and she denies any dyspnea
Circulation	Unable to assess due to patient's position

Patient 2 tells you that Patient 1, her husband, is normally on oxygen and the tube was pulled off during the crash. She thinks she may be sitting on the portable oxygen machine. She also thinks that she may have "cracked a rib or two" when she was thrown against the door. She begs you to please help her husband before it is too late.

4. Do you consider Patient 1 to be in stable or unstable condition? Should you wait for further assistance or proceed to gain access to him?
5. Once you are able to gain access, what are your concerns for the use of proper body mechanics while removing these patients?
6. Once Patient 1 is no longer entrapped, how will you attempt to remove him from the vehicle while maintaining cervical spine support?

Principles of Safe Lifting and Carrying

Whenever possible, use a device that can be rolled to move a patient. However, in a situation where a wheeled device is not available, you must make sure that you understand and follow certain guidelines for carrying a patient on a stretcher. Table 8-1 shows the guidelines.

Patient Weight

You should estimate how much the patient weighs before you attempt to lift. Commonly, adult patients weigh between 120 and 220 lb (54 and 100 kg). If you use the correct technique, you and one other EMT should be able to safely lift this weight. Depending on your individual strength, you and another EMT may be able to safely lift an even heavier patient. However, due to safety concerns, try to use four providers to lift when possible. There is more stability with a four-person carry, and the carry requires less strength. You should know how much you can comfortably and safely lift, and do not attempt to lift a proportional weight (the share of the weight that you will bear) that exceeds this amount. If you find that lifting the patient places a strain on you, stop the lift and lower the patient. You should then obtain additional help before again attempting to lift the patient. Be sure to communicate clearly and frequently with your partner and other providers whenever you are lifting a patient.

Do not attempt to lift a patient who weighs more than 250 lb (114 kg) with fewer than four providers, regardless of individual strength. Protocols should include a method to rapidly summon additional help to lift and carry such a patient or, as in the case of a cardiac arrest, provide and maintain the necessary care in the field. In addition, you must know, or be able to find out, the weight limitations of the equipment you are using and how to handle patients who exceed the weight limitations. Special bariatric techniques, equipment, and resources are generally required to move any patient who weighs more than 350 lb (159 kg) to the ambulance (discussed later in the chapter). These resources should be summoned when you arrive on scene and have assessed the situation.

Table 8-1 Guidelines for Carrying a Patient on a Stretcher

- Estimate the weight of both the patient and the associated equipment to be lifted and gauge the limitations of your team's abilities.
- Coordinate your movements with those of the other team members while constantly communicating with them.
- Do not twist your body as you are carrying the patient.
- Keep the weight that you are carrying as close to your body as possible while keeping your back in a locked-in position.
- Do not bend at the waist; this could hyperextend your back. Instead, flex at the hips, and bend at the knees.

Lifting and Carrying a Patient on a Backboard or Stretcher

If a patient is supine on a backboard or is lying in a semi-Fowler position on the stretcher, his or her weight is not equally distributed between the two ends of the device. Between 68% and 78% of the body weight of a patient in a horizontal position is in the torso. Therefore, more of the patient's weight rests on the head half of the device than on the foot half.

A patient on a backboard or stretcher can be lifted and carried by four providers in a **diamond carry**, with one provider at the head end of the device, one at the foot end, and one at each side of the patient's torso **Figure 8-10**. Follow these steps to perform the diamond carry **Skill Drill 8-2**:

1. To best balance the weight, the providers at each side should be located so that they are able to grasp the backboard or stretcher with one hand adjacent to the distal edge of the patient's pelvis and the other midthorax. All four providers lift the device while facing toward the patient Step 1.

Figure 8-10 The diamond carry requires four providers: one at the head of the backboard, one at the foot end, and one at each side of the patient's torso.

2. The provider at each side should grasp the backboard or stretcher with the head-end hand Step 2.
3. The providers at each side turn toward the patient's feet. The provider at the foot end turns to face forward. All four providers should face the same direction and walk forward when carrying the patient Step 3.

A patient on a backboard or stretcher should be carried feetfirst to place the lightest load on the provider at the patient's feet, who, to walk forward, must turn and grasp the handles with his or her back to the device. Carrying the patient feetfirst will also allow a conscious patient to see in the direction of movement, which may reduce anxiety.

It is important that you and your team use the correct lifting techniques to lift the stretcher. One method of lifting and carrying a patient on a backboard is the one-handed carry. With this method, four or more providers each use one hand to support the backboard so that they are able to face forward as they are walking. To perform the one-handed carry, follow the steps in Skill Drill 8-3:

Skill Drill 8-2 Performing the Diamond Carry

Step 1

Position yourselves facing the patient.

Step 2

The providers at each side turn the head-end hand palm down and release the other hand.

Step 3

The providers at each side turn toward the foot end. The provider at the foot end turns to face forward.

1. Before lifting the backboard, be sure that at least two providers are on each side of the backboard facing across from each other and using both hands Step 1.
2. Lift the backboard to carrying height using correct lifting techniques, including a locked-in back Step 2.
3. Once you have lifted the backboard to carrying height, you and your partners turn in the direction you will be walking and switch to using one hand Step 3.

Be sure to pick up and carry the backboard with your back in the upright position. If you need to lean to either side to compensate for a weight imbalance, you have probably exceeded your weight limitation. If this occurs, reevaluate the carry; you may need additional providers or else you might injure yourself or drop the patient.

In most instances, it is best if you push the head of the stretcher while your partner guides the foot of the stretcher. When the stretcher must be carried, it is best if four providers are available to carry it. One provider should be positioned at each corner of the stretcher to provide an even lift. If only two providers are available, or if limited space allows room for only two providers to carry the stretcher, there is a risk that the stretcher will become unbalanced. In a two-person carry, the two providers should stand facing each other, with one person at the head end of the stretcher and the other at the foot end. With this type of carry, one provider will have to walk backward.

Skill Drill 8-3 Performing the One-Handed Carry

Step 1

Face each other and use both hands.

Step 2

Lift the backboard to carrying height.

Step 3

Turn in the direction you will walk, and switch to using one hand.

When you are rolling the wheeled ambulance stretcher, make sure that it is in the fully elevated position. If you are guiding the stretcher from the foot end, make sure your arms are held close to your body, and be careful to avoid reaching significantly behind you or hyperextending your back **Figure 8-11**. Recall that your back should be locked, straight, and untwisted. While you are walking and guiding the stretcher, bend slightly forward at the hips. As you walk, your legs are pulled back with your feet on the ground, your pelvis is moved forward, and the movement of the pelvis is transferred to the stretcher through your straight torso and firmly held arms. Try to keep the line of the pull through the center of your body by bending your knees.

Your partner should control the head end and assist you by pushing with his or her arms held with the elbows bent so that the hands are about 12 to 15 inches (30 to 38 cm) in front of the torso. To protect your elbows from injury, never push an object with your arms fully extended in a straight line and the elbows locked. When you push with the elbow bent but firmly held from bending further, the strong muscles of the arm serve as a shock absorber if the wheels or foot end of the stretcher strikes an obstacle that causes its progress to be suddenly slowed or stopped. Be sure that you push from the area of your body that is between the waist and shoulder. If the weight you are pushing is lower than your waist, push from a kneeling position. Remember not to push or pull from an overhead position.

Figure 8-11 Push the stretcher from the head end. If you are guiding the stretcher from the foot end, make sure your arms are held close to your body, and be careful to avoid reaching significantly behind you or hyperextending your back. Your back should be locked, straight, and untwisted.

▶ Moving a Patient With a Stair Chair

When you must carry a conscious patient up or down a flight of stairs or other significant incline, use a stair chair if the patient's condition allows him or her to be placed in a sitting position. A **stair chair** is a lightweight folding chair with a molded seat, adjustable safety straps, and fold-out handles at both the head and feet **Figure 8-12**. Most models have rubber wheels in the back with casters in front so that they can roll along the floor and make turns. Some have a specially designed track to facilitate movement down steps with little lifting required. Stair chairs serve as an adjunct for moving a patient up or down stairs to the ground floor, where the prepared wheeled ambulance stretcher is waiting. You can roll the stair chair on the floor until you reach the stairwell, and then both providers carry it (rather than roll and bump it) up or down the stairs.

Figure 8-12 A wheeled stair chair can be used to transfer a conscious patient up or down a flight of stairs.

When the patient is upstairs, you should take the wheeled ambulance stretcher to the ground floor landing and prepare it for the patient. Place it at the proper height, lower the side rails, turn down the cover sheet, and remove any equipment that you may have secured on the top. You should then take the stair chair upstairs and load the patient into it. Once reaching the bottom of the stairs, transfer the patient from the stair chair onto the stretcher.

Follow these steps to use a stair chair **Skill Drill 8-4**:

1. Secure the patient to the stair chair with straps. At a minimum, use a lap belt at the hips and a strap around the chest. You should also use some method to secure the arms and hands so the patient does not reach out to grasp something and throw the carrying team off-balance, and ensure that the feet are either strapped or placed in the footrest.

2. Take your places around the patient seated on the chair: one provider at the head end and one at the foot end Step 1. The provider at the head will give directions to coordinate the lift and movement. If a third provider is on scene, he or she may precede you and your partner. Keeping his or her hand on the back of the second provider who is at the feet, the third provider can assist by opening doors and providing guidance and support. For lengthy carries, a third provider can also rotate into the carrying team to provide breaks for the other two.

3. When reaching landings and other flat intervals in the move, lower the chair to the ground and roll the chair to the next position. Upon reaching the ground level where the stretcher awaits, roll the chair into position next to the stretcher in preparation for transferring the patient Step 2.

Skill Drill 8-4 Using a Stair Chair

Step 1

Position and secure the patient on the chair with straps. Take your places at the head and foot of the chair.

Step 2

Lower the chair to roll on landings and for transfer to the stretcher.

As with other carries, always remember to keep your back in a locked-in position and to flex at the hips, not the waist. Bend at the knees and keep the patient's weight and your arms as close to your body as possible. Twisting while carrying or moving a patient will increase your risk of injury. Try to avoid any unnecessary lifting and carrying of the patient. You may find that a log roll or a body drag will aid you in moving your patient onto the backboard or the stretcher. If these techniques will not harm or jeopardize your patient's condition, use one of these moves.

▶ Moving a Patient on Stairs With a Stretcher

When a patient is unresponsive, must be moved in a supine position, or must be immobilized, do not use a stair chair; instead, secure the patient onto a backboard. Be sure that the patient is anatomically secured to the device so that he or she cannot slide significantly when the stretcher is at an angle. Carry the patient on the backboard down the stairs to the prepared stretcher. When moving on stairs, more than half of a patient's weight is distributed to the head end of the backboard, so make sure the strongest provider is positioned at the head end. (Even with four or more providers carrying the patient, the strain on the provider at the head end will be increased when you must negotiate a narrow flight of stairs.) In carrying a patient up or down a flight of stairs, proportionally greater weight will also be distributed to the provider who carries the foot end when the device becomes angled because of the incline or decline. You should anticipate this and, in such cases, make sure the two strongest providers are positioned at the head and foot ends of the board. Because of the incline of the stairway, if one of the two strongest providers is considerably taller than the other, it will be easier if the shorter provider is at the head end and the taller provider is at the foot end. This minimizes bending while lifting and moving the patient. Once you reach the stretcher, place both the backboard and the patient on the stretcher; then secure both to the stretcher with additional straps.

To carry a patient on stairs on a backboard, follow the steps in **Skill Drill 8-5**:

1. Apply a strap that passes tightly across the upper torso and through each armpit, but not over the arms, to hold the patient in place while leaving the arms free. The strap is secured to the handles at both sides of the backboard so that it cannot slide toward the foot end of the backboard. Strap the patient securely to the backboard Step 1.
2. When you carry the patient down stairs or an incline, make sure the backboard or stretcher is carried with the foot end first so that the head end is elevated higher than the foot end. The straps will prevent the patient from sliding down or off the backboard Step 2.

Words of Wisdom

When you encounter a patient in a confined space, such as a bathroom, it can pose a unique set of problems. Prior to moving a patient in a confined space, it is important to discuss the process with your fellow team members. Ensure that everyone agrees with the extrication plan and understands his or her role. Remember that communication with the crew, as well as the patient, will assist in minimizing potential problems.

Loading a Wheeled Stretcher Into an Ambulance

Most patients are placed directly on the wheeled ambulance stretcher. Exceptions include patients with a possible spinal injury or multisystem trauma; you will need to place and secure them onto a backboard. Also, patients who are unresponsive or must be carried down (or up) a flight of stairs while supine should be placed on a backboard. The backboard and patient are then secured onto the stretcher.

Whenever a patient has been placed onto the stretcher, one EMT must hold the main frame to prevent movement. When the stretcher is elevated, the main frame and the patient extend considerably beyond the wheels at both the head end and foot end of the stretcher. Therefore, whenever a patient is on an elevated stretcher, you must ensure that it is held firmly between two hands at all times so that even if the patient moves, the stretcher cannot tip **Figure 8-13**.

Skill Drill 8-5 Carrying a Patient on Stairs

Step 1

Strap the patient securely. Make sure one strap is tight across the upper torso, under the arms, and secured to the handles to prevent the patient from sliding.

Step 2

Carry a patient downstairs with the foot end first, always keeping the head elevated.

Inside the ambulance are strong clamps that fasten around the undercarriage when the stretcher is pushed into them. The clamps are located in a rack on the floor or side of the patient compartment and will hold the stretcher in place until they are released at the hospital. You can control and release the clamps with a single handle when standing on the ground at the open back doors of the ambulance when the stretcher is to be unloaded. The stretcher is designed to be rolled on flat surfaces. Ensure the intended travel path is free from debris and potential obstacles. If the patient must be moved over a lawn or other irregular surface, you must lift and carry the stretcher over the terrain. A four-person carry is much safer if the stretcher must be moved over rough ground.

If the loaded stretcher must be carried down a short flight of steps, be sure to first retract the undercarriage; however, this is not necessary when the stretcher must be lifted over a curb, a single step, or an obstacle of a similar height **Figure 8-14**.

Some older or less expensive wheeled ambulance stretchers do not feature extra wheels below the head end of the main frame. These stretchers are not self-loading. When you reach the back of the ambulance with such a stretcher, you must lower it until the undercarriage is in its lowest retracted position and then, with you and your partner at each side of the stretcher, lift it to the height of the floor of the ambulance and roll it into the track that locks it into place.

An intravenous (IV) pole is attached to many stretchers. The IV pole can be unfolded or extended above the main frame to hold an IV bag above the patient while you move the stretcher to the ambulance. Some wheeled ambulance stretchers even include a carrier to hold a cardiac monitor or automated external defibrillator (AED) and portable oxygen unit. If the model you use does not include these features, you will have to secure the portable oxygen unit and cardiac monitor or AED to the top surface of the stretcher mattress at the patient's legs. If possible, remove these items before lifting the stretcher to avoid the excess weight.

Figure 8-13 Make sure that you hold the main frame of the stretcher when it is elevated so that even when the patient moves, the stretcher does not tip over.

Figure 8-14 You need not retract the undercarriage of the stretcher when lifting it over a curb, a single step, or an obstacle of similar height.

Table 8-2 shows the guidelines that you must follow to load the stretcher into the ambulance.

Follow these steps to load the stretcher into an ambulance **Skill Drill 8-6**:

1. Tilt the head end of the main frame upward, and place it into the patient compartment with the wheels on the floor. The two additional wheels that extend just below the head end are attached to the main frame and will enable this movement. Ensure that the safety bar under the head of the stretcher catches on the hook prior to lifting the stretcher Step 1.

Table 8-2 Guidelines for Loading the Stretcher Into the Ambulance

- Make sure there are enough providers for sufficient lifting power.
- Follow the manufacturer's directions for safe and proper use of the stretcher.
- Make sure that all stretchers and patients are fully secured before the ambulance is moved.

2. With the patient's weight supported by these two head-end wheels and the EMT at the foot end of the stretcher, move to the side of the main frame and release the undercarriage lock to lift the undercarriage up to its fully retracted position. The wheels of the undercarriage and the two on the head end of the main frame will now be on the same level Step 2.
3. Simply roll the stretcher the rest of the way into the back of the ambulance, where it will rest on all six wheels Step 3.
4. Secure the stretcher in the ambulance with the strong clamps that fasten around the undercarriage when the stretcher is pushed into them. The clamps are located in a rack on the floor or side of the patient compartment Step 4.

Safety Tips

Choose one EMT to be the team leader and direct all movements to prevent confusion. He or she should explain the procedure in advance and verbalize instructions such as, "We will lift on 3," or "We will count to 3 and then lift."

Directions and Commands

To safely lift and carry a patient, you and your team must anticipate and understand every move, and each move must be executed in a coordinated manner. Before any lifting is initiated, the team leader should indicate where each team member is to be located and rapidly describe the sequence of steps that will be performed to ensure the team knows what is expected. If you must lift and move the patient through a number of separate stages, the team leader should first give an abbreviated overview of the stages, followed by a more detailed explanation of each stage just before it will occur.

Orders that will initiate the actual lifting or moving or any significant changes in movement should be given in two parts: a preparatory command and a command of execution. For example, if the team leader says, "All ready to stop. STOP!," the phrase "All ready to stop" will get your attention, identify who should act, and prepare you to act; the declarative "STOP!" will indicate the exact moment of execution. Commands of execution should be delivered in a louder voice. Often, a countdown is helpful when you need to lift a patient. To avoid confusion in using a countdown, the leader should always clarify whether "three" is to be a part of the preparatory command or whether it is to serve as the order to execute. He or she can say, "We're going to lift on three. One, two, THREE!" or "I'm going to count to three, and then we're going to lift. One, two, three, LIFT!"

Words of Wisdom

Remember that moving a patient is a dynamic process and the team leader must be prepared to alter the sequence of moves as needed.

YOU are the Provider PART 3

Once the vehicle has been stabilized by the fire department, you are able to gain access through the rear driver's side door that is about halfway open. The vehicle is still lying on the passenger's side. A paramedic unit is standing by awaiting removal of Patient 1. You are able to wedge about half of a backboard through the doorway with a firefighter holding the other end, but there is no room inside for additional providers.

Patient 1

Recording Time: 5 Minutes	
Appearance	Motionless; ashen skin with cyanosis around the mouth
Level of consciousness	Unresponsive
Airway	Snoring respirations
Breathing	Increased rate; shallow depth
Circulation	Weak and rapid radial pulse; no obvious bleeding

Patient 2

Recording Time: 5 Minutes	
Respirations	Seems to be a little rapid, but still unable to visualize patient
Pulse	Unable to assess due to patient's position
Skin	Pink where visualized
Blood pressure	Unable to assess
Oxygen saturation (Spo_2)	Unable to assess

7. What type of move is best for removing Patient 1?
8. What steps can you take to maximize safety while lifting a patient?

Skill Drill 8-6 Loading a Stretcher Into an Ambulance

Step 1

Tilt the head of the stretcher upward, and place it into the patient compartment with the wheels on the floor and the safety bar latched on the hook.

Step 2

The second EMT on the side of the stretcher releases the undercarriage lock and lifts the undercarriage.

Step 3

Roll the stretcher into the back of the ambulance.

Step 4

Secure the stretcher to the clamps mounted in the ambulance.

You will often have to perform several additional steps to place the patient onto a backboard and/or carry him or her down a flight of stairs. You will also have to add a stop at the top of the stairway so that everyone can reposition before carrying the patient down the stairs. Repositioning usually requires lowering the backboard to the ground and lifting it again when all providers are in their proper places. If you are carrying the patient in a stair chair, the additional step occurs after you have descended the stairs and reached the stretcher. At that point, you will have to assist or lift the patient from the stair chair onto the stretcher.

You should carefully plan ahead and select the methods that will involve the least amount of lifting and carrying. Remember to always consider whether there is an option that will cause less strain to you and the other providers.

Safety Tips

Follow these rules to keep you and your patient safe:

- Minimize the number of total body lifts you have to perform.
- Coordinate every lift in advance.
- Minimize the total amount of weight you have to lift.
- *Never* lift with your back.
- Do not carry what you can put on wheels.
- Do not hesitate to ask for help at any time.

Emergency Moves

When there is a potential for danger, use an **emergency move** to drag or pull a patient to a safe place before assessment and care are provided. The risk of serious harm or death due to fire, explosives, or hazardous materials, your inability to protect the patient from other hazards, or your inability to gain access to others in a vehicle who need lifesaving care are all situations in which you should use an emergency move.

The only other time you should use an emergency move is if you cannot properly assess the patient or provide critical emergency care because of the patient's location or position.

If you are alone and danger at the scene makes it necessary for you to use an emergency move, regardless of a patient's injuries, you should use a drag to pull the patient along the long axis of the body. This will help to keep the spinal column in line as much as possible. When performing an emergency move, one of your primary concerns is the danger of aggravating an existing spinal injury. Remember that it is impossible to remove a patient quickly from a vehicle while providing as much protection to the spine as would a spinal immobilization device such as a KED. However, if you follow certain guidelines during the move, you can usually remove a patient from a life-threatening situation without causing further injury to the patient.

You can move a patient on his or her back along the floor or ground by using one of the following methods:

- Pull on the patient's clothing in the neck and shoulder area **Figure 8-15A**. If the shirt has buttons, the top two should be undone to prevent the patient from choking.
- Place the patient onto a blanket, coat, or other item that can be pulled **Figure 8-15B**.
- Rotate the patient's arms so that they are extended straight on the ground beyond his or her head, grasp the wrists, and, with the arms elevated above the ground, drag the patient **Figure 8-15C**.
- Place your arms under the patient's shoulders and through the armpits, and, while grasping your opposite wrist, drag the patient backward **Figure 8-15D**.

If you are alone and must remove an unresponsive patient from a vehicle, first move the patient's legs so they are clear of the pedals and are against the seat. Then rotate the patient so that his or her back is positioned toward the open vehicle door. Next, place your arms through the armpits and support the patient's head against your body **Figure 8-16A**. While supporting the patient's weight, drag the patient from the seat. If the legs and feet clear the vehicle easily, you can rapidly drag the patient to a safe location by continuing this method **Figure 8-16B**. If the legs and feet do not clear the vehicle easily, you can slowly lower the patient until he or she is lying on his or her back next to the vehicle, clear the legs from the vehicle, and, as previously described, use a long-axis body drag to move the patient a safe distance from the vehicle.

You should use one-person techniques to move a patient only if an immediately life-threatening danger exists and you are alone or, because of the pressing nature of the danger, your partner is moving a second patient simultaneously. Additional one-provider drags, carries, and lifts are shown in **Figure 8-17**.

Figure 8-15 Dragging methods. **A.** Emergency clothes drag. **B.** Blanket drag. **C.** Arm drag. **D.** Arm-to-arm drag.

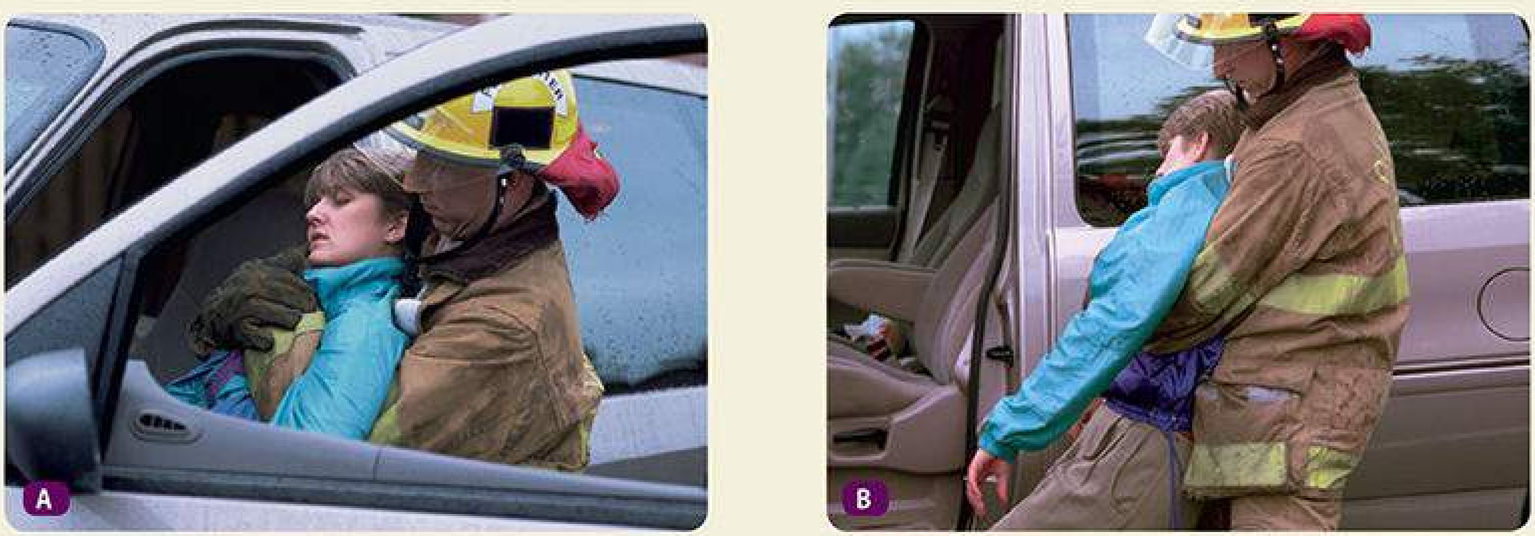

Figure 8-16 One-person technique for moving an unresponsive patient from a vehicle. **A.** Grasp the patient under the arms. **B.** Lower the patient down into a supine position.

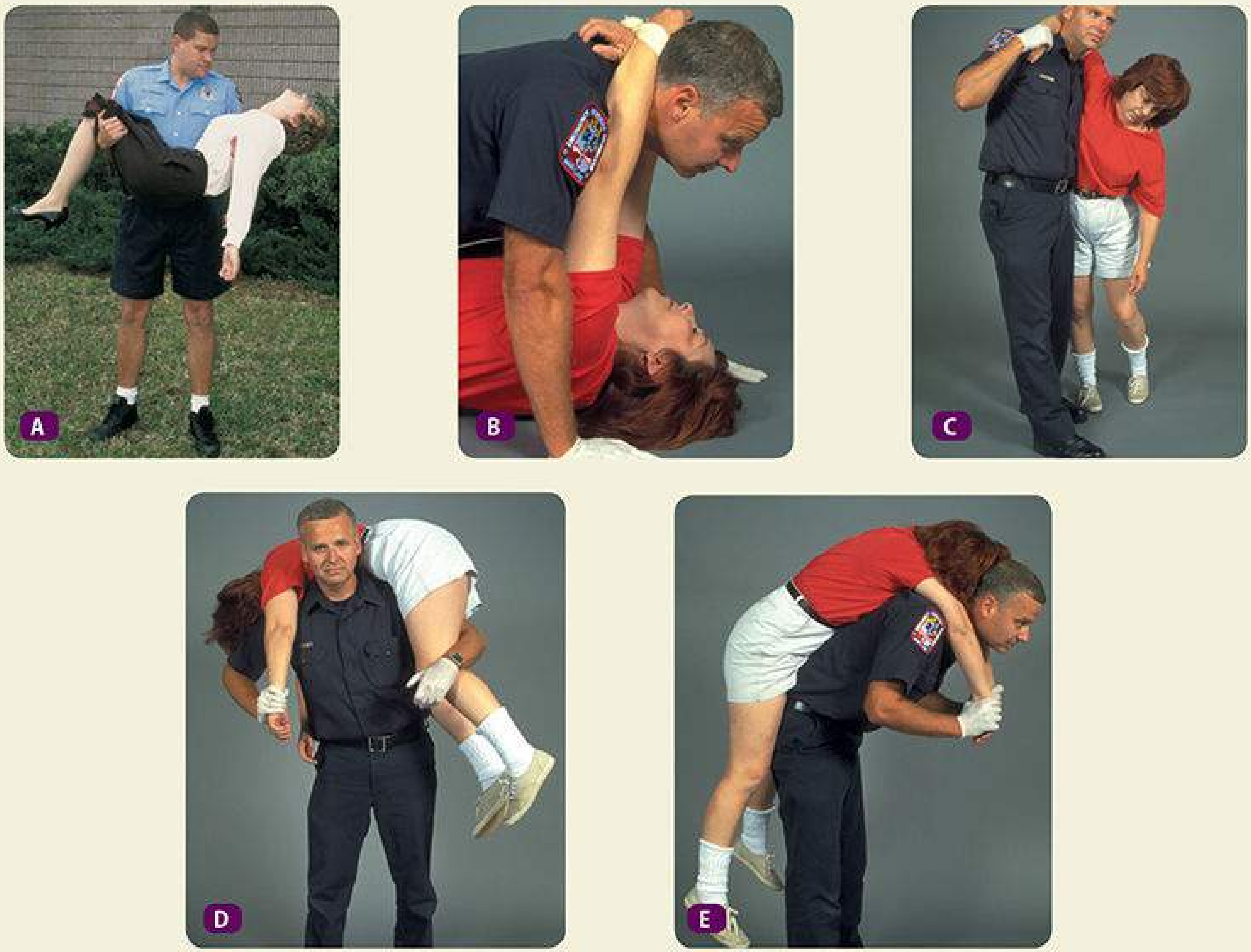

Figure 8-17 One-person drags, carries, and lifts. **A.** Front cradle. **B.** Firefighter's drag. **C.** One-person walking assist. **D.** Firefighter's carry. **E.** Pack-strap carry.

Urgent Moves

An urgent move may be necessary to move a patient with an altered level of consciousness, inadequate ventilation, or shock (hypoperfusion). An extreme weather condition may also make an urgent move necessary. In some cases, patients must be urgently moved from the location or position in which they are found. When a patient who is sitting in a vehicle must be urgently moved, use the rapid extrication technique.

Rapid Extrication Technique

The backboard, short backboard, and vest-type devices are known as spinal immobilization devices. Normally, you would use an extrication-type vest or short backboard device to immobilize a seated patient with a suspected spinal injury before removing the patient from the vehicle (see Chapter 38, *Vehicle Extrication and Special Rescue*). However, proper placement of either of these devices on the patient usually requires between 6 and 8 minutes, and in some cases even longer. By using the **rapid extrication technique** instead, the patient can be moved from sitting in the vehicle to supine, on a backboard if required, in 1 minute or less. However, the rapid nature of this type of extrication can potentially increase the risk of damage if the patient has a spinal injury. Because of this possible patient injury, all available options need to be considered prior to performing a rapid extrication. Table 8-3 describes the situations in which you should use the rapid extrication technique.

Table 8-3 Situations in Which to Use the Rapid Extrication Technique

- The vehicle or scene is unsafe.
- Explosives or other hazardous materials are on the scene.
- There is a fire or a danger of fire.
- The patient cannot be properly assessed before being removed from the vehicle.
- The patient needs immediate intervention that requires a supine position.
- The patient has a life-threatening condition that requires rapid transport to the hospital.
- The patient blocks your access to another seriously injured patient.

In such cases, the delay that occurs in applying immobilization devices is a contraindication. However, the manual support and stabilization that you provide when using the rapid extrication technique produce a greater risk of spine movement. Because of this increased risk, do not use the rapid extrication technique if no urgency exists.

The rapid extrication technique requires a team of three providers who are knowledgeable and practiced in the procedure. Take the following steps when using the rapid extrication technique Skill Drill 8-7. Whether a backboard is used for this skill will depend on your local protocols. Here, use of a backboard is included.

1. The first provider applies manual in-line support of the patient's head and cervical spine from behind. Support may be applied from the side, if necessary, by reaching through the driver's side doorway Step 1.
2. The second provider serves as team leader and, as such, gives the commands until the patient is supine on the backboard. Because the second provider lifts and turns the patient's torso, he or she must be physically capable of moving the patient. The second provider works from the driver's side doorway. If the first provider is also working from that doorway, the second provider should stand closer to the door hinges toward the front of the vehicle. The second provider applies a cervical collar and may perform the primary assessment Step 2.
3. The second provider provides continuous support of the patient's torso until the patient is supine on the backboard. Once the second provider takes control of the patient's torso, usually in the form of a body hug, he or she should not let go of the patient for any reason. Some type of cross-chest shoulder hug usually works well, but you will have to decide what method works best for you on any given patient. You must remember that you cannot simply reach into the vehicle and grab the patient; this will only twist the patient's torso. You must rotate the patient as a complete unit.
4. The third provider works from the front passenger's seat and is responsible for rotating the patient's legs and feet as the torso is turned, ensuring that they are free of the pedals and any other obstruction. With care, the third provider should first move the patient's nearer leg laterally without rotating the patient's pelvis and lower spine. The pelvis and lower spine rotate only as the third provider moves the patient's second leg during the next step. Moving the nearer leg

early makes it much easier to move the second leg in concert with the rest of the body. After the third provider moves the legs together, they should be moved as a unit Step 3.

5. These initial steps of the rapid extrication technique direct the team to its starting positions and responsibilities. The first provider applies in-line support and stabilization of the head and neck. The second provider gives orders and supports the torso. The third provider moves and supports the patient's legs. The team is now ready to move the patient.
6. The patient is rotated 90 degrees so that the patient's back is facing out the driver's door and the feet are on the front passenger's seat. This coordinated movement is done in three or four short, quick "eighth turns." The second provider directs each quick turn by saying, "Ready, turn," or "Ready, move." Hand position changes should be made between moves.
7. In most cases, the first provider will be working from the back seat and will have removed the headrest (if possible). At some point, either because the doorpost is in the way or because he or she cannot reach farther from the back seat, the first provider will be unable to follow the torso rotation. At that time, the third provider should assume temporary inline support of the head and neck until the first provider can regain control of the head from outside the vehicle. If a fourth provider is present, the fourth provider stands next to the second provider. The fourth provider takes control of the patient's head and neck from outside the vehicle without involving the third provider. As soon as the change has been made, the rotation can continue Step 4.
8. Once the patient has been fully rotated, the backboard should be placed against the patient's buttocks on the seat. Do not try to wedge the backboard under the patient. If only three providers are present, be sure to place the backboard within arm's reach of the driver's door before the move so that the backboard can be pulled into place when needed. In such cases, the far end of the backboard can be left on the ground. When a fourth provider is available, the first provider exits the back seat of the vehicle, places the backboard against the patient's buttocks, and maintains pressure toward the interior of the vehicle from the far end of the backboard. (Note: when the door opening allows, some providers prefer to insert the backboard onto the seat before the patient is rotated.)
9. As soon as the patient has been rotated and the backboard is in place, the second provider and the third provider lower the patient onto the backboard while supporting the head and torso so that neutral alignment is maintained. The first provider holds the backboard until the patient is secured Step 5.
10. Next, the third provider must move across the front seat to be in position at the patient's hips. If the third provider stays at the patient's knees or feet, he or she will be ineffective in helping to move the body's weight. The knees and feet follow the hips.
11. The fourth provider maintains manual in-line support of the head and now takes over giving the commands. The second provider maintains the direction of the extrication. The second provider stands with his or her back to the door, facing the rear of the vehicle. The backboard should be immediately in front of the third provider. The second provider grasps the patient's shoulders or armpits. Then, on command, the second provider and the third provider slide the patient 8 to 12 inches (20 to 30 cm) along the backboard, repeating this slide until the patient's hips are firmly on the backboard Step 6.
12. At that time, the third provider gets out of the vehicle and moves to the opposite side of the backboard, across from the second provider. The third provider now takes control at the shoulders, and the second provider moves back to take control of the hips. On command, these two providers move the patient along the backboard in 8-to-12-inch (20-to-30-cm) slides until the patient is placed fully on the backboard Step 7.
13. The first (or fourth) provider continues to maintain manual in-line support of the patient's head. The second provider and the third provider now grasp their side of the backboard and then carry it and the patient away from the vehicle onto the prepared stretcher nearby Step 8.

In some cases, you will be able to rest the head end of the backboard on the stretcher while the patient is moved onto the backboard. In other situations, you will not be able to do this. Once the backboard and patient have been placed on the stretcher, begin lifesaving treatment immediately. If you used the rapid extrication technique because the scene was dangerous, you and your team should immediately move the stretcher a safe distance away from the scene before you assess or treat the patient.

The steps of the rapid extrication technique must be considered a general procedure to be adapted as needed. Two-door vehicles differ from four-door models. Larger vehicles differ from smaller compact models, pickup trucks, full-size sedans, and four-wheel-drive vehicles. You will handle a large, heavy adult differently from a small adult or child. Every situation will be different—a different vehicle, a different patient, and different partners. Your resourcefulness and ability to adapt are necessary elements to successfully perform the rapid extrication technique.

Skill Drill 8-7 Performing the Rapid Extrication Technique

Step 1

The first provider provides in-line manual support of the head and cervical spine.

Step 2

The second provider gives commands, applies a cervical collar, and performs the primary assessment.

Step 3

The second provider supports the torso. The third provider frees the patient's legs from the pedals and moves the legs together, without moving the pelvis or spine.

Step 4

The second provider and the third provider rotate the patient as a unit in several short, coordinated moves. The first provider (relieved by the fourth provider as needed) supports the patient's head and neck during rotation (and later steps).

Step 5

The first (or fourth) provider places the backboard on the seat against the patient's buttocks. (Use of a backboard may depend on local protocols.)

Step 6

The third provider moves to an effective position for sliding the patient. The second and the third providers slide the patient along the backboard in coordinated 8-to-12-inch (20-to-30-cm) moves until the patient's hips rest on the backboard.

Step 7

The third provider exits the vehicle, moves to the backboard opposite the second provider, and they continue to slide the patient until the patient is fully on the backboard.

Step 8

The first (or fourth) provider continues to stabilize the head and neck while the second provider and the third provider carry the patient away from the vehicle and onto the prepared stretcher.

Nonurgent Moves

When both the scene and the patient are stable, carefully plan how to move the patient. If your patient move is rushed or poorly planned, it may result in discomfort or injury to the patient, you, and/or your team. Before you attempt any move, the team leader must be sure that there are enough providers, any obstacles have been identified or removed, the proper equipment is available, and the procedure and path to be followed have been clearly identified and discussed. Remember, communication is the key to success.

In nonurgent situations, you and your team may choose one of several methods for lifting and carrying a patient and should coordinate your movements through direct verbal commands. Three general methods are presented here, which may serve as a basis for your plan. You may adapt these procedures to meet your needs on a case-by-case basis.

Direct Ground Lift

The **direct ground lift** is used for patients with no suspected spinal injury who are found lying supine on the ground. Use this lift when you have to lift and carry the patient some distance to be placed on the stretcher. If you find the patient semiprone or lying on his or her side, first log roll the patient onto his or her back. Ideally, the direct ground lift should be performed by three providers; however, it can be done with only two. Perform the direct ground lift as follows **Skill Drill 8-8**:

1. Take your places on one side of the patient with the first provider at the patient's head, the second provider at the patient's waist, and the third provider at the patient's knees. All providers kneel on one knee, preferably the same knee.
2. The patient's arms should be placed on his or her chest if possible **Step 1**.

YOU are the Provider — PART 4

There is no easy way to remove Patient 1, but by bracing yourself through the seats you are able to grab his belt and pull him toward you. Once you get the patient's head and shoulders between the headrests, the firefighter helps pull him onto the backboard. As soon as he is secured on the backboard, several other providers help the firefighter pull the backboard out of the vehicle and transfer Patient 1 to the waiting paramedic unit for evaluation, treatment, and transport. You now have access to Patient 2, who is sitting waist-deep in water and still reporting pain in her back and right side. She tells you that she has a history of back pain and thinks she can move a little with help.

Patient 2

Recording Time: 20 Minutes	
Level of consciousness	Alert and oriented
Respirations	20 breaths/min; adequate depth
Pulse	112 beats/min; strong and regular
Skin	Pink, cool, and moist
Blood pressure	148/92 mm Hg
Spo_2	99% (on room air)

9. How is a patient's weight distributed when he or she is on a carrying device? Why is it important to know this?
10. Considering her complaints and the fact that her condition is stable, what are your best options for removing Patient 2?

3. The first provider places one arm under the patient's neck and shoulders and cradles the patient's head. The first provider then places the other arm under the patient's low back.
4. The second provider places one hand under the patient's waist, and the other under the knees.
5. The third provider places one arm under the patient's knees and the other under the ankles.
6. On command, the team lifts the patient up to knee level as each provider rests an arm on his or her knee **Step 2**.
7. As a team and on command, each provider rolls the patient in toward his or her chest. Again on command, the team stands and carries the patient to the stretcher **Step 3**.

Note: The steps are reversed to lower the patient onto the stretcher.

Skill Drill 8-8 The Direct Ground Lift

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Step 1

Line up on one side of the patient, with one provider at the head, one at the waist, and one at the patient's knees. All providers should be kneeling. Place the patient's arms on his or her chest, if possible.

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Step 2

On command, lift the patient to knee level.

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Step 3

On command, roll the patient toward your chest, and then stand and carry the patient to the stretcher.

Extremity Lift

The extremity lift may also be used for patients with no suspected extremity or spinal injuries who are supine or in a sitting position. The extremity lift may be especially helpful when the patient is in a very narrow space or there is not enough room for the patient and several EMTs to stand side by side. Perform the extremity lift as follows Skill Drill 8-9:

1. Kneel behind the patient's head as your partner kneels at the patient's feet. You and your partner should be facing each other.
2. The patient's hands should be crossed over his or her chest.
3. Place one hand under each of the patient's armpits. Grasp the patient's wrists or forearms and pull the upper torso until

the patient is in a sitting position Step 1.

4. Your partner moves to a position between the patient's legs, facing in the same direction as the patient, and slips his or her hands under the patient's knees Step 2.

5. As you give the command, stand fully upright and move the patient to the stretcher Step 3.

Skill Drill 8-9 Extremity Lift

Step 1

The patient's hands are crossed over the chest. Grasp the patient's wrists or forearms and pull the patient to a sitting position.

Step 2

Your partner moves to a position between the patient's legs, facing in the same direction as the patient, and places his or her hands under the knees.

Step 3

Rise to a crouching position. On command, lift and begin to move.

You will be less likely to injure yourself if you bend at the hips and knees and use your legs for lifting. However, this lift and carry method increases pressure on the patient's chest, so the patient may be uncomfortable in this position.

Transfer Moves

There are several ways to transfer the patient from a bed onto the stretcher.

Direct Carry

Transfer a supine patient from a bed to the stretcher using the direct carry method Skill Drill 8-10.

1. Position the stretcher parallel to the bed, facing the same direction as the bed. Prepare the stretcher by unbuckling the straps and removing any other items from it. Secure the stretcher to prevent movement.
2. Position yourself at the head of the bed facing towards the patient. Your partner should be positioned between the bed and the stretcher facing both you and the patient.
3. Slide your arms under the patient's neck and shoulders. Your partner should slide his or her hands under the patient's knees and lock them together or use them to grasp the posterior part of the patient's thighs Step 1.
4. Lift the patient upwards slowly and smoothly. Your partner should move the patient's knees from the left side of his body to the right to facilitate placing the patient onto the stretcher Step 2.
5. Slowly carry the patient from the bed to the stretcher Step 3.
6. Gently lower the patient to the stretcher and secure with straps Step 4.

This carry can also be performed with three providers. If a third provider is available, he or she can be positioned to support the patient's feet and legs from the bottom of the bed.

Draw Sheet Method

To move the patient from a bed onto a stretcher, use the draw sheet method. Place the stretcher next to the bed, making sure it is at the same height or slightly lower than the bed and that the rails are lowered and straps are unbuckled. Be sure to hold or secure the stretcher to keep it from moving. Loosen the bottom sheet underneath the patient, or log roll the patient onto a blanket Figure 8-18A. Reach across the stretcher, and grasp the sheet or blanket firmly at the patient's head, chest, hips, and knees Figure 8-18B. Gently slide the patient onto the stretcher Figure 8-18C.

Skill Drill 8-10 Direct Carry

Step 1

Position the stretcher parallel to the bed. Secure the stretcher to prevent movement. Face the patient while standing between the bed and the stretcher. Position your arms under the patient's neck and shoulders. Your partner should position his hands under the patient's knees.

Step 2

Lift the patient from the bed in a smooth, coordinated fashion.

Step 3

Slowly carry the patient to the stretcher.

Step 4

Gently lower the patient onto the stretcher and secure with straps.

When lifting a patient by a sheet or blanket, center the patient on the sheet and tightly roll up the excess fabric on each side. This produces a cylindrical handle that provides a strong, secure way to grasp the fabric **Figure 8-19**. Though not routinely carried on an ambulance, you may also have access to sliding boards or other devices in the hospital or nursing homes that will assist you in sliding the patient from bed to stretcher or stretcher to bed with minimal effort.

Using a Scoop Stretcher

Another option when moving a patient is to use a scoop stretcher. With a scoop stretcher, the two halves of the device are inserted under each side of the patient, and the two sides are fastened together. Then the patient is lifted and carried to the nearby prepared stretcher. (Note that you can also log roll a patient onto a scoop stretcher that is already locked together.) To use a scoop stretcher, follow the steps in **Skill Drill 8-11**.

1. With the scoop stretcher separated, measure the length of the scoop and adjust to the proper length Step 1.
2. Position the stretcher, one side at a time. Lift the patient's side slightly by pulling on the far hip and upper arm, while your parnter slides the stretcher into place Step 2.
3. Lock the stretcher ends together by engaging their locking mechanisms one at a time and continue to lift the patient slightly as needed to avoid pinching Step 3.
4. Apply and tighten straps to secure the patient to the scoop stretcher before transferring to the stretcher Step 4.

Other Carries

Other carries are performed in the following manner:

- Place a backboard next to the patient, and, after using a log roll or slide to move the patient onto the backboard, secure the patient and lift and carry the backboard to the nearby prepared stretcher.
- Assist an able patient to the edge of the bed, and place the patient's legs over the side, helping the patient to sit up. Move the stretcher so that its foot end touches the bed near the patient. Help the patient to stand and rotate so that he or she can sit down on the center of the stretcher. Lift the patient's legs, and rotate them onto the stretcher while your partner lowers the patient's torso onto the stretcher.

To avoid the strain of unnecessary lifting and carrying, use the draw sheet method or assist an able patient to the stretcher whenever possible.

To move a patient from the ground or the floor onto the stretcher, use one of the following methods:

Figure 8-18 The draw sheet method. **A.** Log roll the patient onto a sheet or blanket. **B.** Place the stretcher parallel to the bed. Secure the stretcher. Gently pull the patient to the edge of the bed. **C.** Transfer the patient to the stretcher.

A, B, C: © Jones & Bartlett Learning. Courtesy of MIEMSS.

Figure 8-19 When lifting a patient by a bed sheet, center the patient on the sheet and tightly roll up the excess fabric on each side. This produces a cylindrical handle that provides a strong way to grasp the fabric.

- Lift and carry the patient to the nearby prepared stretcher using a direct body carry.
- Use a log roll or long-axis drag to place the patient onto a backboard, and then lift and carry the backboard to the stretcher. Place both the backboard and the patient onto the stretcher.
- Use a scoop stretcher.
- Log roll the patient onto a blanket, centering the patient on the blanket and rolling up the excess material on each side **Figure 8-20A**. Lift the patient by the blanket, and carry him or her to the nearby stretcher **Figure 8-20B**.

If a patient is sitting in a chair and cannot assist you, transfer the patient from the chair to a stair chair as described earlier in this chapter **Figure 8-21A** and **Figure 8-21B**.

Words of Wisdom

Ensure a thorough patient care report by including details of how you moved the patient. For example: "Moved patient to stretcher with draw sheet lift."

Geriatrics

Most patients transported by EMS are geriatric patients. For many older patients, the fear of illness and disability is ever present, and an emergency trip to the hospital can be a terrifying and disorienting experience. The possibility of never returning home is a real fear for many of these patients. In addition, there are physiologic changes that occur with aging that require special attention on your part as an EMT.

Skill Drill 8-11 Using a Scoop Stretcher

Step 1

Adjust the length of the stretcher.

Step 2

Lift the patient slightly and slide the stretcher into place, one side at a time.

Step 3

Lock the stretcher ends together, and avoid pinching both the patient and your fingers!.

Step 4

Secure the patient to the scoop stretcher, and transfer it to the stretcher.

1. **Skeletal changes:** Brittle bones (osteoporosis), rigidity, and spinal curvatures (kyphosis and spondylosis) Figure 8-22 present special challenges in packaging and moving older patients. Many patients cannot lie supine on a backboard or scoop stretcher without causing additional injury, such as fractures, pressure sores, and skin breakdown. Special care and creativity must be used in immobilizing such patients. For example, a patient with spinal curvature may have to be placed on his or her side and immobilized in place with towel and blanket rolls to prevent exacerbating his or her injuries. Be sure to consult your local protocols and medical director about geriatric-specific devices, such as a vacuum mattress (discussed later in this chapter), and alternative ways of immobilizing such patients.

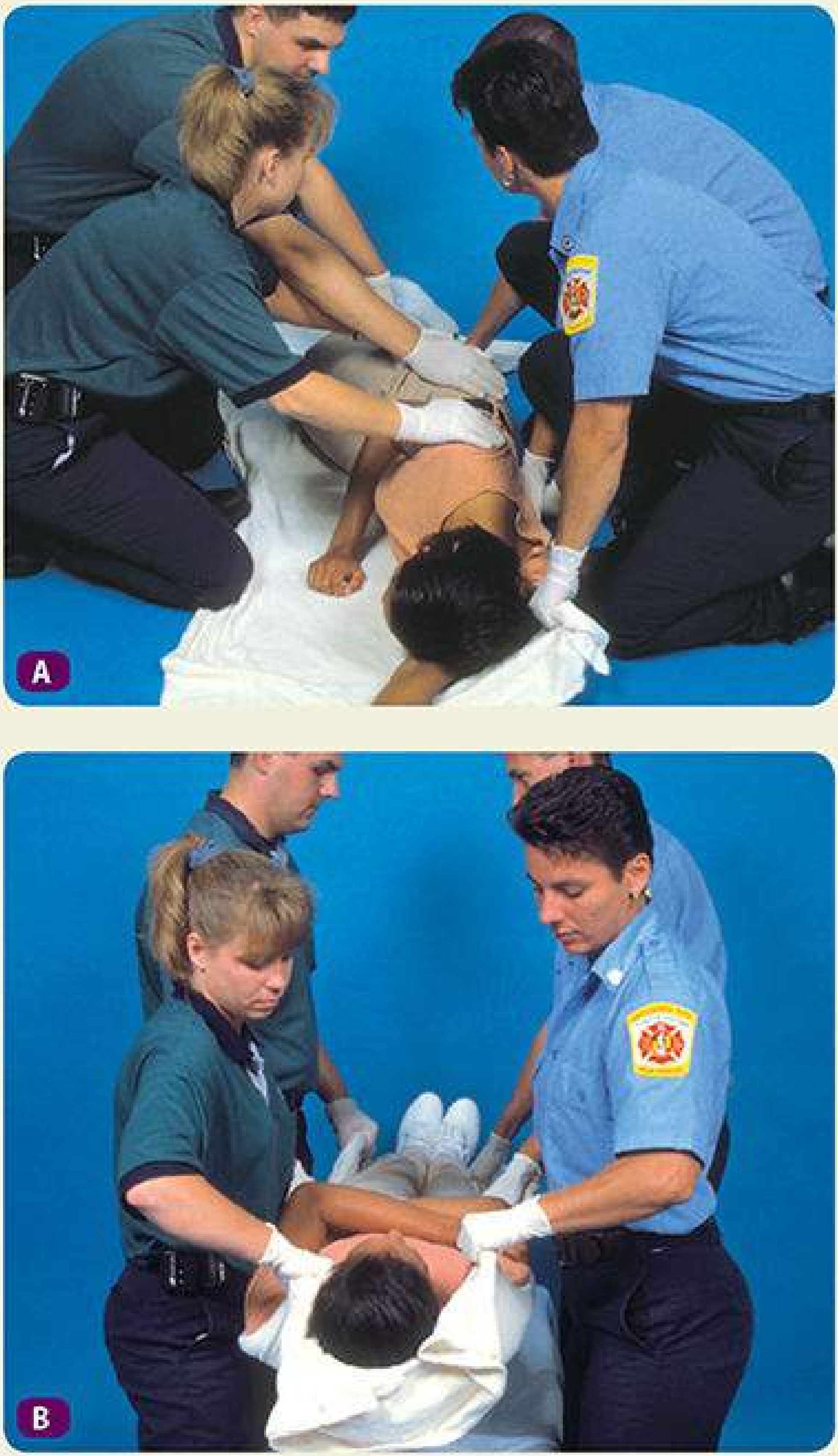

Figure 8-20 Log rolling a patient on the ground. **A.** Log roll the patient onto a blanket. **B.** Lift the blanket, and transfer the patient to the stretcher.

A, B: © Jones & Bartlett Learning. Courtesy of MIEMSS.

2. **Fear:** A sympathetic and compassionate approach can go a long way in lessening the natural fear many older patients experience when interacting with EMS. Slow down, explain, and anticipate: these actions can help you gain an older patient's cooperation and take some of the anxiety out of the process of packaging and transportation. Imagine how frightening it can be for a patient who lives in constant fear of falls and broken bones to be strapped to a stretcher and carried down a flight of stairs.

Figure 8-21 Moving a patient from a chair to a stair chair. **A.** If present, any removable side pieces on the chair should be removed or placed in a position so as to not interfere. Slide your arms through the patient's armpits, and grasp the patient's crossed forearms. Your partner grasps the patient's legs at the knees. **B.** Gently lift the patient into the locked stair chair.

Special Populations

Cover the older patient with a blanket to protect privacy and keep the patient warm. Cut clothes only when absolutely necessary. Many older patients live on a fixed income and cannot afford to replace damaged clothing.

Bariatrics

Over one-third of the adults in the United States (78.6 million people) are considered obese. The incidence of obesity is higher among adults aged 40 to 59 years (nearly 40%) than among adults aged 20 to 39 (30%) or older adults aged 61 years or older (35%). The numbers among children are also alarming; approximately 17% of all children and adolescents in the United States are classified in the obese category. The obesity rate has tripled compared to just one generation ago. In 2008, the estimated annual cost of medical care for obese patients in the United States was $147 billion, or approximately $1,429 higher per obese person than a person of normal weight. Obesity has reached epidemic proportions in the United States, and many programs are now aimed at teaching people from a young age the importance of exercise and a healthy diet.

Figure 8-22 Skeletal changes. **A.** Kyphosis. **B.** Spondylosis.

Obesity has become such a significant issue that a new field of medicine has emerged to provide specialty care for obese patients. **Bariatrics** is the branch of medicine concerned with the management (prevention or control) of obesity and allied diseases. It comes from the Greek words *baros*, weight, and *iatreia*, medical treatment. There is a direct correlation between the degree of obesity and the frequency and severity of health problems; therefore, the larger the patient, the more likely he or she is to need emergency treatment and transportation. This issue is taking an increasing toll on the health of EMTs because back injuries account for the largest number of missed days of work and both temporary and permanent disability.

Although manufacturers are producing equipment with ever higher capacities, this does not address the danger to the users of that equipment. European ambulance manufacturers regularly install mechanical lifts on their units; however, these features are not as common in the United States.

Additional Patient-Moving Equipment

Bariatric Stretchers

Because of the large girth of bariatric patients, they may not fit comfortably on the standard wheeled stretcher. As a result, a specialized type of wheeled stretcher has been developed, called the bariatric stretcher **Figure 8-23**. This type of stretcher is similar in design to the common wheeled stretcher; however, it has several differences. Bariatric stretchers typically have a wider patient surface area to allow for increased comfort, as well as increased dignity when transporting the patients. Bariatric stretchers also have a wider wheelbase, allowing for increased stability when rolling the patient over uneven terrain. Bariatric stretchers are sometimes equipped with optional features such as a tow package, which allows an ambulance-mounted winch to assist in loading the patient into the ambulance, decreasing the potential for EMT back injuries. Another optional feature is telescoping side lift handles, which allow for increased leverage when lifting with multiple providers. However, the most important feature of the bariatric stretcher is the increased weight-lifting capacity. Typical wheeled ambulance stretchers, depending on manufacturer ratings, are rated to a maximum weight of 650 lb (295 kg). Bariatric stretchers are usually rated between 850 and 900 lb (386 to 408 kg).

Figure 8-23 A bariatric stretcher.

Courtesy of Stryker Medical, a division of Stryker Corporation.

Pneumatic and Electronic Powered Wheeled Stretchers

In an effort to decrease the potential for back injuries to EMS providers, manufacturers have developed pneumatic and electronic stretchers. Similar in appearance to conventional wheeled stretchers, electronic stretchers are battery operated and have electronic controls to facilitate raising and lowering of the undercarriage at the touch of a button **Figure 8-24**. A drawback to the powered wheeled stretcher is that by adding the electronic controls, as well as the associated equipment, the weight of the stretcher is increased, typically by 75 to 100 lb (34 to 45 kg). Coupled with the weight of the patient on the loaded stretcher, this creates a potential hazard when transporting the patient over uneven terrain or up and down steps.

YOU are the Provider PART 5

A cervical collar is applied and Patient 2 is secured to a Kendrick Extrication Device (KED). You are then able to remove her from the wreckage and onto a backboard. After loading her into the ambulance, you perform a complete assessment and transport her to the local trauma center for evaluation.

Recording Time: 27 Minutes	
Level of consciousness	Alert and oriented
Respirations	16 breaths/min; adequate depth
Pulse	110 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	148/72 mm Hg
Spo_2	100% (on room air)

On arrival at the hospital, the patient tells you that she is still in pain, although it is not as severe and feels like “a pulled muscle.” After moving her from the wheeled stretcher to the hospital bed, you give your verbal report to the staff nurse and return to service.

11. How can you minimize the risk of injury while moving a patient on a wheeled ambulance stretcher?

Portable/Folding Stretchers

A **portable stretcher** is a stretcher with a strong, rectangular, tubular metal frame and rigid fabric stretched across it **Figure 8-25**. Portable stretchers do not have a second multipositioning frame or adjustable undercarriage. Some models have two wheels that fold down about 4 inches (10 cm) underneath the foot end of the frame and legs of a similar length that fold down from the head end at each side. The wheels make it easier to move the loaded stretcher. The legs should not be used as handles.

Some portable stretchers can be folded in half across the center of each side so that the stretcher is only half its usual length during storage. Many ambulances carry a portable stretcher to use if a patient is in an area that is difficult to reach with a wheeled ambulance stretcher or if a second patient must be transported on the squad bench of the ambulance.

Figure 8-24 An electronic stretcher.

Courtesy of Stryker Medical, a division of Stryker Corporation.

Figure 8-25 A portable stretcher.

© Steve Gorton/Getty.

A portable stretcher weighs much less than a wheeled stretcher and does not have a bulky undercarriage. However, because most models do not have wheels, you and your team must support all of the patient's weight and any equipment along with the weight of the stretcher.

Flexible Stretchers

Several types of flexible stretchers are available and can be rolled up across either the stretcher's width or length, so that the stretcher becomes a smaller, tubular package for storage and carrying **Figure 8-26**. When you must carry the equipment a considerable distance from the nearest place that the ambulance can be located, this is an important consideration. A **flexible**

stretcher forms a rigid stretcher that conforms around the patient's sides and does not extend beyond them. When these stretchers are extended, they are particularly useful when you must remove a patient from or through a confined space. Certain flexible stretchers can also be used if the patient must be belayed or rappelled by ropes.

Figure 8-26 A flexible stretcher.

The flexible stretcher is the most uncomfortable of all the various devices, but it provides excellent support and immobilization. When the stretcher is wrapped around the patient and the straps are secured, the patient is completely secured. The stretcher can then be lowered by rope or slid down a flight of stairs by resting it on the front edge of each step.

▶ Short Backboards

You can use a short backboard to immobilize the torso, head, and neck of a seated patient with a suspected spinal injury until you can immobilize the patient on a backboard. Short backboards are 3 to 4 feet long (approximately 1 m). However, the wooden short backboard has generally been replaced with a vest-type device, such as the Kendrick Extrication Device (KED), that is specifically designed to immobilize the patient until he or she is moved from a sitting position to a supine position on a backboard Figure 8-27. The vest-type devices are easier to use than the wooden short backboard.

Vacuum Mattresses

Another alternative to the backboard, especially for immobilizing geriatric and pediatric patients, is the vacuum mattress. With this device, the patient is placed on the mattress and the air is removed from the device, allowing it to mold around the patient. It fits snugly to the curvatures and contours of the body and limits pressure point tenderness. As the mattress molds to the body, it provides a high degree of immobilization and comfort. It also provides thermal insulation, thereby reducing the risk of hypothermia. Padding may be used for tender areas, but is not required for most patients.

Figure 8-27 The Kendrick Extrication Device (KED) is a vest-type immobilization device.

It is imperative to maintain spinal immobilization while placing the patient on the device and to secure the patient properly once he or she is placed on the mattress. The vacuum mattress cannot be used on patients weighing 350 lb (159 kg) or more. See Chapter 28, *Head and Spine Injuries*, for more information about the vacuum mattress.

Basket Stretchers

Use a rigid **basket stretcher**, also called a Stokes litter, to carry a patient across uneven terrain from a remote location that is inaccessible by ambulance or other vehicle Figure 8-28. If you suspect that the patient has a spinal injury, first secure him or her on a backboard and then place the backboard into the basket stretcher. Once you have reached the ambulance and wheeled ambulance stretcher, you can remove the patient secured to the backboard from the basket stretcher and place the patient on the stretcher.

Basket stretchers are made of plastic with an aluminum frame or have a full steel frame that is connected by a woven wire mesh. The wire basket is very uncomfortable for the patient unless the wire is padded. Either type can be used to carry a patient across fields, rough terrain, or trails or on a toboggan, boat, or all-terrain vehicle. Basket stretchers surround and support the patient, yet their design allows water to drain through holes in the bottom. Basket stretchers are also used for technical rope rescues and some water rescues. Not all basket stretchers are rated or appropriate for each of these specialized rescue uses. The types of basket stretchers that are acceptable for specialized rescue must be determined by providers with additional special training.

Figure 8-28 A basket stretcher.

Scoop Stretchers

The **scoop stretcher**, or orthopaedic stretcher, is designed to be split into two or four pieces **Figure 8-29**. These sections are fitted around a patient who is lying on the ground or another relatively flat surface. The parts are reconnected, and the patient is lifted and placed on a backboard or stretcher. A scoop stretcher may be used for patients who have been struck by a motor vehicle.

A scoop stretcher is efficient; however, both sides of the patient must be accessible. You must also pay special attention to the closure area beneath the patient so that clothing, skin, and other objects are not trapped or pinched. As with the backboard, you must fully immobilize and secure the patient before moving him or her; however, you cannot slip a scoop stretcher under the long axis of the patient's body. Scoop stretchers are narrow, well constructed, and compact and have excellent body support features but are not adequate when used alone for standard immobilization of a spinal injury. You and your team should practice often with a scoop stretcher to be ready for using it with a patient. It is important to remember that some scoop stretchers have internal supports running throughout their length; this feature prohibits hospitals from being able to obtain a radiograph while the patient is secured to it, often mandating another move to a standard backboard prior to obtaining the radiograph.

Figure 8-29 A scoop stretcher.

Neonatal Isolettes

When you need to transport a neonatal patient from one hospital to another, the common wheeled ambulance stretcher will not suffice. To safely transport a neonatal patient, the patient must be placed inside of an isolette, sometimes referred to as an incubator. The isolette keeps the neonatal patient warm with moistened air in a clean environment and helps to protect the infant from noise, drafts, infection, and excess handling. The specialized transport devices come in one of two forms: the isolette is placed directly on top of the wheeled stretcher and secured with seat belts, or a free-standing type of isolette is secured into the back of the ambulance, taking the place of the standard stretcher Figure 8-30.

Decontamination

It is essential that you decontaminate your equipment after use, for your own safety, the safety of the EMTs using the equipment after you, and the safety of your patients, to prevent the spread of disease. Just as you expect a hospital bed to be disinfected after the last patient, so too with your stretcher and other transport equipment. Know and follow your local standard operating procedures for disinfecting equipment after each call.

Figure 8-30 Neonatal isolette.

Patient Positioning

It is imperative while treating a patient that he or she be properly positioned based on the chief complaint. Certain patient conditions, such as head injury, shock, spinal injury, pregnancy, and obese patients, call for special lifting and moving techniques. While a patient with a potential spinal injury should be fully immobilized, a patient with no suspected injury reporting chest pain or respiratory distress should be placed in a position of comfort—typically a Fowler or semi-Fowler position—unless he or she is hypotensive. Patients who are in shock should be packaged and placed in a supine position. Patients in late stages of pregnancy should be positioned and transported on their left side if they are uncomfortable or hypotensive when supine. Place an unresponsive patient with no suspected spinal, hip, or pelvic injury into the recovery position by rolling the patient onto his or her side without twisting the body. Transport a patient who is nauseated or vomiting in a position of comfort, but ensure that you are positioned appropriately to manage and maintain a patent airway. Obese patients should be positioned the same as other patients with a similar condition; however, particular attention must be paid to ensure their dignity is maintained.

Medical Restraints

While not a common occurrence, there may be a time when you are called on to physically restrain a patient; for example, during a behavioral emergency. After evaluating the patient for correctible causes of combativeness, such as head injury, hypoxia, or hypoglycemia, you must decide whether to restrain your patient. There may be legal consequences for either applying the restraints (such as charges of assault and battery) or failing to restrain a patient who should have been restrained (such as a lawsuit). Contact law enforcement and consult local protocols prior to applying restraints; in some jurisdictions, medical control authorization is needed before an EMT can apply restraints. Chapter 22, *Psychiatric Emergencies*, discusses combative patients in more detail.

The decision to restrain a patient is not one to be taken lightly; however, if the patient poses a danger to you, your team members, himself or herself, or bystanders, the application of physical restraints needs to be considered. However, before you take action to restrain the patient, attempt to speak to the patient in a calming manner, while remaining firm in your requests. If de-escalation does not work and the patient continues to be combative, a plan needs to be developed and agreed upon by all personnel present as to who will do what, when it will happen, and how you will accomplish the restraint.

There should be a minimum of five personnel to assist in the restraint of a combative patient, one for each extremity and one for the head. One EMT should be established as the team leader, the one who will give commands. Be direct. State your intentions, what you expect of the patient, what you are doing, and maintain good eye contact.

When preparing to secure the patient on the stretcher, it is of the utmost importance to place the patient in the supine position. If the patient is placed in a prone position, positional asphyxia could develop. In prone positioning, the increased weight on the patient's lungs and his or her inability to fully expand the thoracic cavity could render the patient unable to breathe, creating a preventable, life-threatening emergency.

If a patient for whom use of medical restraints is indicated is in the supine position, some type of humane restraint should be applied to each extremity, such as triangle bandages, roller gauze, commercially available disposable restraints, or leather restraints. Preferably the patient should be restrained onto a backboard, which allows for easy movement should the patient begin to vomit. However, if it is impractical or inadvisable to secure the patient to the backboard, then secure the patient to the stretcher. Regardless of whether the patient is secured to a backboard or the stretcher, one arm should be secured above the patient's head and one arm should be secured at the patient's side. This technique will not give the patient the leverage to break free from the restraints. After the upper extremities are secured, each leg should be secured as well. Ensure that you will be able to quickly remove the restraints during transport if necessary. Patients should not be transported in handcuffs unless a police officer rides in the ambulance with you during transport.

After application of the restraints, it is imperative to assess the patient's ABCs, mental status, and distal circulation (pulse and motor and sensory function) frequently **Figure 8-31**. Document your findings on the patient care report. Include what types of restraints were used and why in the report, which is essential if the case is reviewed for medicolegal reasons.

Figure 8-31 After application of the restraints, it is imperative to assess the patient's distal circulation frequently.

Personnel Considerations

As an EMT, you will be required to assist in the movement of patients. In an effort to minimize injuries, prior to moving any patient, a complete plan needs to be developed and discussed among your team. Some questions to ask are the following:

Words of Wisdom

Restraints should never be punitive. Only apply restraints to patients who pose a threat to you, your team members, themselves, or bystanders, and follow local protocols for the use of restraints. If a restrained patient starts to spit, cover the patient's mouth with a simple face mask or surgical mask. Once restraints have been applied, never remove them until you arrive at the hospital and are requested to remove them by the hospital staff.

- Am I physically strong enough to lift and move this patient?
- Is there adequate room to get the proper stance to lift the patient?
- Do I need additional providers for lifting assistance?

The answers to these questions need to be evaluated prior to moving your patient. Remember that injured EMTs cannot help anyone.

YOU are the Provider SUMMARY

1. What immediate challenges do you face?

Your first concern is for the stability of the vehicle. Prior to attempting to physically access the patients, safety measures must be taken to stabilize the vehicle and prevent further rollover or collapse during the extrication process.

The next consideration is for the size of the patient. How much does the patient weigh? Does he or she weigh more than you and your partner can safely lift? There is also the consideration of working in an enclosed space that may not allow for additional providers to help.

Additionally, there are two patients and at least one is in critical condition. This further increases the stress on you and may lead to injury if the lift is not adequately planned. While your intention to help the patient is admirable, you must remember that you will be useless to the team and the patient if you are injured in the process.

2. Why is knowledge of body mechanics important when lifting and moving a patient?

Body mechanics describes the way you move your body. Posture is an important component in body mechanics. Good posture means the spine is in a neutral position. Knowing how your body moves will minimize the risk of a back injury when you are lifting or moving a patient. Always keep your back in a straight and upright position, and lift without twisting.

3. What other resources are needed?

You already know that Patient 1 is unresponsive and showing signs of dyspnea with cyanosis. You also know that both patients are entrapped in the overturned vehicle, and extrication will be required. Therefore, immediately call for paramedic backup and a rescue unit, as well as lifting assistance. There will be a delay in care as the patients are extricated. Having advanced units standing by will decrease the time to definitive care. If you are a long distance from a Level I trauma center, consider the use of air transport, if available.

Law enforcement should be dispatched for crowd control and to help with directing traffic around the scene to make it safe for everyone to work. Each agency has its own job to do, and the sooner each agency is dispatched, the quicker the patient will receive optimal care.

4. Do you consider Patient 1 to be in stable or unstable condition? Should you wait for further assistance or go ahead and gain access to him?

The condition of Patient 1 is unstable due to his altered level of consciousness and cyanosis. However, never enter a scene that is not safe. With the vehicle lying on its side in such a precarious position, any weight added could cause it to roll over and crush you or cause further injury to the patients. The vehicle must be stabilized prior to gaining access to the patients. Safety of the crew is paramount before any patient care is provided.

If Patient 2 is able to lift her arms and the tubing is long enough, it may be possible to toss a nonrebreathing mask into the vehicle and have Patient 2 place the mask over the face of Patient 1 to provide him with oxygen before further treatment begins. Any further care will have to be postponed until the vehicle has been stabilized.

5. Once you are able to gain access, what are your concerns for the use of proper body mechanics while removing these patients?

The overturned vehicle is a confined space that only allows for access by one EMT. This means that you must consider your lifting limits and think through what type of equipment may be utilized to place the least amount of physical stress on you. The patients may have to be moved in carefully planned stages. Try to use your legs to do the majority of the lifting, and try to keep your back as straight as possible with the limitations imposed.

6. Once Patient 1 is no longer entrapped, how will you attempt to remove him from the vehicle while maintaining cervical spine support?

Due to the mechanism of injury, cervical spine control for both patients is warranted. Patient 1 must be removed first. After gaining access, you will have to assess the situation and available space to see if a backboard can be introduced through the back door of the vehicle. If not, is there any other device that you may slide underneath the patient to assist with moving him? You can place an appropriately sized cervical collar on the patient, but remember that this does not provide stabilization unless someone is actually holding the head and neck in alignment. This is far from an ideal lifting situation, so you must proceed cautiously and try to manipulate his spine as little as possible. This is a situation where an urgent move is required and time is of the essence. Be as careful as possible while removing the patient.

7. What type of move is best for removing Patient 1?

Due to the unstable condition of the patient, it is necessary to move him as quickly and safely as possible. Unfortunately, with such a confined space there is no way to utilize additional help to maintain spinal alignment. If the rescue team is able to wedge a backboard through the open door of the vehicle, it will give you a platform to stand or kneel on, as well as something on which to move the patient. The best option for moving Patient 1 is to use a clothes drag (remember never to pull on pockets or belt loops, as they may break loose, causing the patient to fall down) or to grab underneath his arms and pull him upward if you are able to reach that far. If Patient 2 is able to use her arms, she may be able to help push upward from his hips to assist you in moving him. He will have to be pulled between the headrests because there is no other access. Make sure he is moved in small increments, using your arms to "curl" and repositioning often to protect your back. After his head and shoulders are pulled though the seats, a second provider can possibly reach through far enough to help pull him onto the backboard and then assist in removing him and the backboard from the vehicle.

8. What steps can you take to maximize safety while lifting a patient?

To safely lift and carry a patient, you and your team must anticipate and understand every move, and each move must be coordinated. To avoid confusion, which may result in one or more providers suddenly bearing an unexpected amount of weight, the team leader (typically the provider closest to the head of the patient) should call out all of the lifting commands.

The following general guidelines should be followed to maximize safety when lifting any patient:

- Keep your legs shoulder width apart.
- Keep your back in a straight, locked-in position.
- Keep the patient's weight as close to your body as possible.
- Bend at the knees, not the waist, when lifting.
- Avoid lifting and reaching at the same time.
- Avoid twisting your body as you are lifting.
- Lift with your palms facing up (power grip).
- Communicate with your partner (or team) at all times.

9. How is a patient's weight distributed when he or she is on a carrying device? Why is it important to know this?

To position your team accordingly, and thus minimize the potential for injury, it is important to know how a patient's weight is distributed when he or she is on a carrying device.

If a patient is supine on a backboard or a scoop stretcher or is in a semisitting position on an ambulance stretcher, his or her weight is not equally distributed between the two ends of the device. When a patient is in a horizontal position, between 68% and 78% of his or her weight is in the torso. Therefore, the strongest provider(s) should be positioned at the head end of the carrying device. However, you should still position the remaining providers so that each one—including the provider(s) at the patient's head—bears an equal amount of the patient's weight.

10. Considering her complaints and the fact that her condition is stable, what are your best options for removing Patient 2?

An urgent move is not required because the patient's condition is stable. Think through the possibilities while you provide reassurance to the patient. She has the potential for spinal injuries because of the mechanism of injury. She is also reporting back pain. The best way to move a stable patient reporting neck or back pain is to use a short vest device such as a KED. Apply a cervical collar to the patient and then position the KED behind the patient and have her thread the leg straps underneath her legs. Continuously remind the patient to hold her head still and try to move as little as possible because there is no room for another provider to hold cervical spine control. Once the device is positioned, you will have to lean through the seats to attach and secure the straps. Once secured, the patient can be moved as a unit. Pull her through the seats and onto the awaiting backboard where you will have additional assistance to remove her from the vehicle.

11. How can you minimize the risk of injury while moving a patient on a wheeled ambulance stretcher?

When you move a patient on a wheeled ambulance stretcher, make sure that it is elevated whenever possible, not lowered to the ground. If the stretcher is lowered to the ground, you will have to bend down and move the patient at the same time; this increases the potential for a back injury.

When the stretcher is elevated, the main frame and the patient are considerably higher than the wheels; this makes the stretcher top-heavy. Therefore, when you are moving a patient on an elevated stretcher, ensure that you hold the frame firmly between both of your hands at all times so that if the patient moves, the stretcher will not tip over.

If you are guiding the stretcher from the foot end, make sure your arms are held close to your body, and avoid reaching a great distance behind you or hyperextending your back. Your back should be locked, straight, and untwisted. To avoid hyperextending your elbows or injuring your shoulder, keep your elbows slightly flexed and use the muscles of your arms to pull.

If you are guiding the stretcher from the head end, push with your arms and bend your elbows so that your hands are about 12 to 15 inches (30 to 38 cm) in front of your torso. To protect your elbows from injury, avoid pushing the stretcher with your arms fully extended and your elbows locked. When you push with your elbows bent but firmly held from bending further, the strong muscles of your arms serve as a shock absorber if the wheels of the stretcher strike an obstacle, causing the stretcher to come to an abrupt stop.

EMS Patient Care Report (PCR)

Date: 09-20-16	**Incident No.:** 013409	**Nature of Call:** Motor vehicle crash		**Location:** 125 Parkview Place	
Dispatched: 0822	**En Route:** 0822	**At Scene:** 0828	**Transport:** 0938	**At Hospital:** 0947	**In Service:** 0955

Patient Information

Age: 82 **Sex:** F **Weight (in kg [lb]):** 69 kg (152 lb)	**Allergies:** Penicillin **Medications:** Ibuprofen, lisinopril **Past Medical History:** Chronic back pain, hypertension **Chief Complaint:** Back pain, right side pain

Vital Signs

Time: 0833	**BP:** Unable to assess	**Pulse:** Unable to assess	**Respirations:** A little rapid, but unable to visualize	**Spo$_2$:** N/A
Time: 0912	**BP:** 148/92	**Pulse:** 112	**Respirations:** 20	**Spo$_2$:** 99%
Time: 0928	**BP:** 148/72	**Pulse:** 110	**Respirations:** 16	**Spo$_2$:** 100%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

Dispatched to the scene of a motor vehicle crash where a sedan-type vehicle was found lying on the passenger's side in ditch partially filled with water. Upon arrival secondary units were requested to stabilize vehicle and a paramedic unit was requested for backup. Both patients were unrestrained and the female patient was pinned underneath the male, who was unresponsive.

Once the vehicle was stabilized the male patient was removed and turned over to the awaiting paramedic team. The woman was then able to be accessed. 82-year-old female unrestrained passenger with a history of chronic back pain was reporting pain to her back and right side. She was alert and oriented with no significant injuries noted. A cervical collar was applied. In order to remove the patient from the vehicle, a Kendrick Extrication Device (KED) was placed behind the patient, and, with her help, the device was secured around her body and legs. Using the KED, the patient was pulled up over the seats and onto an awaiting backboard.

Once the patient was removed from the vehicle and secured to the backboard she was loaded into the ambulance. Vital signs were obtained and a secondary assessment was completed en route to the local trauma center. There were no significant injuries found and the patient remained stable during transport. Upon arrival at the trauma center patient report was given to the receiving nurse and the crew returned to service.**End of report**

Note: The responding paramedic team provided documentation for the care of the male patient turned over upon removal from the wreckage.

Prep Kit

Ready for Review

- The wheeled ambulance stretcher and the backboard are the most commonly used devices to move and transport patients.
- It is best to move a patient on a device that can be rolled. However, if a wheeled device is not available, you must understand and follow certain guidelines for carrying a patient on a stretcher or backboard.
- Whenever you move a patient, you must take special care to avoid injury to you, your team, and the patient.
- The safety of you, your team, and the patient depends on the use of proper lifting techniques and maintaining a proper hold when lifting or carrying a patient. You must practice each technique with your team often so that you are able to perform the move quickly, safely, and efficiently.
- The same basic body mechanics apply for safe reaching, pulling, lifting, and carrying.
- Good body mechanics are important to prevent injuries, but are not always sufficient. Special devices and technology should be used when possible to further decrease your risk of injury.
- The first key rule of lifting is to always keep your back in an upright position and lift without twisting. You can lift and carry significant weight without injury as long as your back is in the proper upright position.
- Do not hyperextend your back when reaching overhead.
- The power lift is the safest and most powerful way to lift.
- Pushing is better than pulling.
- If you do not have a proper hold, you will not be able to bear your share of the weight, or you may lose your grasp with one or both hands and possibly cause a low back injury to one or more providers.
- When you must carry a patient up or down a flight of stairs or other significant incline, use a stair chair. The exception to this is when the patient is in cardiac arrest, must be moved in a supine position, or must have his or her spine immobilized during transport, in which case the patient will be moved on the stairs on a backboard.
- If you must carry a loaded backboard or stretcher up or down stairs or other inclines, be sure that the patient is tightly secured to the device to prevent sliding.
- Be sure to carry the backboard or stretcher foot end first so that the patient's head is elevated higher than the feet.
- Directions and commands are important parts of safe lifting and carrying.
- You must constantly coordinate your movements with those of the other team members and communicate with them.
- You and your team must anticipate and understand every move and execute it in a coordinated manner.
- The team leader is responsible for coordinating the moves.
- Try to use four providers whenever resources allow.
- Know how much you can comfortably and safely lift and do not attempt to lift more than this amount.
- Rapidly summon additional help to lift and carry a weight that is greater than you are able to lift.
- Perform an urgent move if a patient has an altered level of consciousness or inadequate ventilation, is in shock, or during extreme weather conditions.
- You should normally move a patient with nonurgent moves, in an orderly, planned, and unhurried manner, selecting methods that involve the least amount of lifting and carrying.
- At times, you may have to use an emergency move to maneuver a patient before providing assessment and care.
- Other devices that are used to lift and carry patients include portable stretchers, flexible stretchers, backboards, basket stretchers (Stokes litters), and scoop stretchers.
- Training and practice are required to use all the equipment that is available to you.
- You will learn the technical skills of patient packaging and handling through practice and training.

Vital Vocabulary

backboard A long, flat board made of rigid, rectangular material that is used to provide support to a patient who is suspected of having a hip, pelvic, spinal, or lower extremity injury; also called a spine board, trauma board, and longboard.

bariatrics A branch of medicine concerned with the management (prevention or control) of obesity and allied diseases.

basket stretcher A rigid stretcher commonly used in technical and water rescues that surrounds and supports the patient yet allows water to drain through holes in the bottom; also called a Stokes litter.

body mechanics The relationship between the body's anatomical structures and the physical forces associated with lifting, moving and carrying; the ways in which the body moves to achieve a specific action.

diamond carry A carrying technique in which one provider is located at the head end of the stretcher or backboard, one at the foot end, and one at each side of the patient; each of the two providers at the sides uses one hand to support the stretcher or backboard so that all are able to face forward as they walk.

direct ground lift A lifting technique that is used for patients who are found lying supine on the ground with no suspected spinal injury.

emergency move A move in which the patient is dragged or pulled from a dangerous scene before assessment and care are provided.

extremity lift A lifting technique that is used for patients who are supine or in a sitting position with no suspected extremity or spinal injuries.

flexible stretcher A stretcher that is a rigid carrying device when secured around a patient but can be folded or rolled when not in use.

portable stretcher A stretcher with a strong, rectangular, tubular metal frame and rigid fabric stretched across it.

power grip A technique in which the stretcher or backboard is gripped by inserting each hand under the handle with the palm facing up and the thumb extended, fully supporting the underside of the handle on the curved palm with the fingers and thumb.

power lift A lifting technique in which the EMT's back is held upright, with legs bent, and the patient is lifted when the EMT straightens the legs to raise the upper body and arms.

rapid extrication technique A technique to move a patient from a sitting position inside a vehicle to supine on a backboard in less than 1 minute when conditions do not allow for standard immobilization.

scoop stretcher A stretcher that is designed to be split into two or four sections that can be fitted around a patient who is lying on the ground or other relatively flat surface; also called an orthopedic stretcher.

stair chair A lightweight folding device that is used to carry a conscious, seated patient up or down stairs.

wheeled ambulance stretcher A specially designed stretcher that can be rolled along the ground. A collapsible undercarriage allows it to be loaded into the ambulance; also called an ambulance stretcher.

Assessment *in Action*

A call comes in for an injured person in a wooded area. Dispatch tells you that the patient, a 42-year-old man, was cutting down a tree when it fell on him. Upon arrival you are led to an area about 200 yards from where you have to leave the ambulance outside the tree line. When you reach the patient he is lying supine with a large tree trunk across his upper legs and pelvic region. Bystanders who were working with him are using a jack to try to lift up the tree high enough to get him out. The patient is alert and reports tremendous pain in his right hip and upper thigh.

1. What is the best way to remove the patient once the tree is lifted?

   A. Power lift
   B. Clothes drag
   C. Extremity lift
   D. Direct lift

2. When freeing the patient, it is imperative to use which proper body mechanics?

   A. Keep your back straight.
   B. Keep your feet close together.
   C. Bend as far forward at the hips as possible.
   D. Keep your back curved.

3. Should you consider spinal immobilization for this patient?

   A. Yes, every patient should be immobilized.
   B. Yes, there is a significant MOI.
   C. No, he is not reporting neck or back pain.
   D. No, there is no significant MOI.

4. Once the patient is free, how should he be moved to the backboard?

   A. Extremity lift
   B. Direct ground lift

C. Scoop stretcher
D. Log roll with attention to cervical spine

5. When you use a body drag to move a patient, your back should be locked and straight and:

A. your feet should be close together.
B. your arms should be fully extended with elbows locked.
C. your elbows should only extend just beyond the anterior torso.
D. you should bend from the waist with your feet 12 inches (30 cm) apart.

6. When lifting a backboard, you should use the:

A. lateral lift.
B. diamond carry.
C. power grip.
D. power lift.

7. The scoop stretcher is also known as a(n):

A. orthopaedic stretcher.
B. flexible litter.
C. basket litter.
D. ambulance stretcher.

8. Because you are unable to bring the stretcher to the patient, the best way to carry him to the stretcher is using the:

A. diamond carry.
B. firefighter's carry.
C. direct carry.
D. emergency carry.

9. Describe how constant communication between team members can avoid provider injury.

10. What are three questions you should ask yourself before lifting a patient?

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SECTION
2

9 Patient Assessment

CHAPTER 9

Patient Assessment

National EMS Education Standard Competencies

Assessment

Applies scene information and patient assessment findings (scene size-up, primary and secondary assessment, patient history, and reassessment) to guide emergency management.

Scene Size-up

› Scene safety (pp 317–318)

› Scene management

- Impact of the environment on patient care (pp 317–318)
- Addressing hazards (p 318)
- Violence (p 318)
- Need for additional or specialized resources (p 321)
- Standard precautions (pp 319–320)
- Multiple patient situations (pp 320–321)

Primary Assessment

› Primary assessment for all patient situations (pp 323–336)

- Level of consciousness (pp 324–325)
- ABCs (pp 326–332)
- Identifying life threats (pp 325–326, 332–335)
- Assessment of vital functions (pp 323–325, 329–330)
- Initial general impression (pp 323–324)

› Begin interventions needed to preserve life (pp 325–326, 332)

› Integration of treatment/procedures needed to preserve life (pp 335–336)

History Taking

› Determining the chief complaint (pp 338–339)

› Mechanism of injury/nature of illness (pp 318–319)
› Associated signs and symptoms (pp 338–340)
› Investigation of the chief complaint (pp 338–339)
› Past medical history (pp 338–340)
› Pertinent negatives (p 340)

Secondary Assessment

› Performing a rapid full-body scan (pp 348–353)
› Focused assessment of pain (pp 348, 353–372)
› Assessment of vital signs (pp 354–363, 370–372)
› Techniques of physical examination
- Respiratory system (pp 353–356)
  - Presence of breath sounds (pp 355–356)
- Cardiovascular system (pp 356–363)
- Neurologic system (pp 363–368)
- Musculoskeletal system (pp 369–370)
- All anatomic regions (pp 366, 368–370)

Monitoring Devices

› Obtaining and using information from patient monitoring devices including (but not limited to)
- Pulse oximetry (p 371)
- Noninvasive blood pressure (p 372)

Reassessment

› How and when to reassess patients (p 375)
› How and when to perform a reassessment for all patient situations (p 375)

Knowledge Objectives

1. Identify the components of the patient assessment process. (p 315)
2. Explain how the different causes and presentations of emergencies will affect how EMTs perform each step of the patient assessment process. (p 315)
3. Discuss some of the possible environmental, chemical, and biologic hazards that may be present at an emergency scene, ways to recognize them, and precautions to protect personal safety. (pp 317–318)
4. Discuss the steps EMTs should take to survey a scene for signs of violence and protect themselves and bystanders from real or potential danger. (pp 317–318)
5. Describe how to determine the mechanism of injury (MOI) or nature of illness (NOI) at an emergency and the importance of differentiating trauma patients from medical patients. (pp 318–319)
6. List the minimum standard precautions that should be followed and personal protective equipment (PPE) that should be worn at an emergency scene, including examples of when additional precautions would be appropriate. (pp 319–320)
7. Explain why it is important for EMTs to identify the total number of patients at an emergency scene and how this evaluation relates to determining the need for additional or specialized resources, implementation of the incident command system (ICS), and triage. (pp 320–321)
8. Describe the principal goals of the primary assessment process, including how to identify and treat life threats and determine if immediate transport is required. (p 323)
9. Explain the process of forming a general impression of a patient as part of primary assessment and the reasons why this step is critical to patient management. (pp 323–324)
10. Explain the importance of assessing a patient's level of consciousness (LOC) to determine altered mental status and include examples of different methods used to assess alertness, responsiveness, and orientation. (pp 324–325)
11. Describe the assessment of airway status in patients who are both responsive and unresponsive, including examples of possible signs and causes of airway obstruction in each case as well as the appropriate EMT response. (pp 326–327)
12. Describe the assessment of a patient's breathing status, including the key information EMTs must obtain during this process and the care required for patients who have both adequate and inadequate breathing. (pp 327–328)
13. List the signs of respiratory distress and respiratory failure. (p 329)
14. Describe the assessment of a patient's circulatory status, including the different methods for obtaining a pulse and

appropriate management depending on the patient's status. (pp 329–330)
15. Explain the variations required to obtain a pulse in infant and child patients compared with adult patients. (pp 329–330)
16. Describe the assessment of a patient's skin color, temperature, and condition, including examples of both normal and abnormal findings and the information this provides related to the patient's status. (pp 330–331)
17. Discuss the process of assessing and methods for controlling external bleeding. (p 332)
18. Discuss the steps used to identify and subsequently treat life-threatening conditions that endanger a patient during an emergency. (pp 332–333)
19. List the steps EMTs should follow during the primary assessment of a trauma patient, including examples of abnormal signs and appropriate related actions. (pp 334–335)
20. Explain the process for determining the priority of patient care and transport at an emergency scene and include examples of conditions that necessitate immediate transport. (pp 335–336)
21. Discuss the importance of protecting a trauma patient's spine and identifying fractured extremities during patient packaging for transport. (pp 335–336)
22. Discuss the process of taking a focused history, its key components, and its relationship to the primary assessment process. (p 338)
23. Describe examples of different techniques EMTs may use to obtain information from patients during the history-taking process. (pp 340–346)
24. Discuss different challenges EMTs may face when taking a patient history on sensitive topics and strategies that can be used to facilitate each situation. (pp 341–343)
25. Describe the purpose of a secondary assessment and a physical exam; include how to determine which aspects of the physical exam to use, and the steps. (pp 348–353)
26. Explain situations in which patients may receive a focused assessment, including examples by body system of what each focused assessment should include based on a patient's chief complaint. (pp 353–373)
27. List normal blood pressure ranges for adults, children, and infants. (p 364)
28. Explain the importance of performing a reassessment of the patient and the steps in this process. (p 375)

Skills Objectives

1. Demonstrate how to use the AVPU scale to test for patient responsiveness. (p 324)
2. Demonstrate how to evaluate a patient's orientation and document his or her status correctly. (p 325)
3. Demonstrate the techniques for assessing a patient's airway and correctly obtain information related to respiratory rate, rhythm, quality, and character of breathing, and depth of breathing. (pp 326–328)
4. Demonstrate how to assess a radial pulse in a responsive patient and an unresponsive patient. (pp 329–330)
5. Demonstrate how to assess a carotid pulse in an unresponsive patient. (pp 329–330)
6. Demonstrate how to palpate a brachial pulse in a child who is younger than 1 year (or a manikin). (pp 329–330)
7. Demonstrate how to obtain a pulse rate in a patient. (pp 329–330)
8. Demonstrate how to assess capillary refill in an adult or child older than 6 years. (p 332)
9. Demonstrate how to assess capillary refill in an infant or child younger than 6 years; include variations that would be required when assessing a newborn. (p 332)
10. Demonstrate how to perform a rapid exam during primary assessment of a patient. (pp 334–335, Skill Drill 9-1)
11. Demonstrate how to perform a secondary assessment. (pp 349–353, Skill Drill 9-2)
12. Demonstrate how to measure blood pressure by auscultation. (pp 360–361, Skill Drill 9-3)
13. Demonstrate how to measure blood pressure by palpation. (pp 362–363, Skill Drill 9-4)
14. Demonstrate how to test pupil reaction in response to light in a patient and document his or her status correctly. (pp 364–365)
15. Demonstrate the assessment of neurovascular status. (pp 366–368, Skill Drill 9-5)
16. Demonstrate the use of a pulse oximetry device to evaluate the effectiveness of oxygenation in the patient. (pp 370–372)
17. Demonstrate the use of electronic devices to assist in determining the patient's blood pressure in the field. (p 372)
18. Demonstrate how to assess a patient's blood glucose level. (p 373, Skill Drill 9-6)

Patient Assessment

Scene Size-up

Ensure scene safety
Determine mechanism of injury/nature of illness
Take standard precautions
Determine number of patients
Consider additional/specialized resources

Primary Assessment

Form a general impression
Assess level of consciousness
Assess the airway: identify and treat life threats
Assess breathing: identify and treat life threats
Assess circulation: identify and treat life threats
Perform primary assessment
Determine priority of patient care and transport

History Taking

Investigate the chief complaint (history of present illness)
Obtain SAMPLE history

Secondary Assessment: Medical

Systematically assess the patient
- Secondary assessment and/or focused assessment

Assess vital signs using the appropriate monitoring device

Secondary Assessment: Trauma

Systematically assess the patient
- Secondary assessment and/or focused assessment

Assess vital signs using the appropriate monitoring device

Reassessment

Repeat the primary assessment
Reassess vital signs
Reassess the chief complaint
Recheck interventions
Identify and treat changes in the patient's condition
Reassess the patient
- Unstable patients: every 5 minutes
- Stable patients: every 15 minutes

Introduction

One of the most important skills that you can develop as an EMT is the ability to assess your patients. This skill is used in every patient encounter and is the basis for all treatment you will provide as an EMT. This chapter provides the framework and information necessary for you to be able to understand and conduct the patient assessment. The assessment process is divided into five main parts:

1. Scene size-up
2. Primary assessment
3. History taking
4. Secondary assessment
5. Reassessment

Although these steps represent a logical approach to patient assessment, the order in which they are performed may vary depending on the patient's condition and the environment in which you find him or her. For example, the same components of patient assessment used to evaluate a medical patient are used to assess a trauma patient; however, it may be necessary to change the order of some steps after scene size-up based on your findings and the need to prioritize the care of certain conditions. Regardless of the patient's complaint or the environment in which you find yourself, the key to effective patient assessment is to remain organized.

Rarely does one sign or symptom show you the patient's status or underlying problem. Rather, it is the combination of many signs and symptoms that will direct the care that you provide for your patient. A **symptom** is a subjective condition that the patient feels and tells you about. A **sign** is an objective condition that you can observe or measure. Therefore, it is essential to have a basic understanding of the causes and presentations of commonly encountered emergencies so that you know what to look for.

For example, a man with chest pain may be having a heart attack. Or, he may have a lung infection, a pulmonary embolism, or a simple strained muscle in the chest. He may also have sustained chest trauma. He describes the pain as crushing, radiating down the left arm and up into the jaw; he is pale and soaked in sweat; the episode began while he was shoveling snow; he has a history of coronary bypass surgery; and has nitroglycerin in his pocket. On the basis of this information, it seems likely the patient is experiencing, and should be treated for, a myocardial infarction.

As an EMT, the treatment you will provide for patients is based on symptoms, not an exact diagnosis. Many conditions may have similar signs and symptoms. As your career in EMS progresses, you may begin to formulate a list of potential conditions or injuries a patient may be experiencing as you treat them. Remember, it is essential to collect all pertinent information and be able to interpret how it fits together.

The patient assessment process is the foundation upon which all levels of EMT education are built and is the starting point for all patient care. EMS providers cannot effectively treat their patients if they cannot correctly assess them. Strong assessment skills will assist you in the process of saving lives.

Words of Wisdom

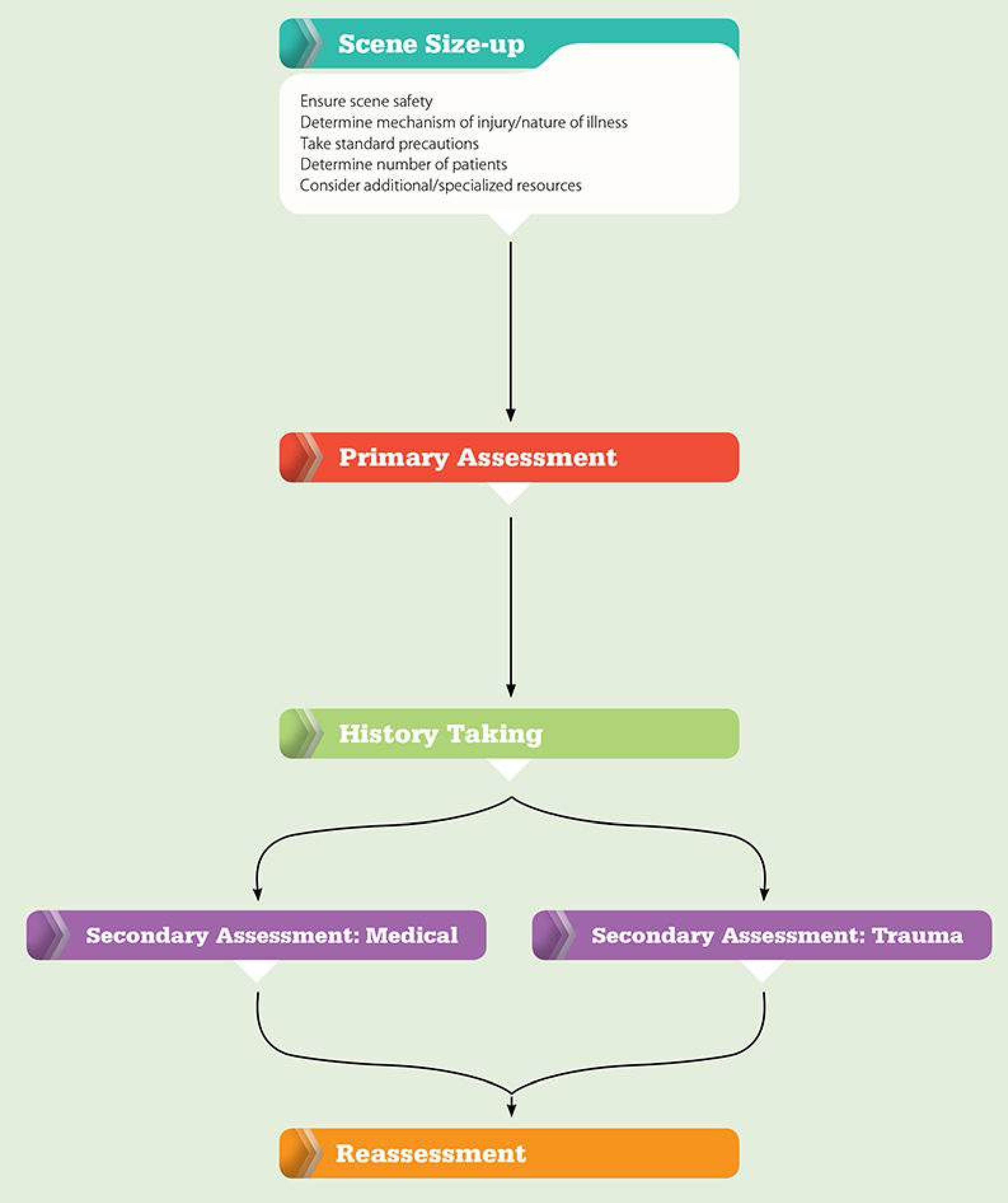
Although the steps of patient assessment represent a logical approach to the evaluation of a patient, the order in which they are performed is dictated by the patient's condition.

YOU are the Provider — PART 1

At 1815 hours, you are dispatched to an apartment complex at 1326 South Main Street for a "man down." The dispatcher has no additional information to provide, and law enforcement officers have been dispatched. The weather is overcast and rainy, the temperature is 62°F (16.7°C), and the traffic is light. Your response time to the scene is approximately 4 minutes.

1. What are the components of patient assessment?
2. Will your assessment of the patient differ if he is injured versus ill? If so, how?

Patient Assessment



Scene Size-up

Scene size-up refers to your evaluation of the conditions in which you will be operating. While this will be the focus of your attention when you first arrive on scene, continuous **situational awareness** is necessary throughout the entire call to ensure safety. Situational awareness is paying attention to the conditions and people around you at all times and the potential risks those conditions or people pose.

For example, before you know the specific location of the incident, consider how the weather, time of day, currently available resources, and other incidents in the same response district may affect your ability to operate safely and effectively. Scene size-up is listed at the top of the assessment algorithm because it is the first thing you must consider, but it does not end when you move through the rest of the assessment process.

When you are alerted for an emergency call, your dispatcher will provide you with some basic information about the request for your assistance. From the moment you are called into action until you reach your patient, you will consider a variety of things that will have an impact on how you operate on scene and provide patient care. These include road and traffic hazards that will affect where you park your vehicle, incident hazards such as fire, hazardous materials, or scenes of violence that may affect how and if you approach the scene, and more. Your scene size-up must combine an understanding of your situation and conditions prior to responding, the information the dispatcher gave you, and an observation of the scene itself to help you ensure safe and effective operations.

Ensure Scene Safety

Issues that you may encounter in the prehospital setting can range from minor difficulties to major dangers. Even scenes that first appear relatively safe and secure can turn unsafe with little notice. Look for possible difficulties and dangers as you approach the scene. Ask yourself, "Is it safe for my team and me to enter the scene and approach and manage the patient?" If the answer to this question is, "No, the scene is not yet safe to approach and manage the patient," then do what you can to make it safe or call for additional resources. These may include firefighters, utility workers, hazardous materials technicians, or law enforcement personnel, depending on the condition that is making the scene unsafe.

Before you step out of your response vehicle, observe for issues such as uneven or unstable surfaces, water, mud, and ice on the ground. Remember, you have to gain access to a patient to provide care, typically while carrying gear and a stretcher with you. In addition, when you leave, you will be moving up to a 100-pound (45 kg) stretcher, if it is motorized, and possibly a patient weighing 200 pounds (90 kg) or more, as well as patient care equipment and the patient's personal belongings. If your footing was compromised going in, you are going to have an even more difficult time coming out.

If you must exit your vehicle or approach the patient on a working roadway, you must consider traffic safety issues as well as other physical hazards. When operating in the area of an active roadway, you must wear, at a minimum, a high-visibility Class 2 or 3 safety vest approved by the American National Standards Institute. This vest helps make you visible to others on the roadway while minimizing interference with other clothes and equipment. A variety of other traffic-incident management techniques may be appropriate, including the use of personnel and traffic markers such as cones, flares, and signs to divert traffic around the area, and the strategic positioning of emergency vehicles to protect the area.

Consider environmental conditions that may present hazards at the scene. Is it cold, snowing, raining, hot, or humid? The weather may present a difficulty by itself, but consider how it may affect the physical terrain you may encounter, such as wooded areas, hills, mountains, gorges, rivers, lakes, streams, and islands. Even relatively minor weather conditions may present a significant hazard if responders and patients may be exposed to them for a significant amount of time; for example, during a long approach to, or while carrying out, a patient across difficult terrain **Figure 9-1**.

Figure 9-1 At times you may need to carry patients out of areas with difficult terrain.

Courtesy of James Tourtellote/US Customs and Border Protection.

Working in unfavorable conditions and on unstable surfaces is a large part of prehospital care. Without knowing the infinite number of situations you may become involved in, a good rule to use when faced with a wide variety of possibilities is that any actions you may take to protect yourself (eg, heavy coats, rain gear, life jackets, air conditioned or heated vehicles) should also be considered for the patient. If you are putting on equipment to address environmental hazards and can safely do so, provide the patient with the same or similar equipment. If you move away from the scene to take cover from an environmental hazard, move the patient with you when possible. Taking your time to stay focused on what you are doing will go a long way in preventing injuries to yourself and your patients.

If appropriate, help protect bystanders from becoming patients as well. Many bystanders attempt to help during an emergency; always remember that they are not trained to handle complicated EMS equipment, illnesses, or injuries.

Hazards come in many different forms, shapes, and sizes. You may encounter environmental hazards; physical hazards (such as sharp metal and broken glass, or slip-and-fall hazards from leaking fluids at a motor vehicle biohazards (such as blood and body fluids); chemical hazards (such as the release of a hazardous material); electrical hazards (such as downed power lines); water hazards; fires; explosions; and the threat of physical violence, to name a few. **Figure 9-2**.

You must be aware of scenes that have the potential for violence due to violent patients, distraught family members, angry bystanders, gangs, or unruly crowds. When you enter the home of a patient, look around the immediate area. Are there weapons visible in the area to which a patient or others may have access? Weapons need not be typical like a knife or gun; they can also be items such as a screwdriver, hammer, or simple things sitting on the kitchen table or nightstand by the bed. Always be observant for such objects, and if they are not secured, make sure that you place yourself between the patient and the potential danger, thus preventing possible access to the object. Request the assistance of law enforcement personnel if the scene is unsafe with the potential for violence **Figure 9-3**.

An emergency scene is a dynamically changing environment and simply checking the safety of the scene once at the beginning of the call is not enough. As an EMT, you must remain aware of changes in your surroundings that may present safety hazards to you, your EMS team, the patient, or bystanders. Regardless of when the hazards present themselves, it is up to you to either make the scene safe if you have the education and equipment to safely do so, or call for additional resources and move to a safe location.

Figure 9-2 Evaluate the scene for hazards as soon as you arrive.

Figure 9-3 If the scene is unsafe, request law enforcement support.

Determine Mechanism of Injury/Nature of Illness

Virtually all calls for assistance to which you may respond can be categorized as medical conditions, traumatic injuries, or both. Some emergency calls may involve a medical problem that leads to a traumatic injury, such as a patient who becomes weak and dizzy from a low blood glucose level, causing her to stumble, fall, and break her ankle. As an EMT, you will need to be able to identify the general classification and underlying issue(s) of the emergency to which you respond.

Traumatic injuries are the result of physical forces applied to the outside of the body, usually from an object striking the body or a body striking an object. These are generally classified according to the type or amount of force, how long it was applied, and where it was applied to the body. This is described as the **mechanism of injury (MOI)**. The MOI can be used as a guide to help you focus your assessment.

Certain parts of the body are more easily injured than others. The brain and the spinal cord are very fragile and easy to injure. Fortunately, they are protected by the skull, the vertebrae, and several layers of soft tissues. The eyes are also easily injured. Even small forces on the eye may result in serious injury. The bones and certain organs are stronger and can absorb small forces without resulting injury. A good understanding of anatomy and physiology will help you identify times when a mechanism of injury may lead to injury to parts of the body not directly impacted. For example, consider a patient who has fallen off a roof, landing feetfirst. This patient's MOI would direct attention to possible injury to the feet. But significant energy likely transferred to other body areas and may have caused further injury in the patient's legs, pelvis, and even his or her spine.

Terms commonly associated with MOI include blunt trauma and penetrating trauma. With blunt trauma, the force of the injury occurs over a broad area, and the skin is sometimes not broken. However, the tissues and organs underneath the area of impact may be damaged. With penetrating trauma, the force of the injury occurs at the specific point of contact between the skin and the object. The object pierces the skin and creates an open wound that carries a higher potential for infection.

As an EMT, you will also care for patients who require EMS attention because of illnesses or conditions not caused by an outside force. For these patients with medical problems, you must examine the general type of illness the patient is experiencing, or the **nature of illness (NOI)**. An example of this would be a patient who tells you that he feels like he cannot get enough air. This patient's NOI would be difficulty breathing and, like the MOI, would help direct both your assessment and your care.

There are similarities between the MOI and the NOI. Both require you to search for clues regarding how the incident occurred. You must make an effort to determine the general type of illness, which is often best described by the patient's **chief complaint**, the most serious thing the patient is concerned about and the reason EMS was called. To quickly determine the NOI, talk with the patient, family, or bystanders about the problem. At the same time, use your senses to check the scene for clues as to the possible problem. You may see open or spilled medication containers, poisonous substances, or unsanitary living conditions. You may smell an unusual or strong odor, such as the odor of fresh paint in a closed room. You may hear a hissing sound, such as a leak from a home oxygen system. Keep these observations of the scene in mind as you begin to assess a medical patient.

Be aware of scenes with multiple patients who are exhibiting similar signs or symptoms. An example would be an older couple experiencing flulike symptoms, headache, nausea, and vomiting. These symptoms may be indicative of carbon monoxide poisoning, which would also indicate an unsafe scene for you and your partner.

The Importance of the MOI and NOI

Considering the MOI or NOI early can be of value in preparing to care for your patient. For example, when you begin to gather equipment from the unit, what would you take to treat a patient reporting chest pain? How would that equipment differ from the equipment used for a pedestrian struck by a vehicle? The appearance of the scene may also guide your preparation. Other MOIs may include falls, motor vehicle crashes, assaults, and industrial accidents. Examples of NOIs include seizures, heart attacks, diabetic problems, and poisonings. Family members, bystanders, or even law enforcement personnel may also provide important trauma or medical information to help you assist the patient.

You may be tempted to categorize your patient immediately as a trauma or medical patient. Remember, the fundamentals of a good patient assessment are the same despite the unique aspects of trauma and medical care. If an unconscious patient is found at the bottom of a ladder, did he fall off the ladder, strike his head, and become unconscious? Or did he experience a medical problem that caused him to have a loss of consciousness and then fall off the ladder? Early in the assessment, it can be difficult to identify with absolute certainty whether the problem is of a traumatic or medical origin. Although further assessment is needed to come to a conclusion, considering the MOI or NOI early will help you begin your assessment.

Take Standard Precautions

Standard precautions and **personal protective equipment (PPE)** need to be considered and adapted to the prehospital task at hand. Personal protective equipment includes clothing or specialized equipment that protects the wearer. The type of PPE used depends on the specific job duties required during a patient care interaction. For example, rescue personnel may wear PPE such as helmets, eye protection, boots, gloves, and turnout gear designed to protect them from injury when working to extricate a patient trapped in a damaged motor vehicle. Hazardous materials technicians may don a protective suit designed to prevent contamination by potentially lethal hazardous materials.

Standard precautions are protective measures that have traditionally been recommended by the Centers for Disease Control and Prevention (CDC) for use in dealing with objects, blood, body fluids, and other potential exposure risks of communicable disease. If you have a primary responsibility for patient care, you will need to follow standard precautions when assessing and treating the patient. They are required in each and every patient encounter. These measures may not provide absolute protection from exposure to infectious diseases or bloodborne pathogens, but they are the most effective way to reduce your risk of exposure. The concept of standard precautions assumes that all blood, body fluids, nonintact skin, and mucous membranes may pose a substantial risk of infection. This includes blood and other potentially infectious materials that are dried, because some diseases such as hepatitis can live for days outside the body.

Take standard precautions before actual patient contact, often before you step out of your response vehicle **Figure 9-4**. After you make contact with a patient, it may be too late to think about what precautions should have been considered. The use of standard precautions in EMS, including but not limited to consistent handwashing (with soap and water or with alcohol-based hand cleansers) before and after care, gloves, eye protection, a mask, and a gown, may be dictated by local standards or protocols. At a minimum, gloves must be in place before any patient contact. Remember that after contact with a patient, gloves may be contaminated by infectious materials, so avoid handling EMS equipment with the same gloves used during patient contact. The use of eye protection may be necessary during patient interactions. Standard eyeglasses may not offer enough protection because most are not designed with side splash guards. For that reason, eyewear should protect you from potential exposures from many different directions. Blood and body fluids that contain potentially infectious materials may become airborne; consider wearing a mask if there is a risk of splash or spray. A mask will provide protection from some airborne diseases, but its level of protection will depend on the type of mask, a proper fit, and your ability to apply and wear it properly.

You must be appropriately educated in the use of standard precautions, which should include training in the many types of PPE used in different situations. If you are not trained in the application of PPE, you should not approach a scene or make patient contact but should call for additional help. After making contact with the patient, if you discover a condition that warrants a higher level of PPE than you are using, do not hesitate to regroup and upgrade your protection. For example, if you discover in your primary assessment that a patient has a productive cough and a history of tuberculosis (TB), and you are not wearing an N95 mask, you and your crew should immediately don appropriate respiratory protection. If you suspect you have been exposed to a communicable disease without the protection of proper PPE, follow your local agency’s protocols for postexposure reporting, testing, and prophylaxis.

Figure 9-4 Proper protective equipment is vital when you are called to a scene in which you may be exposed to blood or other body fluids.

Determine Number of Patients

As part of the scene size-up, it is essential that you accurately identify the total number of patients. This evaluation is critical in determining your need for additional resources, such as firefighters, a specialized rescue group, a hazardous materials team, or additional ambulances. When there are multiple patients, use the **incident command system**, identify the number of patients, and then begin triage **Figure 9-5**. The incident command system is a flexible system implemented to manage a variety of emergency scenes. Emergency responders work in groups according to their function or assigned area, with the leader of each group reporting to the person in charge of the incident, the incident commander. **Triage** is the process of sorting patients based on the severity of their condition. Once all patients have been triaged, treatment and transport of these patients can begin. Usually the most experienced EMT is assigned to perform triage. This process helps allocate personnel, equipment, and resources to provide the most effective care to everyone. When a large number of patients are present or there are more patients than the responding unit can effectively handle, put your mass-casualty plan into action, utilizing the incident command system and your local protocols. These topics are covered in Chapter 39, *Incident Management*.

Figure 9-5 With multiple patients, use the incident command system, call for additional resources, and then begin triage.

Consider Additional/Specialized Resources

Some trauma or medical situations may require more ambulances, whereas others may have a need for specialized resources. Basic life support units may be all that are needed for some patients; however, advanced life support (ALS) should be requested for patients with severe injuries or complex medical problems depending on available resources and local protocols. ALS care may be provided by AEMTs or paramedics, depending on how your EMS system is set up. Air medical support may be another resource for ALS in your area. Follow your local protocols in requesting ALS resources.

In addition to EMS and fire suppression, many resources such as hazardous materials management, technical rescue services including complex extrication from motor vehicle crashes, wilderness search and rescue, high-angle rope rescue, and water rescue are typically available through the fire department **Figure 9-6**.

Figure 9-6

Scenes involving toxic substances may require specially trained rescuers with extra protective equipment.

Courtesy of Tempe Fire Department.

Law enforcement personnel may be needed to assist with traffic or scene control and should be the first to enter crime scenes and hostile environments.

If any situation presents itself as a danger to you, your partner, or your patient, you must retreat to a safe area. Be aware of the potential for danger at all times and understand when additional or specialized resources are required.

To determine if you require additional resources, ask yourself the following questions:

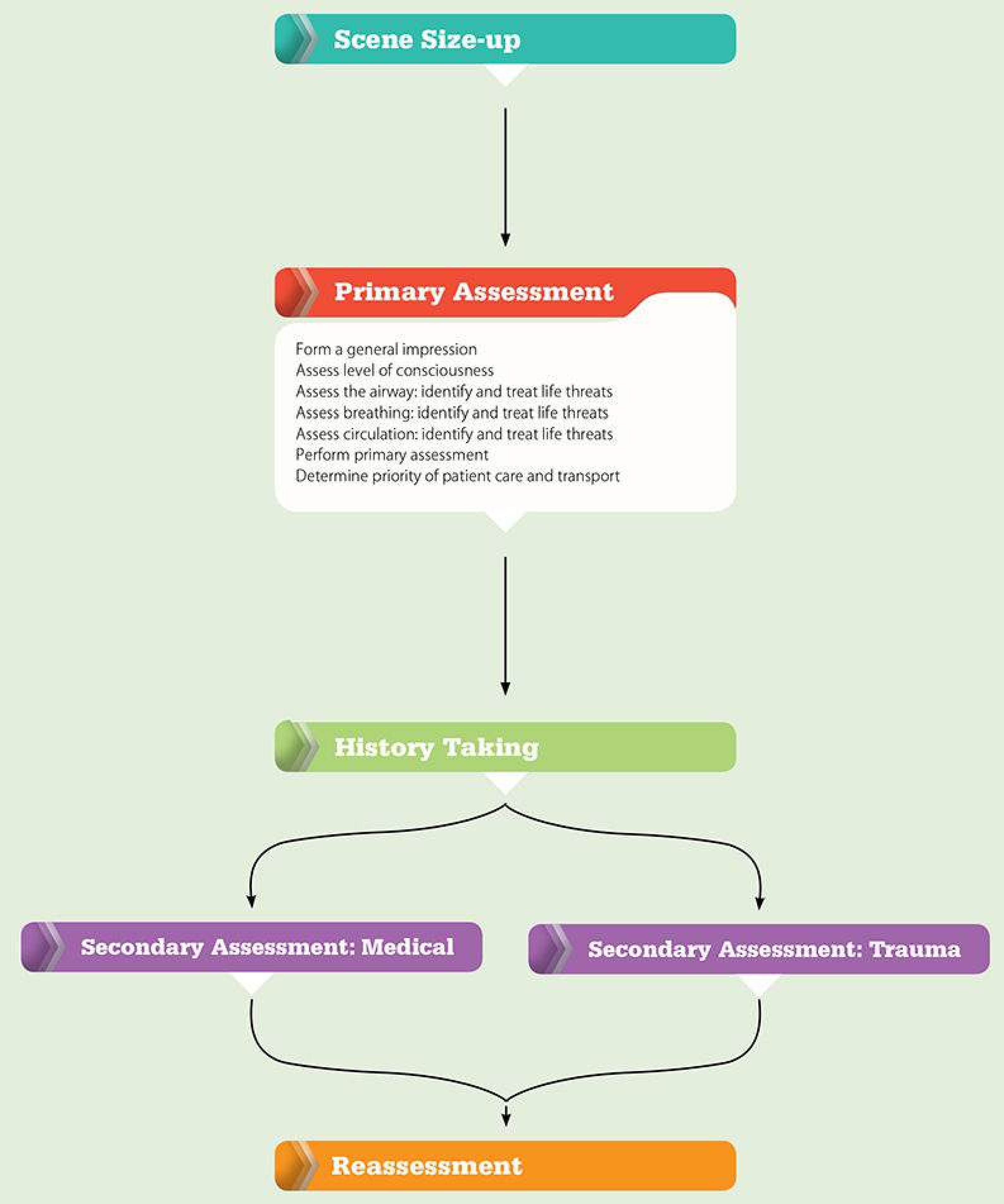
- Does the scene pose a threat to you, your patient, or others?
- How many patients are there?
- Do we have the resources to respond to their conditions?

Knowing how your EMS system is organized will help you determine the additional resources that may be required. The sooner these resources are identified, the sooner they can be requested.

Words of Wisdom

Keep in mind that standard precautions are the infection prevention practices intended to reduce the risk of transmission of bloodborne and other pathogens from both identified and unrecognized sources of infection. These precautions include hand hygiene; use of personal protective equipment such as gloves, gowns, and masks; safe injection practices; safe handling of potentially contaminated equipment and surfaces; and respiratory hygiene/ cough etiquette. The term *standard precautions* has replaced terms for similar concepts, such as *body substance isolation*, and is promoted by both the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO).

Patient Assessment



Primary Assessment

During the scene size-up, you evaluated potential or actual scene hazards and threats, protected yourself and your team, and decided whether you needed additional resources. You also evaluated the dispatch information, the environment into which you are responding, and your initial view of the patient setting to begin to understand what happened and what action you should take. It is critical for these steps to be accomplished before you make direct contact and begin to focus on the patient. Nevertheless, the heart of patient assessment begins when you first greet the patient and begin the **primary assessment**.

The primary assessment has a single, all-important goal: to identify and begin treatment of immediate or imminent life threats. To do this, you must physically examine the patient and assess level of consciousness (LOC) and airway, breathing, and circulation (ABCs); however, this is not an in-depth physical exam or assessment of **vital signs**. These will be addressed later in the secondary assessment. During the primary assessment, you must identify signs of life threats and immediately work to correct them **Figure 9-7**. From here you will be able to determine the priority of patient care and transport.

Form a General Impression

Any time you meet someone new, you form an initial general impression about that person. Forming the **general impression** of a patient is a similar process, but the focus is on rapid identification of potentially life-threatening problems. The general impression is formed to determine the priority of care and is the first part of your primary assessment. This includes noting things such as the person's age, sex, race, level of distress, and overall appearance, which may lead you to anticipate different problems. A woman reporting abdominal pain, for example, may have more serious implications than a man with the same complaint because of the complexity of the female reproductive system.

Think of your general impression as an overall visual assessment, gathering information as you approach the patient. Make sure that the patient sees you coming to avoid surprising the patient or causing the patient to turn to see you, possibly making any injuries worse. Note the patient's position and whether the patient is moving or still.

Avoid standing over the patient, if possible, especially if he or she is seated or lying down. This helps to show respect for the patient and helps the patient feel comfortable and less threatened as you begin your assessment. Refer to the patient by name. The initial general impression continues during your introduction **Figure 9-8**. Introduce yourself to the patient by stating, "Hi, I am Sam, an EMT with the fire department, and I am here to help you." After you introduce yourself, ask the patient about the chief complaint. Is the patient able to respond to your greeting easily and appropriately? The patient's response can give you insight into the level of consciousness, airway patency, respiratory status, and overall circulatory status before you begin your examination. Sometimes life-threatening conditions are obvious even during the general impression. If a life-threatening condition is found, treat it immediately.

Figure 9-7 A survey of the patient's airway, breathing, and circulatory status is used to establish whether the patient has a life-threatening condition(s) and what you should do about it.

Figure 9-8 As you approach the patient, form a general impression of his or her overall condition.

You will define your patient's condition as stable, stable but potentially unstable, or unstable to direct further assessment and treatment. This determination must be made so that prehospital care providers can work together with an appropriate sense of urgency. However, you must constantly be aware of changes in the patient's condition.

Assess Level of Consciousness

Early in your assessment, you will need to evaluate the patient's level of consciousness. This will help you rapidly determine if the patient has a life-threatening injury and to what extent the patient will be able to provide reliable information about his or her own condition as well as follow your directions. The patient's level of consciousness can tell you a great deal about his or her neurologic and physiologic status. The brain requires a constant supply of oxygen and glucose to function properly. In the primary assessment, you need to ascertain only the gross LOC by determining which of the following categories best fits your patient:

- Unconscious
- Conscious with an altered LOC
- Conscious with an unaltered LOC

Focus your initial assessment of a patient who is unconscious on problems with airway, breathing, and circulation, which are critical life threats. Sustained unconsciousness should warn you that a critical respiratory, circulatory, or central nervous system problem or deficit may exist, and you should presume that the patient has a critical injury or life-threatening condition until proven otherwise.

An altered LOC in a conscious patient can be caused by medications, drugs, alcohol, or poisoning. It may indicate that inadequate perfusion is adversely affecting the brain and its ability to function. **Perfusion** is the circulation of blood within an organ or tissue to provide necessary oxygen and nutrients and to remove waste. Further assessment will be required for any patient with an altered LOC.

Often, the same system that you use to perform the assessment will help you relay your findings in a clear and concise way to other medical providers either verbally or through documentation. This is the case with the AVPU scale used to assess a patient's level of consciousness depending on how well he or she responds to external stimuli, including verbal stimuli (sound) and painful stimuli (such as pinching the patient's ear lobe). The **AVPU scale** tests a patient's **responsiveness** based on the following criteria:

- **Awake and Alert.** The patient's eyes open spontaneously as you approach, and the patient appears to be aware of you and responsive to the environment. The patient is awake, appears to follow commands, and the eyes visually track people and objects.
- **Responsive to Verbal Stimuli.** The patient is not alert and awake. The patient's eyes do not open spontaneously. However, the patient's eyes do open when you speak to him or her, or the patient is able to respond in some meaningful way when spoken to; for example, by moaning, speaking, or moving. A patient who does not respond to your normal speaking voice but who responds when you speak loudly is responding to loud verbal stimuli.
- **Responsive to Pain.** The patient does not respond to your questions but moves or cries out in response to painful stimulus. There are appropriate and inappropriate methods of applying a painful stimulus **Figure 9-9**. Be aware that some methods may not give an accurate result if a spinal cord injury is present.
- **Unresponsive.** The patient does not respond spontaneously or to a verbal or painful stimulus. Unresponsive patients usually have no cough or gag reflex and lack the ability to protect their airway. If you are in doubt about whether a patient is truly unresponsive, assume the worst and treat appropriately.

To determine whether a patient who does not respond to verbal stimuli will respond to a painful stimulus, gently but firmly pinch the patient's skin. Areas where this technique works best are on the patient's ear, back of the upper arm (triceps), or the trapezius area (the muscle above the collar bone). Another effective technique is to apply upward pressure along the ridge of the orbital rim along the underside of the eyebrow. A patient who moans or withdraws is responding to the painful stimulus. Be sure to note the type and location of the stimulus and how the patient responded. Remember that the point is not to cause as much pain as possible, but to see if the patient responds to or withdraws from the sensation of pain where you have caused it.

Words of Wisdom

When using the AVPU scale, be sure to note how the patient responded. Tap a patient who is hard of hearing with your fingers repeatedly. If the patient responds, note that the patient is hard of hearing but responds to being tapped.

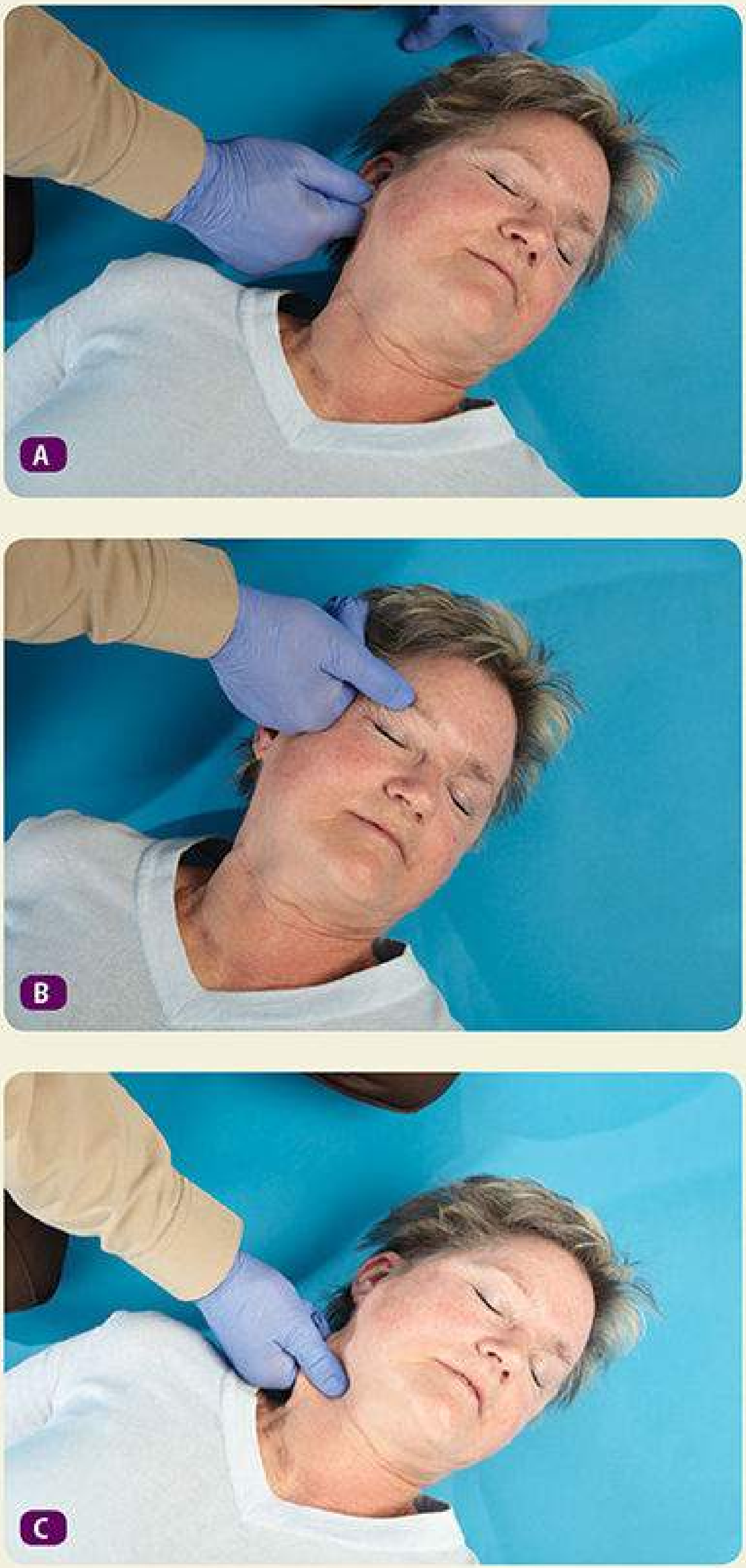


Figure 9-9 Methods of gauging a patient's responsiveness to painful stimuli. **A.** Gently but firmly pinch the patient's ear lobe. **B.** Press on the bone above the eye. **C.** Gently but firmly pinch the muscles of the neck.

If the patient does not respond to a painful stimulus on one side, try to elicit a response on the other side. Note that a patient who remains flaccid and does not move or make a sound is considered unresponsive.

For a patient who is alert or responsive to verbal stimuli, next evaluate orientation. **Orientation** tests a patient's mental status by checking his or her memory and thinking ability. The most common test evaluates a patient's ability to remember four things:

- **Person.** The patient is able to remember his or her name.
- **Place.** The patient is able to identify his or her current location.
- **Time.** The patient is able to tell you the current year, month, and approximate date.
- **Event.** The patient is able to describe what happened (the MOI or NOI).

These questions were not selected at random. They evaluate long-term memory (person and place), intermediate memory (place and time when asking year or month), and short-term memory (time when asking approximate date and event). If the patient knows these facts, the patient is said to be "alert and fully oriented," "alert and oriented to person, place, time, and event," or "alert and oriented × 4." It is important to determine, if possible, the patient's normal mental status. A number of circumstances, including ongoing illness, history of stroke, traumatic brain injury, developmental delay, Alzheimer disease, and more, may cause a patient to have a baseline of not being fully alert and oriented. Any deviation from alert and oriented to person, place, time, and event, or from a patient's normal baseline is considered an **altered mental status**.

If you determine that the patient has any of the indicators for spinal immobilization listed in **Table 9-1**, ensure that the patient's cervical spine (c-spine) is manually stabilized by either you or another provider. If it is not possible to both manually stabilize the patient's c-spine and continue your assessment to identify and correct life threats, do your best to ensure that the patient's spine remains in a stable position while you continue your primary assessment.

Identify and Treat Life Threats

Your role as an EMT is to determine if a life threat is present and, if so, to quickly address it. A life-threatening condition can quickly lead to death; the rapid process may begin with the absence or loss of meaningful communication between you and the patient. A severely sick or injured person becomes less aware of his or her surroundings and stops being able to communicate. Unless an intervention occurs, loss of consciousness may follow. The patient will become totally unresponsive to external stimuli. The muscles become slack, among them the muscles of the jaw, thus permitting the tongue to sag against the posterior part of the throat, obstructing the airway. When air can no longer enter the lungs, the patient stops breathing, cutting off the intake of oxygen and the release of carbon dioxide. The heart cannot continue to function without oxygen, and it will soon stop beating. Starved of oxygen, brain cells begin to die within a few minutes, leading to irreversible brain damage.

Table 9-1	Indications for Spinal Immobilization
Either blunt or penetrating trauma with any of the following:	▪ Pain or tenderness on palpation of the neck or spine ▪ Patient report of pain in neck or back ▪ Paralysis or neurologic complaint (numbness, tingling, partial paralysis of the legs or arms) ▪ Priapism (male patients)
Blunt trauma with any of the following:	▪ Altered mental status ▪ Intoxication (alcohol or drugs) ▪ Difficulty or inability to communicate
Distracting injury (Any injury that distracts the patient's attention from other injuries he or she may have, even severe injuries. An example is a painful femur or tibia fracture that prevents the patient from noticing back or neck pain.)	
Adapted From: National Association of Emergency Medical Technicians, American College of Surgeons. *PHTLS: Prehospital Trauma Life Support, Eighth Edition.* Jones & Bartlett Learning, pg. 298–301.	

Words of Wisdom

Distracting injuries may prevent patients from reliably identifying neck or back pain associated with an unstable fracture. Therefore, all patients with a long bone fracture and a significant mechanism of injury warrant spinal immobilization.

There are only a few general conditions that cause sudden death: airway obstruction, respiratory failure, respiratory arrest, shock, severe bleeding, and primary cardiac arrest. Often these conditions are manageable or even reversible, but to address them you have to be able to recognize them quickly and take immediate steps to correct them. This is the purpose of the primary assessment.

Lifesaving assessments and interventions include identifying airway obstructions and clearing and then maintaining an open airway. Assess the patient's breathing, and initiate ventilations in patients who have inadequate respirations or no respirations at all. Assess the skin color, temperature, and condition, and the pulse. If these appear to be inadequate, consider treating for shock (Chapter 12, *Shock*, covers the treatment for shock in detail). If the cause of shock is identifiable, attempt to correct the problem. A common example of a life-threatening cause of shock is severe bleeding. If life-threatening bleeding is found, immediately control the bleeding using direct pressure and tourniquets. If you determine that a patient is unresponsive, not breathing, and does not have a pulse, begin cardiopulmonary resuscitation (CPR), starting with high-quality chest compressions. Chapter 13, *BLS Resuscitation*, covers CPR in more detail.

In most cases, identifying and correcting life-threatening issues begins with the airway, followed by breathing and circulation (ABC). However, when a patient is in cardiac arrest, the ABCs should be assessed simultaneously in the interest of minimizing the time to first compression. Also, when a patient has life-threatening bleeding, it is more appropriate to address life threats to circulation first, following a sequence of circulation, airway, and breathing (CAB). In these cases, controlling life-threatening bleeding takes priority over airway and breathing concerns.

Assess the Airway

An airway obstruction can result in partial or complete blockage of air movement into and out of the lungs and therefore inadequate perfusion of the entire body. As you move through the steps of the primary assessment, stay alert for signs of airway obstruction. To prevent death or permanent disability to your patient, ensure that the airway remains open (patent) and adequate.

Responsive Patients

Patients of any age who are talking or crying have an open airway. However, watching and listening to how patients speak, particularly patients with respiratory problems, may provide important clues about the adequacy of their airway and the status of their breathing. A conscious patient who cannot speak or cry most likely has a severe airway obstruction.

If you identify an airway problem, stop the assessment process and work to clear the patient's airway. This may be as simple as positioning the patient so the air moves in and out, suctioning liquids from the airway, or removing an obvious foreign body from the patient's mouth; it may be as complex as abdominal thrusts or chest compressions to remove a foreign body from the airway. Although airway and breathing problems are not the same, their signs and symptoms often overlap. If your patient has signs of difficulty breathing or is not breathing, immediately take corrective actions using appropriate airway management techniques.

Unresponsive Patients

With an unresponsive patient or a patient with a decreased LOC, immediately assess the patency of the airway. Unresponsive patients may have experienced a traumatic event. If there is a potential for trauma, use the jaw-thrust maneuver to open the airway. If you cannot obtain a patent airway using the jaw-thrust maneuver or if it can be confirmed that the patient did not experience a traumatic event, use the head tilt–chin lift maneuver to open and maintain a patent airway. This maneuver is described in Chapter 10, *Airway Management*. Another cause of airway obstruction in an unconscious patient could be relaxation of the tongue muscles, allowing the tongue to fall to the back of the throat. Address this first by positioning the airway, followed by placing an oral or nasal airway. Dentures, blood clots, vomitus, mucus, food, and other foreign objects may also create an obstruction. These can be cleared with manual techniques and suctioning. These techniques are also described in Chapter 10, *Airway Management*. Once you have confirmed that the airway is clear, you can continue your assessment.

Signs of airway obstruction in an unconscious patient include the following:

- Obvious trauma, blood, or other obstruction
- Noisy breathing, such as snoring, bubbling, gurgling, crowing, stridor, or other abnormal sounds (normal breathing is quiet)
- Extremely shallow or absent breathing (Airway obstructions may impair breathing.)

If any of the aforementioned conditions exist, the airway is considered inadequate and you should open the airway using the head tilt–chin lift maneuver, suction as necessary, and use an airway adjunct as necessary. If the patient's airway is not managed quickly and efficiently, the body will not be able to receive the oxygen needed to survive.

Assess Breathing

A patient's breathing status is directly related to the adequacy of his or her airway. Once you have made sure the patient's airway is open, make sure the patient's breathing is present and adequate. A patient who is breathing without assistance is said to have **spontaneous respirations** or spontaneous breathing.

As you assess the patient's breathing, ask yourself the following questions:

- Is the patient breathing?
- Is the patient breathing adequately?
- Is the patient hypoxic?

YOU are the Provider — PART 2

When you arrive on scene, a police officer directs you to a poorly kept apartment on the second floor. The scene is safe. You find the patient, a young man, lying in a prone position on the floor in the kitchen. He was found by his neighbor, who became concerned when he did not answer the door. You carefully roll the patient to a supine position and begin your assessment. An engine company arrives to provide assistance.

Recording Time: 0 Minutes	
Appearance	Pale; blood draining from the side of the mouth
Level of consciousness	Responsive to pain
Airway	Bloody secretions and vomitus in the mouth
Breathing	Slow, shallow, and gurgling
Circulation	Radial pulse, slow and weak; skin, cool and pale

3. Is spinal immobilization indicated? Why or why not?
4. Which of these assessment findings requires your *most* immediate attention?

Positive pressure ventilations should be performed for patients who are not breathing or whose breathing is too slow or too shallow. If the patient is breathing adequately but remains hypoxic, administer oxygen. The goal for oxygenation for most patients is an oxygen saturation of approximately 94% to 99%.

If a patient seems to develop difficulty breathing after your primary assessment, immediately reevaluate the airway. When respirations exceed 28 breaths/ min or are fewer than 8 breaths/min, or are too shallow to provide adequate air exchange, consider providing positive pressure ventilations with an airway adjunct. Remember that air exchange is the critical issue, not the number of breaths. Normal breathing is an effortless process that does not affect a patient's speech, posture, or positioning. Speech is a good indicator of whether a conscious patient is having difficulty breathing. A patient who can speak smoothly without unusual extra pauses is breathing normally. However, a patient who can speak only one word at a time, or must stop every two to three words to catch his or her breath, is having significant difficulty breathing. Normal respirations are not usually shallow or excessively deep. **Shallow respirations** can be identified by little movement of the chest wall (reduced tidal volume) or poor chest excursion. Deep respirations cause a significant rise and fall of the chest. Document when the patient's respirations are shallow or deep.

Observe how much effort is required for the patient to breathe. The presence of **retractions** (indentation above the clavicles and in the spaces between the ribs) or the use of **accessory muscles** of respiration is a sign of inadequate breathing. Accessory muscles include the neck muscles (sternocleidomastoid), the chest pectoralis major muscles, and the abdominal muscles. **Nasal flaring** and seesaw breathing in pediatric patients indicate inadequate breathing. A patient who can speak only two or three words without pausing to take a breath, a condition known as **two- to three-word dyspnea**, has a serious breathing problem.

Patients who are having marked difficulty breathing will instinctively assume a posture in which it is easier for them to breathe. There are two common postures that indicate the patient is trying to increase air flow. The first position is called the **tripod position**. In this position, a patient is sitting and leaning forward on outstretched arms with the head and chin thrust slightly forward; significant conscious effort is required for breathing. The second position is most commonly seen in children—the **sniffing position**. The patient sits upright with the head and chin thrust slightly forward, and the patient appears to be sniffing **Figure 9-10**.

Figure 9-10 A patient in the sniffing position sits upright with the head and chin thrust slightly forward.

Courtesy of Health Resources and Services Administration, Maternal and Child Health Bureau, Emergency Medical Service for Children Program.

Breathing that becomes progressively more difficult requires progressively more effort. When you can see that effort, the patient's breathing is described as **labored breathing**. Initially, labored breathing is characterized by the patient's position, concentration on breathing, and the increased effort and depth of each breath. As breathing becomes more labored, accessory muscles in the chest and neck are used, and the patient may make grunting sounds with each breath. In infants and small children, nasal flaring and supraclavicular and intercostal retractions are commonly associated with labored breathing. Sometimes the patient may be gasping.

Infants and small children may have labored breathing for a sustained period, will then often become exhausted, and finally will no longer have the strength to maintain the necessary energy to breathe. In infants and small children, cardiac arrest is generally caused by respiratory arrest.

Respiratory distress occurs when a person, particularly a child, has difficulty breathing; therefore, the work of breathing is increased. Typically a person in respiratory distress has an increase in respiratory effort and rate. Respiratory failure occurs when the blood is inadequately oxygenated or ventilation is inadequate to meet the oxygen demands of the body. Respiratory arrest is the ultimate result of respiratory failure if it is not corrected Table 9-2.

Table 9-2 Signs of Respiratory Distress and Failure

Respiratory Distress	Respiratory Failure
Agitation, anxiety, restlessness	Lethargy, difficult to rouse
Stridor, wheezing	Tachypnea with periods of bradypnea or agonal respirations
Accessory muscle use; intercostal retractions, neck muscle use (sternomastoid)	Inadequate chest rise/ poor excursion
Tachypnea	Inadequate respiratory rate or effort
Mild tachycardia	Bradycardia
Nasal flaring, seesaw breathing, head bobbing	Diminished muscle tone

Assess Circulation

Assessing circulation helps you to evaluate how well blood is circulating to the major organs, including the brain, lungs, heart, kidneys, and the rest of the body. A variety of problems can impair circulation, including blood loss, shock, and conditions that affect the heart and major blood vessels. Circulation is evaluated by assessing the patient's mental status, pulse, and skin condition. You will also need to search for, identify, and control severe external bleeding.

Assess Pulse

With each heartbeat, the ventricles contract, forcefully ejecting blood from the heart and propelling it into the arteries. Often referred to as a heartbeat, the pulse is the pressure wave that occurs as each heartbeat causes a surge in the blood circulating through the arteries. The pulse is most easily felt at a pulse point where a major artery lies near the surface and can be pressed gently against a bone or solid organ.

Your first consideration when taking a pulse is to determine whether the patient has one. To determine if a pulse is present, you will need to **palpate** (feel) the pulse. Hold together your index and long fingers and place their tips over a pulse point. Press gently against the artery until you feel intermittent pulsations. In responsive patients who are older than 1 year, palpate the radial pulse at the wrist **Figure 9-11A**. In unresponsive patients older than 1 year, palpate the carotid pulse in the neck **Figure 9-11B**. When palpating the carotid pulse, place the fingertips of your index and long fingers in the center of the throat on the wind-pipe and then slide your fingers toward you into the groove between the trachea and the neck muscle. This positions your fingers directly over the carotid artery. Always palpate the carotid pulse on the same side of the patient that you are on. Use caution when palpating the carotid pulse in a responsive patient, especially an older patient. Only gentle pressure on one side of the neck should be used. Never press on the carotid arteries on both sides of the neck at the same time. Doing so can reduce circulation to the brain.

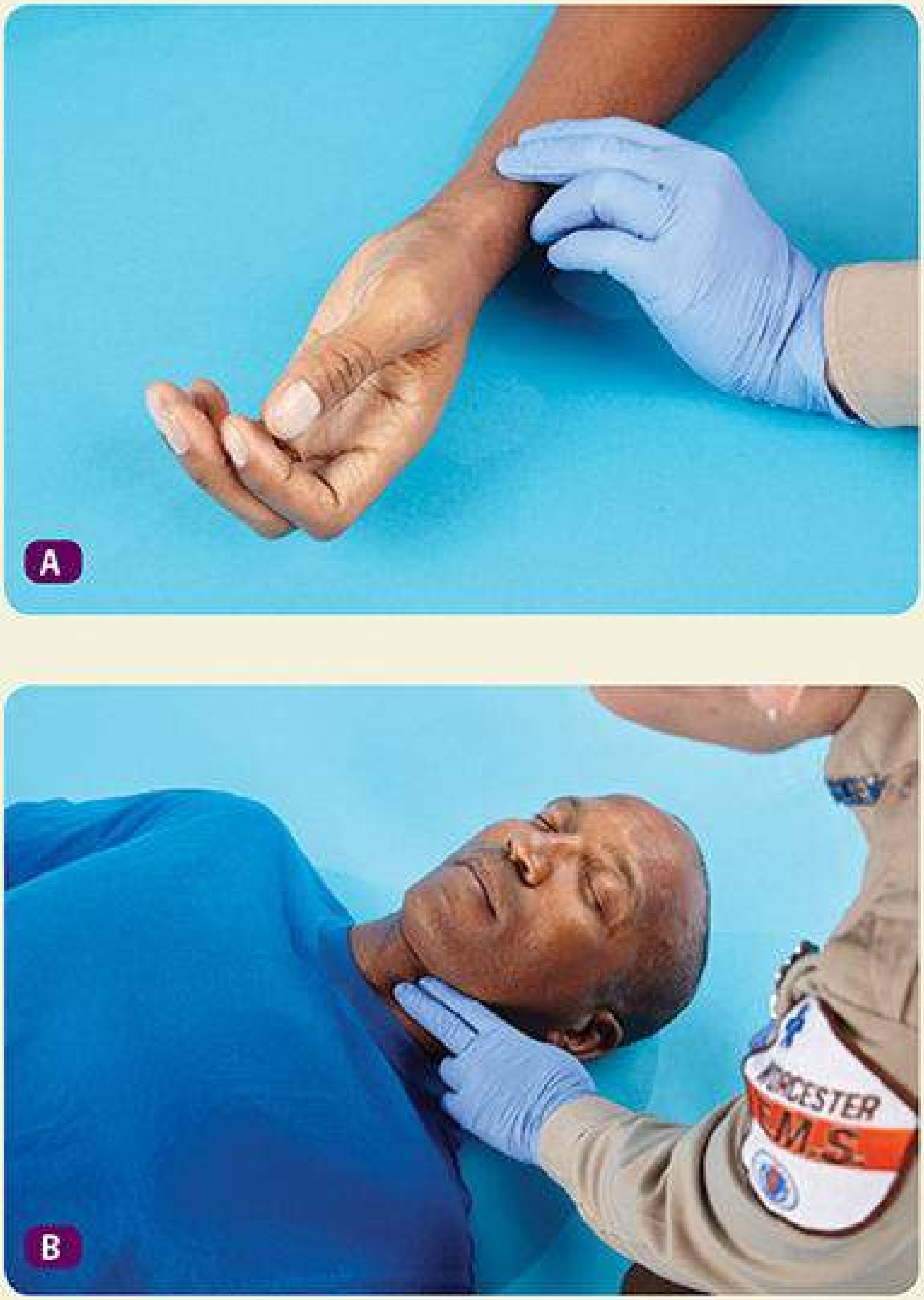


Figure 9-11 **A.** To palpate the radial pulse, place the tips of your index and long fingers over the radial artery, pressing gently until you feel intermittent pulsations. **B.** To palpate the carotid pulse, place the tips of your index and long fingers over the carotid artery, pressing gently until you feel intermittent pulsations.

Sometimes, you may have to slide your fingertips a little to each side and press again until you feel a pulse. When palpating a pulse, do not allow your thumb to touch the patient. If you do so, you may mistake the strong pulsing circulation in your thumb for the patient's pulse.

Special Populations

In infants, the radial and carotid pulses are difficult to locate.

Palpate the brachial pulse, located at the medial area (inside) of the upper arm, in children younger than 1 year **Figure 9-12**. With the infant lying supine, you can access the brachial pulse by elevating the arm over the infant's head. Because most infants have chubby arms, you need to press your adjacent fingertips firmly along the brachial artery, which lies parallel to the long axis of the upper arm, to be able to palpate the pulse.

If you cannot palpate a pulse in an unresponsive patient, begin CPR. If an automated external defibrillator (AED) is available, turn it on and follow the voice prompts, following your local protocol. An AED is indicated for use on patients who have been assessed to be unresponsive and pulseless. An AED with special pediatric pads and a dose-attenuating system should be used on pediatric patients younger than 8 years; if these are not available, an adult AED should be used. In infants (1 month to 1 year), it is preferable to perform manual defibrillation or use a dose-attenuating system; if these are not available, an adult AED should be used. More information about this is available in Chapter 13, *BLS Resuscitation*.

Figure 9-12 To palpate the brachial pulse in an infant, press firmly along the brachial artery on the inside of the upper arm.

If the patient has a pulse but is not breathing, provide ventilations at a rate of 10 to 12 breaths/min for adults and 12 to 20 breaths/min for an infant or a child. Continue to monitor the pulse to evaluate the effectiveness of your ventilations. If the patient becomes pulseless, start CPR and apply the AED. The apparent absence of a palpable pulse in a responsive patient is not caused by cardiac arrest. Therefore, never begin CPR or use an AED on a responsive patient.

With practice, you will be able to assess whether the pulse is too slow, too fast, or irregular without actually counting the pulsations. This will help to speed up your assessment of the ABCs and allow you to focus on finding other potentially life-threatening problems. A pulse rate that is too slow or too fast may change decisions related to transporting your patient. The pulse should be easily felt at the radial or carotid artery and have a regular rhythm. If it is difficult to feel or is irregular, the patient may have problems with his or her circulatory system that may need further evaluation later in your assessment.

Skin Condition

The skin has many functions. It acts as insulation and protection from infection, helps maintain the water content of the body, and has a role in regulating body temperature by changing the amount of blood circulating through the surface of skin.

Assessing the skin is one of the most important and most readily accessible ways of evaluating circulation and perfusion, blood oxygen level, and body temperature. Perfusion is assessed by evaluating a patient's skin color, temperature, moisture, and capillary refill. A normally functioning circulatory system perfuses the skin with oxygenated blood, allowing it to maintain a normal color, temperature, and moisture for the environment. Inadequate blood flow to the skin will result in abnormal findings such as pale, cool skin. This may be associated with hypoperfusion to the brain, lungs, heart, and kidneys. In most situations, hypoperfusion is caused by shock. The degree of hypoperfusion and how long it lasts will determine if a patient will sustain permanent injuries.

Skin Color. Many blood vessels lie near the surface of the skin. The skin's color is determined by the blood circulating through these vessels and the amount and type of pigment that is present in the skin. Blood is red when it is adequately saturated with oxygen. As a result, skin in lightly pigmented people is pink. The pigmentation in most people will not hide changes in the skin's underlying color, regardless of the person's race. In patients with deeply pigmented skin, changes in color may be apparent only in certain areas, such as the fingernail beds, the mucous membranes in the mouth, the lips, the underside of the arm and palm (which are usually less pigmented), and the conjunctiva of the eyes. The **conjunctiva** is the delicate membrane lining the eyelids, and it covers the exposed surface of the eye. In addition, the palms of the hands and soles of the feet should be assessed in infants and children.

Poor peripheral circulation will cause the skin to appear pale, white, ashen, or gray, possibly with a waxy translucent appearance like a white candle. Abnormally cold or frozen skin may also appear this way. When the blood is not properly saturated with oxygen, it appears blue. Therefore, in a patient with insufficient air exchange and low levels of oxygen in the blood, the blood and vessels become blue, and the lips, mucous membranes, nail beds, and skin over the blood vessels appear blue or gray. This condition is called **cyanosis** Figure 9-13.

High blood pressure may cause the skin to be abnormally flushed and red. A patient with a significant fever, heat stroke, sunburn, mild thermal burns, or other conditions in which the body is unable to properly dissipate heat will also appear to have red skin.

Changes in skin color may also result from chronic illness. Liver disease or dysfunction may cause **jaundice**, resulting in the patient's skin and sclera turning yellow. The **sclera** is the normally white portion of the eye and may show color changes even before skin color change is visible.

Skin Temperature. Normal skin temperature will be warm to the touch; normal body temperature is 98.6°F (37°C). Abnormal skin temperatures are hot, cool, cold, and clam-my (moist). When the patient has a significant fever, sunburn, or hyperthermia, the skin feels hot to the touch. The skin will feel cool when the patient is in early shock, has mild hypothermia, or has inadequate perfusion. With poor perfusion, the body pulls blood away from the surface of the skin and diverts it to the core of the body. The result is cool, pale, clammy skin; in your primary assessment, this is a good indication of hypoperfusion and shock. The skin will feel cold when the patient is in profound shock, has hypothermia, or has frostbite.

Figure 9-13

Cyanosis occurs when the patient has low levels of oxygen in the blood.

In most cases it will be adequate to assess the patient's skin temperature by feeling the patient's forehead with the back of your hand to see if it is excessively elevated or decreased. A more accurate temperature obtained with a thermometer will help in patient assessment of some cases such as environmental hypothermia or hyperthermia, infection, and septic shock. Although a wide variety of devices to measure temperature are available for use by EMS, you must operate the device exactly as the manufacturer specifies to obtain an accurate measurement.

Skin Moisture. Dry skin is normal. Skin that is moist or wet from sweat, or excessively dry and hot suggests a problem. In the early stages of shock, the skin will become slightly moist. Skin that is only slightly moist but not covered excessively with sweat is described as clammy, damp, or moist. When the skin is bathed in sweat, such as after strenuous exercise or when the patient is in shock, the skin is described as wet or **diaphoretic**.

Because the skin's color, temperature, and moisture are often related signs, you should consider them together. When recording or reporting your assessment of the skin, first describe the color, then the temperature, and last, whether the skin is dry, moist (clammy), or wet. For example, you could say or write, "Skin: pale, cool, and clammy."

Again, these characteristics are important findings in your primary assessment because hypoperfusion can lead to serious consequences if treatment is delayed or ignored.

Words of Wisdom

Remember to assess:

- Skin color
- Skin temperature
- Skin moisture

Capillary Refill. **Capillary refill** is often evaluated in pediatric patients to assess the ability of the circulatory system to perfuse the capillary system in the fingers and toes. When evaluated in an uninjured limb, capillary refill time (CRT) may provide an indication of the pediatric patient's level of perfusion. It should be kept in mind, however, that especially in an adult patient, capillary refill can be affected by the patient's position, age, history as a smoker, history of medical problems such as diabetes, medications the patient is currently taking, and exposure to a cold environment (**hypothermia**) including frozen tissue (**frostbite**) and **vasoconstriction** (narrowing of a blood vessel). Injuries to bones and muscles of the extremities may cause local circulatory compromise, resulting in hypoperfusion of an extremity rather than hypoperfusion of the body in general.

To test capillary refill, place your thumb on the patient's fingernail with your fingers on the under-side of the patient's finger and gently compress **Figure 9-14A**. The blood will be forced from the capillaries in the nail bed. Remove the pressure applied against the tip of the patient's finger. The nail bed will remain blanched (white) for a brief period. As the underlying capillaries refill with blood, the nail bed will return to its normal pink color.

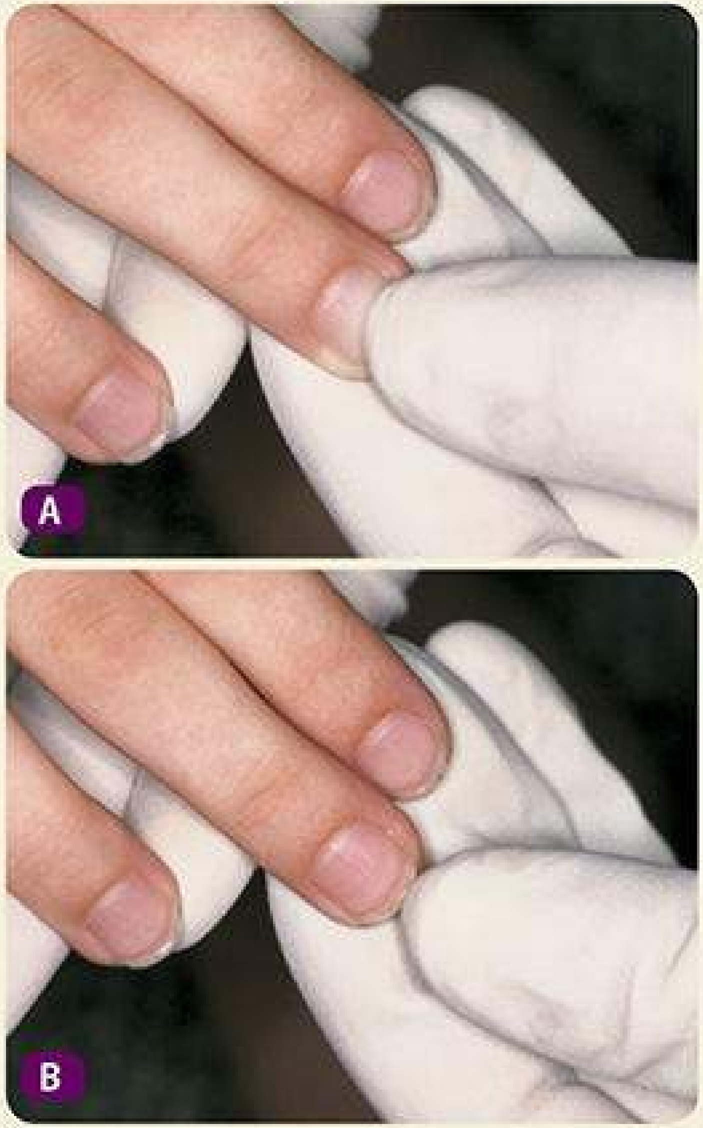


Figure 9-14 **A.** To test capillary refill, gently compress the fingertip until it blanches. **B.** Release the fingertip, and count until it returns to its normal pink color.

A, B: © Jones & Bartlett Learning. Courtesy of MIEMSS.

To assess capillary refill in newborns and young infants, press on the forehead, chin, or sternum.

With adequate perfusion, the color in the infant's or child's nail bed should be restored to its normal pink color within 2 seconds, or about the time it takes to say "capillary refill" at a normal rate of speech **Figure 9-14B**. Report and document the CRT as normal (2 seconds or less). Suspect poor peripheral circulation when capillary refill takes more than 2 seconds or the nail bed remains blanched. In this case, report and document the CRT as "delayed" or "CRT > 2." Again, delayed capillary refill is not considered an accurate indication of poor perfusion in adult patients.

Consider the capillary refill test invalid if the patient is in or has been exposed to a cold environment or if the patient is older. In both situations, delayed capillary refill may be normal, and thus, capillary refill assessment becomes unreliable.

Assess and Control External Bleeding

In trauma patients, identify and immediately control major external bleeding. This step should occur before addressing airway or breathing concerns. In some cases, blood loss can be very rapid and can quickly result in shock or even death.

Signs of blood loss include active bleeding from wounds and/or evidence of bleeding such as blood on the clothes or near the patient. Serious bleeding from a large vein may be characterized by steady blood flow. Bleeding from an artery is characterized by a spurting flow of blood. When you evaluate an unconscious patient, do a sweep for blood by quickly and lightly running your gloved hands from head to toe, pausing periodically to see if your gloves are bloody.

Controlling external bleeding is often very simple. Initially, direct pressure with your gloved hand and soon thereafter a sterile bandage over the wound will control bleeding in most cases. Direct pressure stops the bleeding and helps the blood to **coagulate**, or clot, naturally. Most minor bleeding can be adequately controlled by using direct pressure. When direct pressure is not quickly successful or whenever you encounter obvious arterial hemorrhage of an extremity, apply a tourniquet. More information about applying a tourniquet is found in Chapter 25, *Bleeding*.

Performing a Rapid Exam to Identify Life Threats

It takes about 60 to 90 seconds to perform a rapid exam of the patient's body to identify other injuries that must be managed and/or protected before the patient is transported. This is *not* a systematic or focused physical examination. That will be performed during the secondary assessment.

To perform a rapid exam of the patient to identify life treats, follow the steps in Skill Drill 9-1. Remember, this should take no longer than 60 to 90 seconds!

1. Assess the head, looking and feeling for **DCAP-BTLS** (mnemonic to help you remember Deformities, Contusions, Abrasions, Punctures, Burns, Tenderness, Lacerations, and Swelling) Step 1.
2. Assess the neck, looking and feeling for DCAP-BTLS, jugular venous distention, deviation of the trachea from midline in the neck, and **crepitus**, the sound or feeling of fractured bone ends rubbing or grinding together Step 2. In trauma patients, you should now apply a properly sized cervical collar Step 3. It is particularly important to assess the neck before covering it with a cervical collar.
3. Assess the chest, looking and feeling for DCAP-BTLS, paradoxical motion, subcutaneous emphysema, and crepitus. Listen to breath sounds on both sides of the patient's chest Step 4.
4. Assess the abdomen, looking and feeling for DCAP-BTLS, rigidity (firm or soft), and distention Step 5.
5. Assess the pelvis, looking for DCAP-BTLS. If there is no pain, gently compress the pelvis downward and inward to look for tenderness and instability Step 6.
6. Assess all four extremities, looking and feeling for DCAP-BTLS. Also assess bilaterally for distal pulses and motor and sensory function Step 7.
7. Assess the back and buttocks, looking and feeling for DCAP-BTLS. In all trauma patients, maintain in-line stabilization of the spine while rolling the patient on his or her side in one motion Step 8. It is particularly important that you check the patient's back before you log roll the patient and before you place him or her onto a backboard.

YOU are the Provider — PART 3

Your partner begins assisting the patient's ventilations with high-flow oxygen while an EMT from the engine company obtains his vital signs. You ask the police officer to inspect the patient's apartment for anything suspicious. The officer on the engine tells you that the neighbor has no knowledge of the patient's medical history. The patient's blood glucose level is assessed and reads 108 mg/dL.

Recording Time: 5 Minutes	
Respirations	8 breaths/min and shallow (baseline); ventilations are being assisted
Pulse	42 beats/min; weak and regular
Skin	Cool and pale
Blood pressure	76/58 mm Hg
Oxygen saturation (Spo_2)	95% (with assisted ventilation)

Your primary assessment of the patient reveals no obvious signs of trauma, medical alert tags, or anything else that might explain his condition. The police officer did not find any pill bottles, drug paraphernalia, or anything else suspicious. His driver's license shows that he is 25 years old. You hear on the radio that a paramedic unit has just cleared a scene and is approximately 18 minutes away.

5. Does the patient require further treatment at the scene? If so, what?
6. Should you remain at the scene and wait for the paramedic unit? Why or why not?

Skill Drill 9-1 Performing a Rapid Exam to Identify Life Threats

Step 1

Assess the head. Have your partner maintain in-line spinal stabilization if indicated.

Step 2

Assess the neck.

Step 3

Apply a cervical collar if indicated.

Step 4

Assess the chest. Listen to breath sounds on both sides of the chest.

Step 5

Assess the abdomen.

Step 6

Assess the pelvis. If there is no pain, gently compress the pelvis downward and inward to look for tenderness and instability.

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Step 7

Assess all four extremities. Assess the pulse and motor and sensory function.

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Step 8

Assess the patient's back. If spinal immobilization is indicated, do so with minimal movement to the patient's spine by log rolling the patient in one motion.

Determine Priority of Patient Care and Transport

The primary assessment will assist you in determining transport priority **Figure 9-15**. If you do not identify any injuries that require treatment or rapid transport when completing your assessment of the ABCs, you may find indications for rapid transport during your primary assessment of the patient's body. For example, you may identify an internal hemorrhage by the presence of a distended or firm abdomen or bilateral femoral fractures. These types of conditions are indications for rapid transport.

Would you consider your patient a high, medium, or low priority for transport? Priority designation is used to determine if a patient needs immediate transport or will tolerate a few more minutes on scene. Patients with any of the following conditions are examples of high-priority patients and should be transported immediately:

- Unresponsive
- Poor general impression
- Difficulty breathing
- Uncontrolled bleeding
- Responsive but unable to follow commands
- Severe chest pain
- Pale skin or other signs of poor perfusion
- Complicated childbirth
- Severe pain in any area of the body

Protecting the patient's spine as needed and identifying fractured extremities are integral parts of packaging for transport. If a spinal injury is suspected or found on assessment, consider spinal immobilization. If you are unsure if spinal immobilization is necessary, err on the side of caution and provide immobilization. Spinal injuries can be made worse if you neglect to assess and treat them before moving the patient.

Figure 9-15 Identifying priority patients.

Recognizing the need to transport serious trauma patients is of such importance that you may hear colleagues refer to the **Golden Hour**, also called the Golden Period. This refers to the time from injury to definitive care, during which treatment of shock and traumatic injuries should occur because survival potential is best **Figure 9-16**. Over time the body has increasing difficulty in compensating for shock and traumatic injuries. For this reason, you should spend as little time as possible on scene with patients who have sustained significant or severe trauma. Aim to assess, stabilize, package, and begin transport to the appropriate facility within 10 minutes (often referred to as the "Platinum 10") after arrival on scene whenever possible (a difficult or complex extrication may make this time goal difficult to achieve).

Words of Wisdom

The "Golden Hour" is occasionally referred to as the "Golden Period". Because many injured patients require definitive care in less than an hour, the term "Golden Period" is sometimes substituted. Regardless, the concept is that initial care must be delivered as expeditiously as possible.

Some patients may benefit from remaining on scene and receiving continuing care. For example, an older patient with chest pain may be better served on scene by being administered nitroglycerin and waiting for an ALS vehicle than by immediate transport. Support from ALS should be called for if a unit is not already en route to the scene. If ALS is delayed or farther away, coordinating a rendezvous may be a better decision for a high-priority patient. Your decision to stay on scene or transport immediately will be based on your patient's condition, the availability of more advanced help, the distance you must transport, and your local protocols.

Correct identification of high-priority patients is an essential aspect of the primary assessment and helps to improve patient outcome. While initial treatment is important, it is essential to remember that immediate transport is one of the keys to the survival of any high-priority patient. Transport should be initiated as soon as practical and possible.

Remember, the goal of your primary assessment is to identify and treat life threats, including management of airway, breathing, and circulation problems, as quickly as possible. Measure vital signs precisely during the secondary assessment (discussed later), once time and life threats are less of an issue.

If the patient's condition is stable, reassess vital signs every 15 minutes until you reach the emergency department (ED). If the patient's condition is unstable, reassess vital signs every 5 minutes, or as often as the situation permits, looking for trends in the patient's condition.

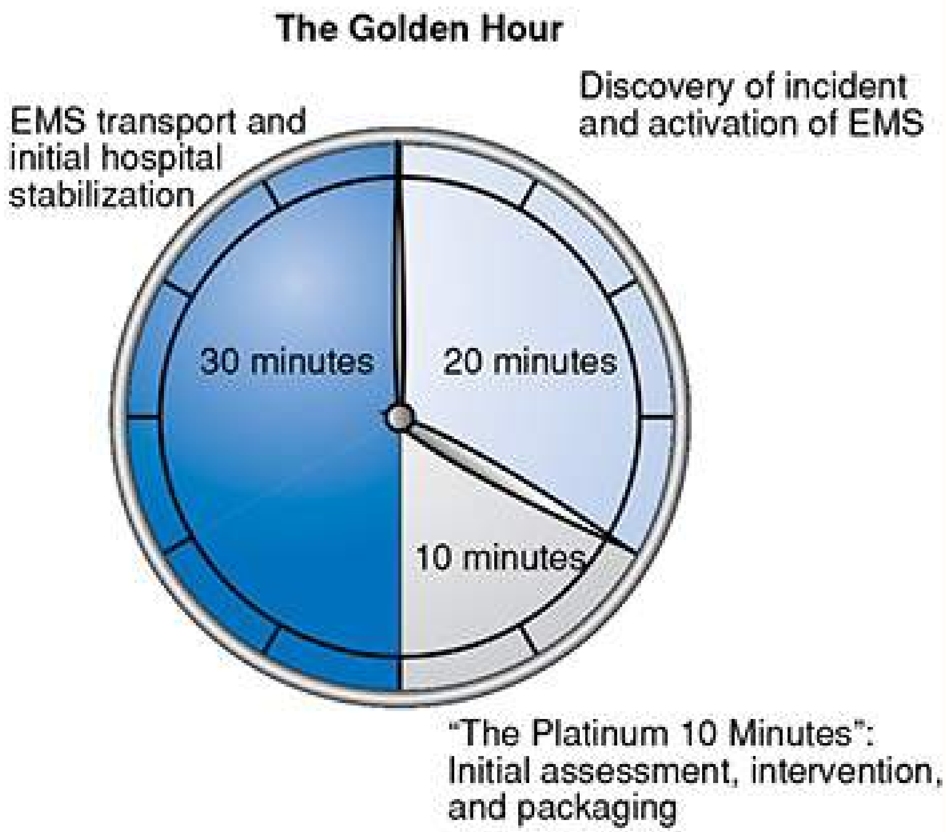


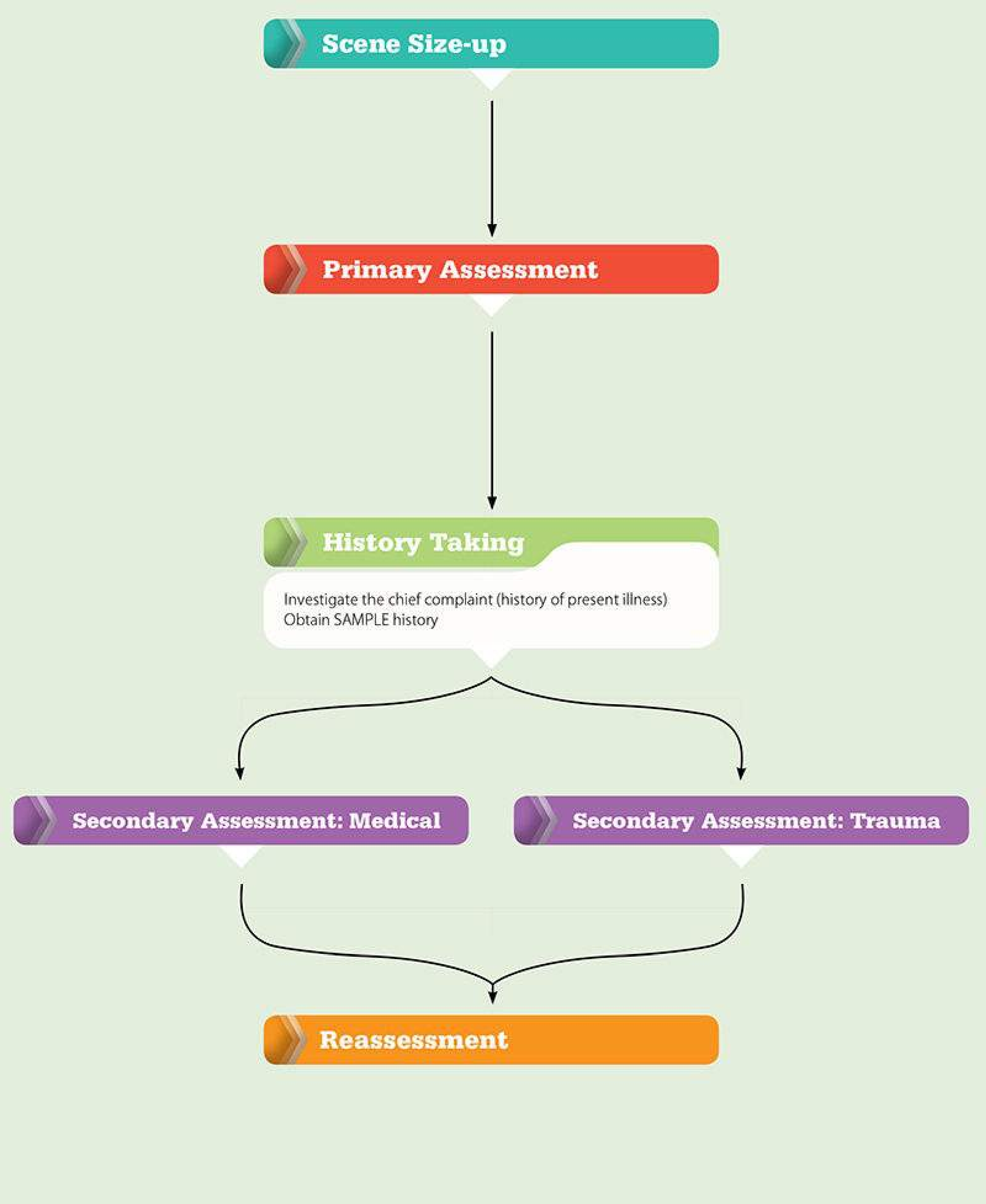
Figure 9-16 The Golden Hour, also called the Golden Period, is the time during which treatment of shock or traumatic injuries is most critical and the potential for survival is best.

Do not be falsely reassured by apparently normal vital signs. The body has amazing abilities to compensate for severe injury or illness, especially in children and young adults. Even patients who have experienced severe medical or traumatic conditions may initially exhibit fairly normal vital signs. However, the body's ability to compensate eventually decreases (decompensated shock), and the vital signs may deteriorate rapidly, especially in children. In fact, this tendency for the vital signs to fall rapidly as the patient decompensates is the reason that it is important to frequently recheck and record vital signs. Treating a patient for shock before obvious signs of shock increases your patient's potential to survive.

Words of Wisdom

Reassess vital signs often, watching for trends that may indicate a patient is unable to compensate for his or her illness or injury. Suspect shock in any patient exhibiting tachycardia and pale, cool, clammy skin, and transport immediately.

Patient Assessment



History Taking

Although history taking is listed after the primary assessment, it is an integral part of the assessment and should be initiated on scene simultaneously with other tasks, if possible. You may work with another responder, allowing one of you to ask questions of people in the vicinity, while the other initiates patient assessment. It is important to gather as much history as possible on scene from family, friends, and bystanders because this information may be lost forever if not retrieved at this time. Also check for medical identification tags and paperwork to gain essential information concerning events leading up to the incident. If the patient is able to answer questions or a family member is transported in the ambulance with the patient, history taking can be expanded while en route. Sometimes the history may be essential to determining patient treatment; however, transport should not be delayed in patients who are in unstable condition. **History taking** provides details about the patient's chief complaint and an account of the patient's signs and symptoms. It is important to document all of the information gathered during this phase of the assessment process. This includes demographic information, past medical history, and current health status of the patient. Be sure to document the following information:

- Date of the incident
- Patient's age
- Patient's gender
- Patient's race
- Past medical history, including any pertinent information about the patient's condition, such as medical problems, traumatic injuries, and surgical procedures
- Patient's current health status, including diet, medications, drug use, living environment and hazards, physician visits, and family history

Investigate the Chief Complaint (History of Present Illness)

The patient's chief complaint is the most serious thing the patient is concerned about **Figure 9-17** and is usually the reason EMS was dispatched. To investigate the chief complaint, begin by making introductions. Make the patient feel comfortable, and obtain permission to treat. Then ask a few simple and direct questions. Refer to the patient as Mr., Ms., or Mrs., using the patient's last name. Open-ended questions such as, "What seems to be the matter?" or "What is bothering you the most today?" will help determine the chief complaint. These questions and others can help to elicit a response that may determine the patient's highest concern. The response is usually expressed in the patient's own words with simple answers like, "My chest hurts," or "I have been feeling weak." This is a good time to gather further information about the chief complaint and identify if there are any associated complaints. For a patient with a chief complaint of chest pain, ask more questions about the patient's chest pain as well as other symptoms and signs commonly related to chest pain such as shortness of breath, sweating, nausea, and weakness. Use eye contact to encourage the patient to continue speaking, and repeat statements back to the patient to show that you understand the situation. Do not interrupt, and be empathetic of the patient's situation. As discussed previously, the problems or feelings the patient reports to you are the symptoms. Symptoms cannot be felt or observed by others. Signs are objective conditions that can be seen, heard, felt, smelled, or measured by you or others **Figure 9-18**.

Figure 9-17 The patient's initial response to the question "What's wrong?" is the chief complaint.

You must consider the wide range of age groups that you will interact with. Information from infants and children may come from a parent or caregiver. Older patients may be slow to respond or have multiple complaints. Over time, every EMT develops his or her own particular technique or style to obtain a patient's chief complaint.

You will also gather information about the chief complaint from observable clues and information received from the original dispatch. If the patient is unresponsive, information about the patient, pertinent past medical history, and clues about the immediate incident may be obtained from family members present, a person who may have witnessed the situation, bystanders, medical alert jewelry, or other patient medical history documentation **Figure 9-19**. Observable signs may include things such as the patient not being able to respond using full sentences and appearing to have some respiratory distress. These clues may indicate the patient's chief complaint is "difficulty breathing," or the clues may be part of a bigger problem that has to do with a lengthy history of cardiac problems.

Figure 9-18 **A.** A symptom is a subjective condition that the patient feels and tells you about. **B.** A sign is an objective finding that you can detect by observing or examining the patient.

A, B: © Jones & Bartlett Learning. Courtesy of MIEMSS.

For example, you are called to the home of an older man who fell. This information was provided by the dispatcher, and you can use it to help process all of the clues that may be presented in what appears to be a simple fall. You find the patient lying at the bottom of the stairs. How many stairs are there, are they carpeted, and is the floor concrete, wood, or tile? Additional observable clues are used to determine a chief complaint. You note that the patient has an obvious deformity to his right arm, and your initial general impression is a possible fracture. Is this the patient's chief complaint, or is this the result of another problem? The patient states he did fall, which is how the injury occurred, and he reports pain in the right arm. However, was the fall the result of tripping on a step, or was it associated with a medical problem such as dizziness, vertigo, or a syncopal episode, all of which may have caused the fall? It is your responsibility to look at the possibilities and ask the appropriate questions to determine the patient's primary complaint.

Figure 9-19 If the patient is unresponsive, try to obtain a pertinent history or patient information from family or bystanders.

Patient interaction sometimes occurs during the worst possible time in the patient's life. These are emergency situations in which patients are afraid and confused. Some patients assume this could be the end of their lives. Sorting through the clues from the emergency scene itself, from the patient's complaints, and from the patient's signs and symptoms and past medical history will assist you in understanding the cause of your patient's problem and enable you to make appropriate, timely decisions about your patient's care.

OPQRST

You may find it helpful to use the **OPQRST** mnemonic for gathering additional information about a patient's history of present illness and current symptoms. While OPQRST can be used most easily for questions about pain, it can be adapted to quantify other symptoms such as dizziness, nausea, or shortness of breath.

O *Onset.* What were you doing when the symptoms began?
P *Provocation/palliation.* Does anything make the symptoms better or worse? How are you most comfortable?
Q *Quality.* What does the symptom feel like? Is it sharp, dull, crushing, tearing? Does it come in waves? Ask the patient to describe the symptom.
R *Region/radiation.* Where do you feel the symptom? Does it move anywhere?
S *Severity.* On a scale of 0 to 10, with 0 being "nothing at all" and 10 being "the worst you can imagine," how would you rate your symptom?
T *Timing.* Has the symptom been constant or does it come and go? How long have you had the symptom? When did it start?

Special Populations

Assessment of pain is important. According to studies by the American Academy of Pediatrics and the Society for Academic Emergency Medicine, a pain scale such as the Wong-Baker scale (discussed in Chapter 34, *Pediatric Emergencies*) may be helpful in assessing a patient's pain, especially in children and patients with a developmental delay.

Identify Pertinent Negatives

The process of gathering a patient's past medical history, history of present illness, and signs and symptoms is important, but sometimes just as important are the signs and symptoms that the patient does not have. These important negative findings are referred to as **pertinent negatives**. Often, a patient's complaint would be expected to be associated with a number of related findings. Examples include chest pain with shortness of breath, palpitations, and sweating or a severe allergic reaction with itching, hives, and trouble breathing. The absence of these findings is relevant, and should be reported and documented. Pertinent negatives are often helpful in identifying a patient's problem and choosing an appropriate treatment.

Obtain SAMPLE History

As discussed previously, the problems or feelings the patient reports to you are the symptoms. Symptoms are complaints that cannot be felt or observed by others. Signs are objective conditions that can be seen, heard, felt, smelled, or measured by you or others. As you obtain a patient history from medical and trauma patients, you will need to know some of the standard techniques for questioning patients. By obtaining a **SAMPLE history**, you will be able to gather important information from the patient. Use the mnemonic SAMPLE to obtain the following information:

S *Signs and symptoms.* What signs and symptoms occurred at the onset of the incident? Does the patient report pain?

A *Allergies.* Is the patient allergic to any medication, food, or other substance? What reactions did the patient have to any of them? If the patient has no known allergies, you should note this on the run report as "No known allergies" or "NKA."

M *Medications.* What medication is the patient prescribed? What dosage is prescribed? How often does the patient take the medication? What prescription, over-the-counter, and herbal medications has the patient taken in the last 12 hours? This includes medications taken for birth control or erectile dysfunction. How much was taken and when? Does the patient take recreational drugs?

P *Pertinent past medical history.* Does the patient have any history of medical, surgical, or trauma occurrences? Has the patient had a recent illness or injury, fall, or blow to the head? Is there important family history that should be known?

L *Last oral intake.* When did the patient last eat or drink? What did the patient eat or drink, and how much was consumed? Did the patient take any drugs or drink alcohol? Has there been any other oral intake in the last 4 hours?

E *Events leading up to the injury or illness.* What are the key events that led up to this incident? What occurred between the onset of the incident and your arrival? What was the patient doing when this illness started? What was the patient doing when this injury happened?

Critical Thinking in Assessment

Assessment is the logical and ordered process of identifying problems and setting priorities to provide treatment, but it is important that this is not done robotically "by the book." When providers do this, it is referred to as *cookbook medicine*—the process of going through steps in a process without considering other options.

Cookbook medicine does not work in emergency medical services because EMS work occurs in a dynamically changing and often chaotic environment. To provide quality patient care in this environment, you must become an expert in gathering, evaluating, and synthesizing information. This is called critical thinking; without it you will find yourself confused and unable to manage any incident that does not appear exactly the same as described in the textbook.

Gathering. The first step in gathering information involves seeking facts to help your clinical decision making and scene management. Gathering information is often a straightforward process of observing the scene and questioning the patient and bystanders. However, you may experience challenges in gathering information, such as patients who are uncooperative, are unconscious, or have communication barriers. Consider a scenario where you receive a call for a patient with a headache and flu-like symptoms. The call occurs during cold weather flu season so it is possible that this patient simply has a cold or flu. As you gather more information on scene, you learn that the patient believes that he got sick from his family and they are all experiencing the same signs and symptoms. The patient also tells you that the heater in their home is not working properly, leaving them with chills, and that he has been happy on the days that he has been able to make it into work because he feels much better there.

Evaluating. The next step is to consider what the information gathered means. In the previous example, while it is possible this is simply a case of cold or flu moving from person to person within a household, you must use critical thinking skills and consider other conditions that would produce the same signs and symptoms. In this case, the same signs and symptoms might be caused by carbon monoxide. Several other elements of information that you have gathered point in that direction as well, including a malfunctioning heater, everyone in the house experiencing the same signs and symptoms, and that the patient feels better when out of the house.

Synthesizing. The final step in critical thinking is putting together the information that you have gathered and validated, and synthesizing it into a plan to manage the scene and/or care for the patient. In the previous example, you may choose to continue your primary assessment of the patient while you direct your partner to reassure the bystanders and try to gather any additional information. You may also recommend the evacuation and evaluation of all occupants of the house, as well as calling for the fire department to meter the house for carbon monoxide.

Taking History on Sensitive Topics

Alcohol and Drugs. The signs and symptoms a patient may have while under the influence of alcohol or drugs may be confusing, hidden, or disguised. Many patients who abuse alcohol and/or drugs may deny having any problems. Families, friends, and coworkers may be unaware that a patient has any drug or alcohol troubles because patients often hide their dependency from these same people. The reasons patients deny using alcohol or drugs can vary greatly. It may be out of fear of losing their employment or driver's license, worry about what friends may think about them, and embarrassment or insecurity about their dependency.

The history that you gather from a chemically dependent patient may be unreliable Figure 9-20. If patients are not telling the people closest to them that they have a problem, you, as an outsider, may have even less success in obtaining information about a patient's current dependency. The signs and symptoms of alcohol or drug use may be masked by the patient's presentation. Use all of your senses when dealing with patient care.

Establish a strong rapport with your patients. Do not judge a patient who may have a chemical dependency, and be professional in your approach. Be honest and open. Above all, impress on the patient that information received will be kept in confidence. Then and only then, a patient may open up to you and provide information that can be valuable in his or her assessment and treatment.

Figure 9-20 Many vehicle crashes involve alcohol. In these cases, the patient history may not be reliable.

Physical Abuse or Violence. All cases of suspected physical abuse or domestic violence must be reported to the appropriate authorities. Follow your state laws and local protocols when dealing with such cases. If you suspect a patient is a victim of physical abuse or domestic violence, do not accuse any person of being responsible for the situation. Instead, immediately involve law enforcement.

Because abuse and physical violence are very sensitive situations, look for hidden clues that such a situation exists.

Information gathered at the scene, during the assessment process, and while transporting a patient may indicate violence or abuse.

What should you look for? When gathering a history, determine if the information provided by the patient and others present at the scene is inconsistent. Do you observe multiple injuries in various stages of healing? Are some bruises red, black, brown, or even green? In some cases, a victim of abuse or violence will not tell you what happened because of fear of further violence when EMS is not present. Victims may not answer your questions because the physical aggressor is still present and is answering questions for the patient. In these cases, separate the people present and interview both parties about the situation.

In cases of domestic violence, involvement can be extremely dangerous. If you determine that the emergency response is part of a domestic abuse situation, call law enforcement personnel immediately **Figure 9-21**.

When involved with cases of physical abuse, be very observant and open-minded, have a high index of suspicion, and be nonjudgmental. Documentation will be very important in cases of abuse and domestic violence. Your documentation should be an objective report of the facts. Avoid subjective, judgmental statements, and include any pertinent statements made by the patient or others present using quotation marks. Remember, these prehospital situations will most likely involve some type of legal process later on. You may be summoned several years later to provide testimony regarding what may have happened, which makes accurate and thorough documentation very important.

Sexual History. Obtaining information about a patient's sexual history may be limited because a number of factors may influence the details a patient may reveal. Religious beliefs, cultural stereotypes, and society's expectations may have a major role in patients not revealing a very personal side of their life, including practices considered by some people to be bizarre or exotic. In addition, some patients find sharing information regarding their sexual history with others very uncomfortable.

Figure 9-21 Do not handle potentially violent calls alone. Summon law enforcement personnel.

When would information about a patient's sexual history become important? As an EMT, you will be involved in the care of female patients reporting lower abdominal pain. You should consider all women of childbearing years who are reporting lower abdominal pain to be pregnant unless ruled out by history or other information. There are a number of questions to ask when faced with this prehospital scenario:

- When was your last menstrual period?
- Are your periods normal? (Is there any vaginal discharge or bleeding not associated with a menstrual period?)
- *If the patient is bleeding:* How many sanitary pads or tampons have you used?
- Do you have urinary frequency or burning?
- What is the severity of cramping, and are there any foul odors?
- Are you sexually active?
- Is there a possibility you may be pregnant?
- Are you taking birth control pills?

When dealing with a male patient, you must inquire about urinary symptoms:

- Is there pain associated with urination?
- Do you have any discharge, sores, or an increase in urination?
- Do you have burning or difficulty voiding?
- Has there been any trauma?
- Have you had recent sexual encounters?

When appropriate, ask about the potential for sexually transmitted diseases. Gathering this information may be difficult and uncomfortable for the patient. Never be judgmental once this information is gathered. All patients should be, and expect to be, treated with compassion and respect. All information gathered from a patient for the purpose of determining a treatment plan is strictly confidential and should not be shared with others unless necessary in the process of treating a patient's medical or traumatic condition.

Special Challenges in Obtaining Patient History

Dealing with patient care, you will be faced with a number of challenges, many of them new and difficult. Each and every patient interaction should be viewed as a new experience and handled as an educational opportunity as well.

Silence. Dealing with patients who say very little or say nothing at all can be difficult and frustrating. Patience is extremely important when dealing with patients and their emergency crises. Patients may be thinking about how to answer you, getting the facts straight, or assessing your crew to determine if they feel comfortable answering you. Using a close-ended question that requires a simple yes or no answer may work best. Consider whether the silence is a clue to the patient's chief complaint.

Always look for visual signs in the patient's environment that may indicate why a patient is not communicating. In addition, look for nonverbal clues, including facial expressions that may show pain or fear. Is the patient distressed or intimidated by your presence? How is the patient sitting or standing? Is there a communication problem? Is there a language problem? There are many reasons a patient may be silent during the prehospital encounter. A good EMT will continue to assess the situation and determine a way to communicate with the patient.

Overly Talkative. On the other end of the spectrum is the patient or bystander who is extremely talkative. Some people just talk a lot, and gathering details about their medical condition may be difficult if they talk around your question or you have a difficult time refocusing the patient's conversation. Some possible causes as to why a patient may be overly talkative could include excessive caffeine consumption; nervousness; ingestion of cocaine, crack, or methamphetamines; or some underlying psychologic issue.

YOU are the Provider — PART 4

As you are packaging the patient and preparing to move him from his apartment, the paramedic unit is dispatched to another call. There are no other paramedic units in your district. You move the patient from his apartment and load him into the ambulance. With an EMT from the engine company assisting you in the back with the patient, you depart the scene and reassess the patient. The closest appropriate hospital is 25 minutes away.

Recording Time: 12 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	6 breaths/min (baseline); ventilations are being assisted
Pulse	44 beats/min; weak and regular
Skin	Pale and cool; cyanosis noted around mouth

Blood pressure	78/54 mm Hg
Spo_2	88% (with assisted ventilation)

7. How has your patient's condition changed from the previous assessments?
8. What should you do in response to the patient's change in condition?

Once you have allowed a talkative patient a chance to express himself or herself, you must keep the patient focused on the questions presented. Have the patient stick to the facts, and clarify statements for the purpose of making sure the information you are gathering is correct. Remember that there is no such thing as too much information.

Multiple Symptoms. Some patients present with multiple symptoms. This is often true of older patients. Prioritize the patient's complaints as you would in triage; start with the most serious and end with the least serious. Always ask for additional information to determine why EMS was called.

Keep an open mind, and do not focus on just one complaint or detail to determine a treatment plan. Always remember there may be a number of possible medical or traumatic causes for a patient's chief complaint.

Anxiety. When a person is involved in an emergency situation, it is natural for that person to appear excited or anxious. Many people have not been faced with a true emergency during their lifetime and part of your job as an EMT will be to help provide calm to the situation. It is important to also consider the context of the situation and recognize that the anxiety you are observing may be a sign of a serious underlying medical condition. Your patient or bystander may be nervous, pacing, vocal, panicked, or, in some extreme cases, experiencing complete hysteria. It is your responsibility to deal not only with the emergency crisis at hand, but also with the people present who are having difficulties coping with the situation. Frequently, anxious patients can be observed in emergency scenes that involve a large number of patients, such as during a disaster. Anxiety also can be observed or encountered during a routine EMS call when family members or patients cannot cope.

Some anxious patients exhibit signs of psychologic shock, such as pallor, diaphoresis, shortness of breath, numbness in the hands and feet, dizziness or light-headedness, and even loss of consciousness. They may have no real medical complaint but may be hiding or concealing something, such as trying to keep a family member, friend, or employer from discovering their dependency on alcohol or drugs. Or, the patient may have been involved in a physical abuse or domestic situation that he or she wants to keep quiet. In any situation involving an anxious patient, be aware of verbal and nonverbal clues. Is the patient making sense during a verbal conversation? Anxiety can also be an early indicator of low blood glucose level, shock, or hypoxia. Perform the appropriate examination to rule out these potentially life-threatening causes early in your assessment.

During a crisis situation, reassure the patient that any nervous or anxious response is normal and can be overcome. It may be possible for you to control an anxious patient by simply smiling or using a delicate touch. Be confident in your approach, and have a positive demeanor. In many patient care interactions, your presence may be all that is required to calm the patient.

As in every response, safety is a paramount concern. Be aware that emergency responses involving anxious and possibly hysterical patients can turn violent. A confident but cautious EMT can prevent a bad situation from getting worse and professionally calm and control anxious patients, friends, and family members.

Anger and Hostility. Every patient encounter has the potential for verbal hostility and physical violence, from a situation involving a 9-year-old boy who was hit by a vehicle to a 90-year-old grandmother experiencing chest pain. Emergency calls have a high potential for sudden violence because friends, family, or bystanders may direct their anger and rage toward you. Do not to take this anger and frustration personally. More important, do not become angry yourself because "anger feeds anger."

When handling potentially violent situations, remain calm, reassuring, and gentle. Always be observant. Be aware of nonverbal clues, such as posture, position, and facial expressions. Look at the patient, and be aware of how the patient is positioned. Is the patient stiff, with hands clenched and feet wide apart? Is his or her body weight all on one leg? This may indicate the patient has assumed a position to allow him or her to kick.

If the scene is not safe or secured, retreat until it is secured. Never let a potentially violent or hostile patient leave the room alone. Understand that everything in reach of a patient has the potential to be used as a weapon.

Intoxication. The number of EMS calls dealing with an intoxicated patient has increased over the years. When you attempt to gather a history for an intoxicated patient, be aware the information may not only be difficult to get, but could also be unreliable. An intoxicated patient may become very impatient with you when he or she is trying to provide you with information. As the patient's impatience increases, so does his or her anger level. Do not put an intoxicated patient in a position where he or she feels threatened and has no way out. As in other emergency cases, the potential for violence and a physical confrontation is high when a patient is intoxicated.

During the assessment and treatment of a patient who has consumed alcohol, be accepting, diplomatic, objective, and nonjudgmental. Because of the intoxication, the patient may not be telling you everything about how he or she feels. Alcohol dulls a patient's senses, which will make it difficult for an intoxicated patient to inform you that something feels painful. Treat the patient with dignity and respect despite the intoxication. Never presume that the patient's condition is the result of alcohol consumption when there may be an underlying medical or traumatic cause for the patient's presentation.

Crying. A crying patient is a breathing patient. A patient who cries may be sad, in pain, or emotionally overwhelmed. No matter the reason for crying, you need to be calm, patient, reassuring, confident, and maintain a soft voice.

Your presence may make a crying patient feel more secure. In some extreme cases, additional verbal intervention will help the patient. As with all patients, treat a crying patient with respect and dignity.

Depression. Depression is a common reason patients call EMS. In fact, according to the WHO, depression is among the leading causes of disability worldwide. Some of the symptoms a patient with depression will have include sadness, a feeling of hopelessness, restlessness, and irritability. The patient may also have sleeping and eating disorders and a decreased energy level. Depression is a normal human response, but it can lead to harmful behavior. In the treatment of depression, be nonjudgmental and compassionate toward the patient's feelings. The most effective treatment in handling a patient's depression is being a good listener. Oftentimes, the patient just needs someone to talk to and someone to listen.

Confusing Behavior or History. Patients sometimes provide more or additional history information to hospital personnel because they are embarrassed or frightened about telling the EMTs and they may feel more comfortable talking with hospital staff. Whatever the situation may be, there are medical causes that you must be aware of that can cause a patient to report a confusing history. Conditions such as hypoxia, stroke, diabetes, trauma, medications, and other drugs could alter a patient's explanation of events. One of the most common causes of confusion is hypoxia. It is not uncommon to encounter an older patient who has dementia, delirium, or Alzheimer disease. It is important to verify the normal mental status of each patient. Do not assume that because a patient is older he or she has one of these conditions.

Confused behavior is not a normal response. After you have properly assessed and treated any life threats, attempt to ask the patient again about the chief complaint or ask someone close to the patient, such as family members or friends, to provide additional details.

Limited Cognitive Abilities. Cognitive disabilities can range from those that are barely recognizable to those that are very severe. You should develop a method for dealing with a patient who has limited cognitive abilities. First, assume you can get an adequate history. Keep your questions simple, and limit the use of medical terms. Be alert for partial answers, and keep asking questions. In cases of patients with severely limited cognitive function, rely on family, caregivers, and friends to supply answers to your questions.

Cultural Challenges. As an EMT, you are likely to provide care for patients from a variety of different backgrounds and cultures. Cross-cultural communication is an important skill for you to develop to provide proper medical care to all patients equally. Just as you may experience physical challenges to providing good field care, you might also need to overcome cultural and literacy barriers to provide proper prehospital services.

For example, you may obtain only a limited patient history if you ask questions using health care terminology. The patient may have limited understanding of medical language and have difficulty answering your questions. Or, you may encounter a patient from a culture that prefers to speak only with health care providers of the same gender.

Strategies for overcoming cultural challenges include gaining an understanding of the cultures and patient backgrounds you might encounter on emergency calls; gaining the assistance of the patient's friends or family members; and enlisting the help of health care providers of the same culture or background.

Language Barriers. We live in a country that is a melting pot of people with diverse nationalities. Not everyone speaks English. For example, you respond to a call for an older woman who fell at a nursing home. The emergency response seems pretty straightforward until you ask the patient what happened and she answers in French. If you don't speak the language, how will you ask the patient to describe what happened and what hurts? Keep in mind that some patients may have disabilities that make it difficult to understand them in any language.

To overcome language barriers, consider using interpreters, translation resources, and related mobile device apps.. The best answer is to find an interpreter, but it is not always that simple. First, determine whether the patient speaks or understands any English by asking the patient or others who may be present. Start by introducing yourself by using your name. Determine whether the patient understands who you are. If the patient is able to respond by giving you his or her name, the patient has the ability to understand some English. Remember that increasing the volume of your questions will not increase the patient's understanding of what you are asking him or her. Keep questions straightforward and brief. Simple is best in these patient situations. Use of hand gestures may be helpful.

Be aware of the language diversity in your community. Some dispatch centers and most hospitals have set up programs within the institution that identify various employees who can speak different languages. Provide the hospital with advance notice that a non–English-speaking patient will be arriving. This will allow the hospital the opportunity to make arrangements for an interpreter.

Family and friends on the scene may temporarily interpret for you in an emergency. Using an untrained interpreter increases the risk of misunderstanding, but often cannot be avoided on 9-1-1 calls. When asking questions through an interpreter, continue to look at the patient. Avoid using children to interpret except when there is no other option.

Hearing Problems. Hearing disabilities in patients range from very slight to total deafness. Hearing problems can make the process of obtaining an in-depth history difficult. When you are treating a patient who has a hearing loss, ask questions slowly and clearly. You may want to use a stethoscope to function like a hearing aid; have the patient place the stethoscope in his or her ears while you speak into the stethoscope bell, which will amplify the sound. Changing the pitch of your voice may also help the patient to hear you.

Oftentimes, a patient who has had a hearing disability for some time will have mastered the technique of reading lips. If the patient has a hearing aid, ask the patient to use it. Speak slowly and face-to-face with the patient. Some deaf patients will attempt to use sign language for communication, which can be difficult for others to understand. Learning simple sign language will help you in the communication process. Probably the simplest way to communicate with a patient who has a hearing deficit is to use a pencil and paper. Write uncomplicated questions that require simple yes or no answers. If the patient cannot see clearly and has glasses, ask the patient to put them on.

Special Populations

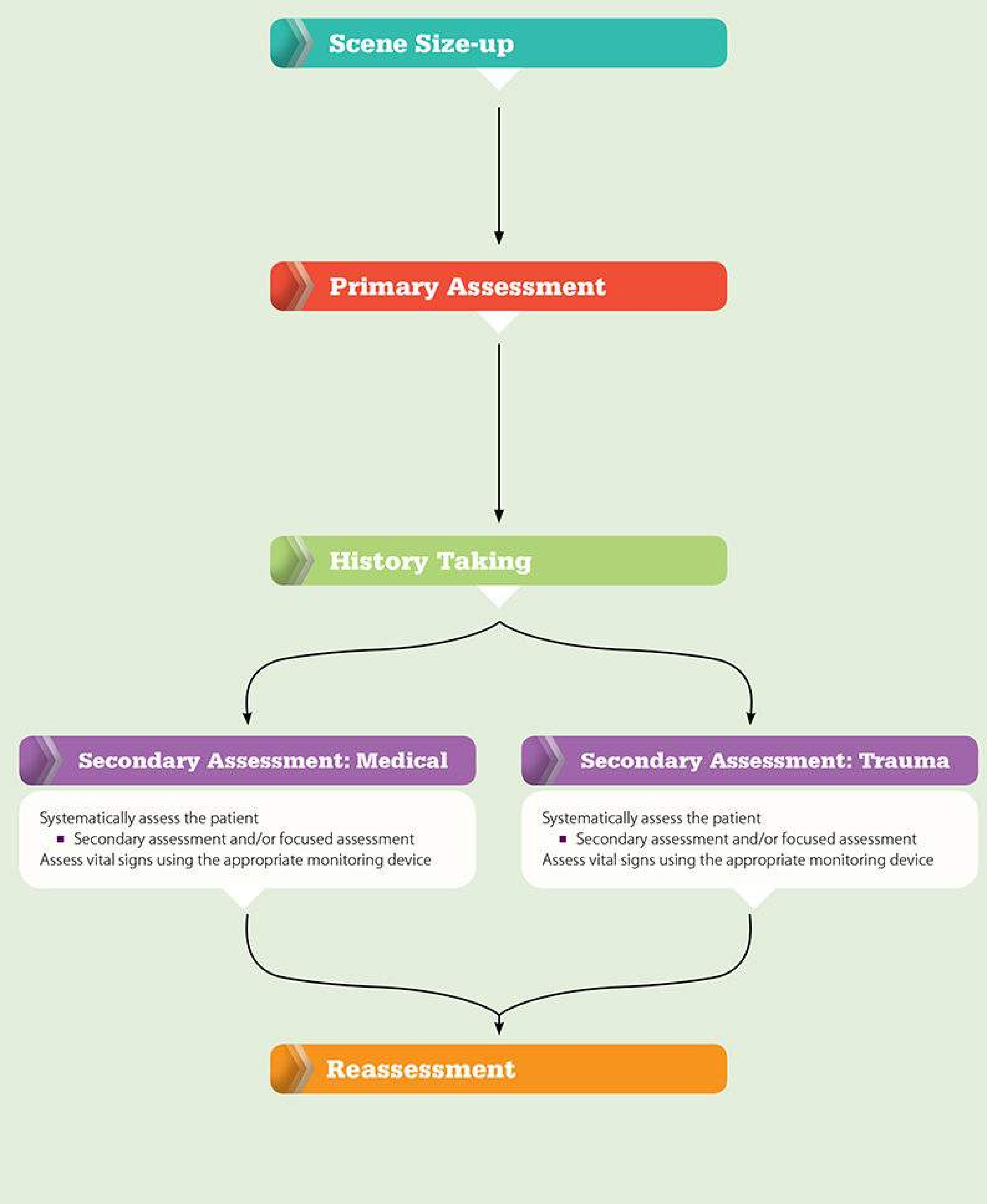
There are many mobile device apps available to help you communicate with patients who are deaf or who speak another language.

Visual Impairments. Identify yourself verbally when you enter the home of a visually impaired patient who has called for help. Announcing yourself when entering a residence lets a patient know that help has arrived. Any response from the patient may help you safely locate the patient's whereabouts.

During the assessment and subsequent treatment of a patient who is visually impaired, it is important that you put any items that have been moved back into their previous position. Many visually impaired patients can move freely about their homes because they know exactly where everything is placed.

During the assessment and history-taking process, explain each step in your vital signs assessment. Notify the patient when you prepare to lift and move him or her on the stretcher. Remember, you are a stranger to the patient, and an EMS vehicle is a foreign environment. A little communication can ease uncertainty in a visually impaired patient. If the patient is not able to provide you with all of the necessary information, try to find someone else who can.

Patient Assessment



Secondary Assessment

If the patient is in stable condition and has an isolated complaint, you may choose to perform the secondary assessment at the scene. If the secondary assessment is not performed at the scene, it is performed in the back of the ambulance en route to the hospital. However, you may not have time to perform a secondary assessment if you have to continually manage life threats that were identified during the primary assessment.

The purpose of the **secondary assessment** is to perform a systematic physical examination of the patient. The physical examination may be a systematic head-to-toe secondary assessment or an assessment that focuses on a certain area or system of the body, often determined by the chief complaint (a focused assessment). Circumstances will dictate which aspects of the physical examination will be used.

Words of Wisdom

Patients may feel vulnerable and exposed during a physical examination. Display compassion during this difficult time. It is also important to cover the patient as much as possible during your assessment to maintain the patient's modesty and body temperature.

The following are guidelines on how and what to assess during a physical examination:

- **Inspection.** Inspection is simply looking at your patient for abnormalities. This is done by looking for anything that may indicate a problem. For example, swelling in a lower extremity may indicate an acute injury or a chronic illness.
- **Palpation.** Palpation describes the process of touching or feeling the patient for abnormalities. Palpation may be gentle or firmer to help you identify where the patient has pain. Your fingertips are best suited for detecting texture and consistency, while the back of your hand is best suited for noting temperature.
- **Auscultation.** Auscultation is the process of listening to sounds the body makes by using a stethoscope. For example, when measuring a patient's blood pressure, you listen (**auscultate**) with a stethoscope to the sound of the flow of blood against the brachial artery as you release the pressure in a blood pressure cuff. This is auscultation of a blood pressure. When auscultating, make sure the earpieces of the stethoscope are facing forward when placed in your ears.

The mnemonic DCAP-BTLS will help remind you what kinds of abnormal findings to look for when inspecting and palpating various body regions.

An integral part of your physical examination is to compare findings on one side of the body with the other side when possible. For example, if a patient reports a grating or grinding sensation in his or her arm or you note air bubbles under the skin that produce a crackling sound, check the other arm before determining that the sensation or noise is caused by fractured bone ends or joints rubbing together (crepitus). If one ankle appears swollen, look at the other. If one shoulder feels "out of joint," feel the other one to compare. When listening to breath sounds, listen to both sides of the chest. If possible, find out what conditions are new and which ones the patient has been experiencing for some time. Do not assume that just because a patient has a condition that is causing discomfort, it just happened. As you assess, ask what, if anything, has changed about the condition.

On some occasions, it may even be helpful to note odors during an examination. Odors can indicate anything from infections, to certain medical conditions, to scene safety threats.

Systematically Assess the Patient—Secondary Assessment

The goal of the secondary assessment is to identify hidden injuries or identify causes that may not have been identified during the 60- to 90-second exam that took place during the primary assessment. Any patient who has sustained a significant MOI, is unconscious, or is in critical condition should receive this type of examination. An unconscious patient is unable to tell you what is wrong; therefore, this type of examination may give you clues to identify the problem.

To perform a secondary assessment of a patient with no suspected spinal injuries, follow the steps in Skill Drill 9-2:

1. Look at the face for obvious lacerations, bruises, and deformities Step 1.
2. Inspect the area around the eyes and eyelids Step 2.
3. Examine the eyes for redness and for contact lenses. Assess the pupils using a penlight Step 3.
4. Look behind the patient's ears to assess for bruising (Battle sign) Step 4.
5. Use the penlight to look for drainage of spinal fluid or blood in the ears Step 5.
6. Look for bruising and lacerations about the head. Palpate for tenderness, depressions of the skull, and deformities Step 6.

7. Palpate the zygomas for tenderness or instability Step 7.
8. Palpate the maxillae Step 8.
9. Check the nose for blood and drainage Step 9.
10. Palpate the mandible Step 10.
11. Assess the mouth and nose for cyanosis, foreign bodies (including loose teeth or dentures), bleeding, lacerations, and deformities Step 11.
12. Check for unusual odors on the patient's breath Step 12.
13. Look at the neck for obvious lacerations, bruises, and deformities. Observe for jugular vein distention Step 13.
14. Palpate the front and back of the neck for tenderness and deformity Step 14.
15. Look at the chest for obvious signs of injury before you begin palpation. Be sure to watch for movement of the chest with respirations Step 15.
16. Gently palpate over the ribs to elicit tenderness. Avoid pressing over obvious bruises and fractures Step 16.
17. Listen for breath sounds over the midaxillary and midclavicular lines Step 17.
18. Listen also at the bases and apices of the lungs Step 18.
19. Look at the abdomen and pelvis for obvious lacerations, bruises, and deformities. Gently palpate the abdomen for tenderness. If the abdomen is unusually tense, describe the abdomen as rigid Step 19.
20. Gently compress the pelvis from the sides to assess for tenderness Step 20.
21. Gently press the iliac crests to elicit instability, tenderness, and/or crepitus Step 21.
22. Inspect all four extremities for lacerations, bruises, swelling, deformities, and medical alert anklets or bracelets. Also assess distal pulses and motor and sensory function in all extremities Step 22.
23. Assess the back for tenderness and deformities. Remember, if you suspect a spinal injury, provide manual spinal stabilization as you log roll the patient Step 23.

Skill Drill 9-2 Performing the Secondary Assessment*

Step 1

Observe the face.

Step 2

Inspect the area around the eyes and eyelids.

Step 3

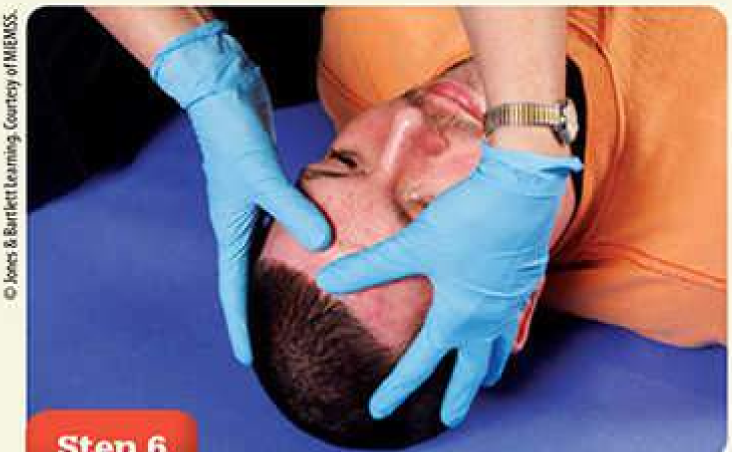
Examine the eyes for redness and contact lenses. Check pupil function.

Step 4

Look behind the ears for Battle sign.

Step 5

Check the ears for drainage or blood.



Step 6

Observe and palpate the head.

Step 7

Palpate the zygomas.

Step 8

Palpate the maxillae.

Step 9

Check the nose for blood and drainage.

Step 10

Palpate the mandible.

Step 11

Assess the mouth and nose.

Step 12

Check for unusual breath odors.

Step 13

Inspect the neck. Observe for jugular vein distention.

Step 14

Palpate the front and back of the neck.

Step 15

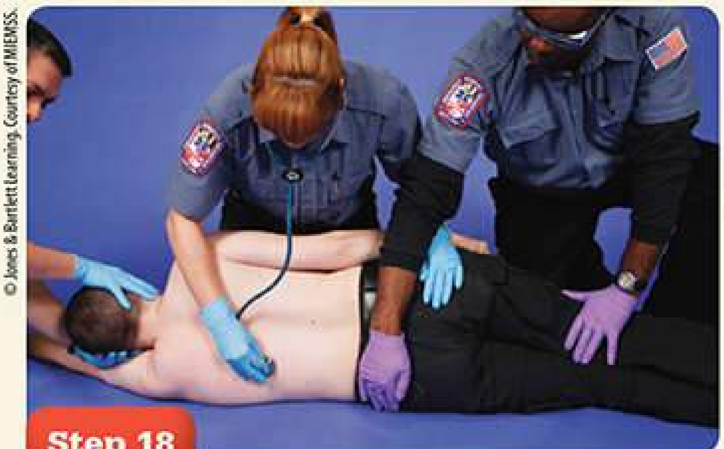
Inspect the chest, and observe breathing motion.

Step 16

Gently palpate over the ribs.

Step 17

Listen to anterior breath sounds (midaxillary, midclavicular).



Step 18

Listen to posterior breath sounds (bases, apices).

Step 19

Observe and then palpate the abdomen and pelvis.

Step 20

Gently compress the pelvis from the sides.

Step 21

Gently press the iliac crests.

Step 22

Inspect the extremities; assess distal circulation and motor and sensory function.

Step 23

Log roll the patient, and inspect the back.

*When performing a secondary assessment on a patient who has sustained significant trauma, provide manual spinal stabilization.

Systematically Assess the Patient—Focused Assessment

A **focused assessment** is generally performed on patients who have sustained nonsignificant MOIs or on responsive medical patients. This type of examination is typically based on the chief complaint. Your assessment can focus on a particular body part that has been affected, such as abrasions to the elbow, or to a particular body system that has been affected such as the cardiovascular, respiratory, neurologic, musculoskeletal, integumentary, or genitourinary system. For example, a person with a laceration to the arm may need to only have that arm evaluated. For a person reporting a headache, carefully and systematically assess the head and/or the neurologic system. The goal of a focused assessment is to focus your attention on the body part or systems affected by the priority problem(s).

Respiratory System

When the patient's chief complaint is focused on the respiratory system, you should have identified and managed life threats during the primary assessment. During the secondary assessment, you will perform an examination directed at obtaining clues that will help determine which treatment to perform and protocols to follow.

Expose the patient's chest. Look again for signs of airway obstruction, as well as trauma to the neck and/or chest. Inspect the chest for overall symmetry. Does the right side of the chest look like the left side? Listen carefully to breath sounds, noting abnormalities. Measure the respiratory rate, chest rise and fall (for tidal volume), and effort. Look for retractions. Is the patient using accessory muscles to help with breathing, and is there increased work of breathing?

For example, sounds of **stridor**, a brassy crowing sound prominent on inspiration, suggest a mildly occluded airway caused by swelling. High-pitched crowing sounds may indicate a mild airway obstruction from a foreign body.

Each complete breath includes two distinct phases: inspiration and expiration. During inspiration (inhalation), the diaphragm and intercostal muscles contract and the chest rises up and out, drawing oxygenated air into the lungs. During expiration (exhalation), the muscles relax and the chest returns to its original position, releasing air with an increased carbon dioxide level out of the lungs. Inhalation and exhalation times occur in a 1:3 ratio; the active inhalation phase lasts one-third the amount of time of the passive exhalation phase.

Breathing is a continuous process in which each breath regularly follows the last with no notable interruption. Breathing is normally a spontaneous, automatic process that should occur without conscious thought, visible effort, marked sounds, or pain. You will assess breathing by watching the patient's chest rise and fall, listening to **breath sounds** with a stethoscope over each lung and, if the patient is unconscious, feeling for air through the mouth and nose during exhalation. Chest rise and breath sounds should be equal on both sides of the chest.

When assessing breathing, you must obtain the following information:

- Respiratory rate
- Rhythm, regular or irregular
- Quality or character of breathing
- Depth of breathing

Respiratory Rate

A normal respiratory rate varies widely in adults, ranging from approximately 12 to 20 breaths/min. Children breathe at even faster rates. With practice, you will be able to estimate the rate and note whether it is too fast or too slow. At times it may be important to actually count the number of respirations during your primary assessment either by listening to breaths, observing the patient for chest rise, or gently placing a hand on the patient's chest and feeling for chest rise.

Respirations are determined by counting the number of breaths the patient takes in 30 seconds and multiplying by two. The result is the number of breaths per minute. For accuracy, count each breath at the same point in its cycle. This is most easily done by counting each peak chest rise. Although you can see peak chest rise, it is easier to place your hand on the patient's chest and feel it. However, be aware that a conscious patient who knows that you are evaluating his or her breathing will often override the automatic rate and depth by breathing more slowly and deeply. To prevent this from happening, check respirations in a conscious, alert patient without making the patient aware of what you are evaluating. This can be easily done by first taking a radial pulse and then, without releasing the wrist or otherwise suggesting a change, counting the chest rise that you see or feel as the patient's forearm rises and falls with the movement of the chest **Figure 9-22**. If the patient coughs, yawns, sighs, or talks during the 30-second period, wait a few seconds and start again. **Table 9-3** shows the normal range of respiratory rates of patients who are at rest.

Respiratory Rhythm. While counting the patient's respirations, also note the rhythm. If the time from one peak chest rise to the next is fairly consistent, respirations are considered regular. If the respirations vary or the rate changes frequently, the respirations are considered irregular. When you document the vital signs, be sure to note whether the patient's respirations were regular or irregular.

Figure 9-22 Assess respirations in a conscious patient by first taking a radial pulse and then, without releasing the patient's wrist, counting the chest rise and fall for 30 seconds.

Table 9-3 Normal Ranges for Respirations

Age	Range (breaths/min)
Adults	12 to 20
Adolescents (13 to 18 years)	12 to 16
School-Aged Children (6 to 12 years)	18 to 30
Preschoolers (4 to 5 years)	22 to 34
Toddlers (1 to 3 years)	24 to 40
Infants	30 to 60

Note: Adult respiratory ranges are per the NHTSA 2009 EMT National EMS Education Standards. Pediatric ranges are modified from Pediatric Advanced Life Support, 2012, the American Heart Association. Ranges presented in other sources may vary.

Quality of Breathing

It may be helpful to listen to breath sounds on each side of your patient’s chest early in the primary assessment. This can help identify the quality of air movement in both lungs. Decreased or absent breath sounds on one side of the chest and decreased movement in the rise and fall on one side indicate inadequate breathing.

Normal breathing is almost silent. In a very quiet environment you may hear only the sounds of air movement at the mouth and nose. Through a stethoscope, normal breath sounds include just the sound of air movement through the bronchi accompanied by a soft, low-pitched murmur. Breathing accompanied by other sounds may indicate a significant respiratory problem. A snoring sound may indicate an upper airway obstruction and is usually a result of the tongue blocking the airway. When the upper airway has a partial obstruction by a foreign body or swelling, you may hear stridor, a harsh, high-pitched, crowing sound. If you can hear bubbling or gurgling in the upper airway, the patient probably has fluid in those passages, potentially impeding the exchange of gases. Suction the patient to clear the airway and reduce the risk of aspiration of fluid into the lungs. You may hear other sounds, like wheezes, a musical sound indicative of a mild lower airway obstruction. The presence of any of these abnormal sounds indicates that an airway or breathing problem exists. Remember that with a complete airway obstruction, the patient will not be able to move any air and will no longer be able to cough or talk. If you hear no sounds, the patient may not be moving any air at all and will require some action to clear the obstruction.

A patient who coughs up thick, yellow or green sputum (matter from the lungs) most likely has a respiratory infection. A patient with a chest injury may cough up blood or frothy white or pink foamlike sputum caused by blood and fluid mixing with air in the lungs. A patient with congestive heart failure may also cough up frothy sputum. The presence of either substance, regardless of its cause, indicates that an urgent, potentially critical cardiovascular and respiratory problem exists, possibly requiring oxygenation, ventilation, and other treatments. Without these treatments, the patient's condition may deteriorate rapidly to a point where the patient can no longer breathe.

Depth of Breathing

The amount of air that the patient is exchanging depends on the rate and the tidal volume. **Tidal volume** is a measure of the amount of air that is moved into or out of the lungs during one breath. The depth of the breath determines whether the tidal volume is normal, less than normal, or more than normal.

Breath Sounds

The following describes how and where to listen to assess breathing:

- First, remember that you can almost always hear a patient's breath sounds better from the patient's back; therefore, if the patient's back is accessible, listen (auscultate) there. If you cannot, listen from the front and sides **Figure 9-23**.
- Auscultate over the upper lungs (apices) at approximately 1 inch (2.5 cm) below the clavicle at the midclavicular line, the midlung fields at the third or fourth intercostal space from the patient's posterior, and the lower lungs (bases) at the sixth intercostal space, midaxillary line.
- Lift the clothing or slide the stethoscope under the clothing. If you listen over clothing, you will primarily hear the sound of the stethoscope sliding over the fabric because breath sounds are muted by clothing.
- Place the diaphragm of the stethoscope firmly against the skin to hear breath sounds.

What are you listening for? You may be able to identify one of the following sounds:

- **Normal breath sounds.** These are clear and relatively quiet during inspiration and expiration.
- **Snoring breath sounds.** These usually indicate a simple, but potentially dangerous, upper airway obstruction, usually caused by the tongue or a foreign body.
- **Wheezing breath sounds.** These suggest an obstruction or narrowing of the lower airways. **Wheezing** is a high-pitched whistling sound that is most prominent on expiration.
- **Crackles**. Wet, crackling breath sounds (usually on both inspiration and expiration) may indicate fluid in the lungs.
- **Rhonchi**. Congested breath sounds may suggest the presence of mucus in the lungs. Expect to hear low-pitched, noisy sounds that are most prominent on expiration. The patient often reports a productive cough associated with these sounds.
- **Stridor.** This is often heard before even listening with a stethoscope and may indicate that the patient has an airway obstruction in the neck or upper part of the chest. Expect to hear a brassy, crowing sound that is most prominent on inspiration.

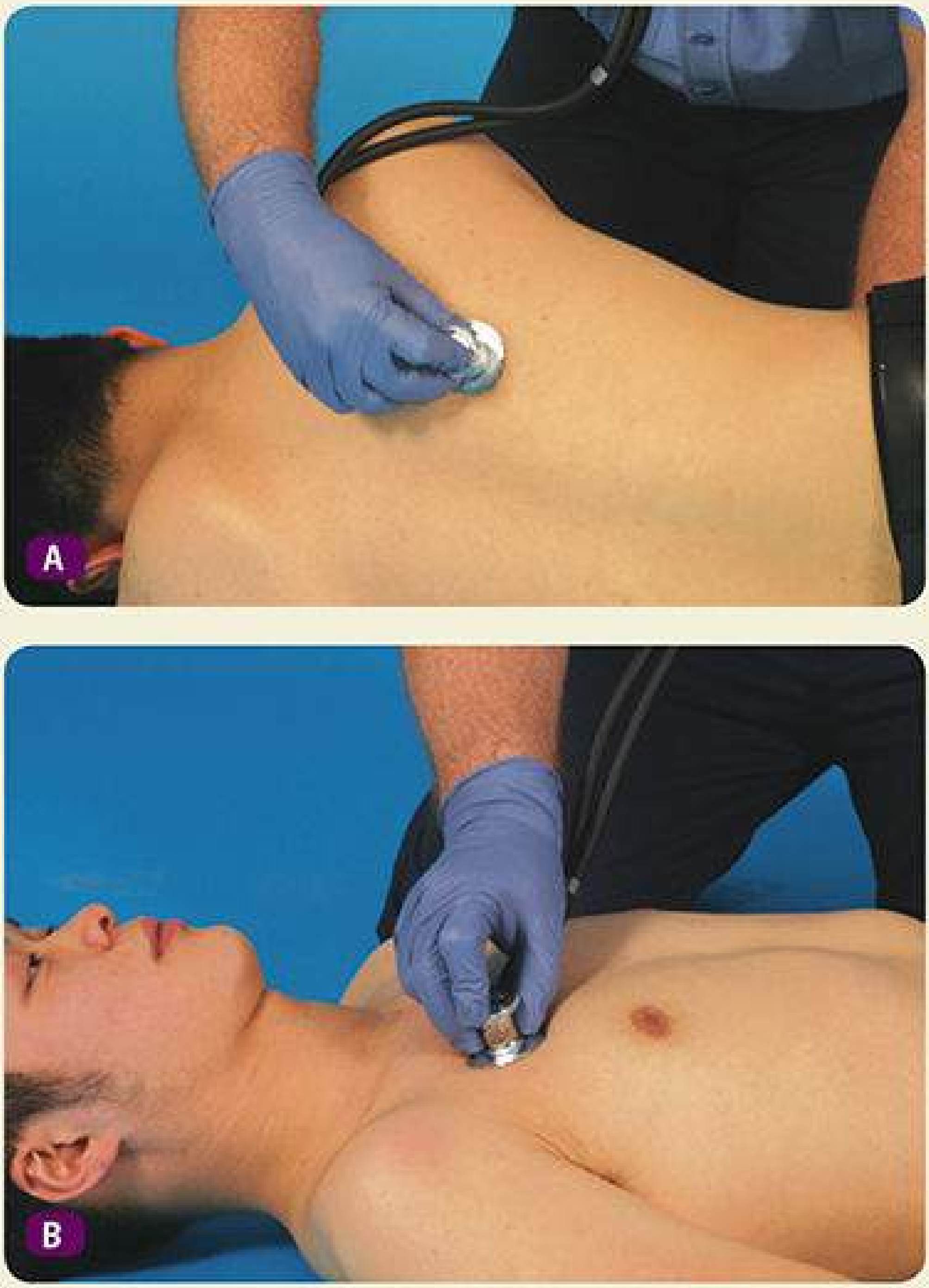


Figure 9-23 **A.** Listen to breath sounds from the patient's back (if possible), over the apices, the midlung fields, and the bases. **B.** If the patient is immobilized on a backboard or in a supine position, listen from the front and sides.

You can determine the quality or character of respirations as you are counting the number of respirations. Table 9-4 shows four ways in which the quality or character can be described. Use your sense of hearing to listen for breath sounds or use the preferred method of auscultation, listening with a stethoscope. Note any abnormal breath sounds and treat the patient accordingly.

Because the location of this complaint is the chest, carefully reevaluate the pulse rate, skin, and blood pressure (described in the next section). Inspect and palpate from the clavicles to the shoulder to the abdomen, and reassess breath sounds. Note any abnormalities found, and document those findings on the patient care report. With this information, you can develop a treatment plan and prioritize transport procedures.

Cardiovascular System

When the patient's chief complaint is associated with chest pain or other discomfort, a physical examination should include looking, listening, and feeling for abnormalities in the patient's thoracic region. Look for trauma to the chest, and listen for breath sounds. Consider the pulse and respiratory rate and the blood pressure. Pay particular attention to rate, quality, and rhythm. Consider your findings when assessing skin condition. Considering these findings will allow you to determine how well the cardiovascular and respiratory systems are functioning. Check and compare distal pulses to determine any right and left side differences. Consider auscultation for abnormal heart sounds; however, keep in mind that obtaining these sounds may be difficult in a noisy prehospital setting. Always remember that a patient's chief complaint may have a medical cause or could be the result of trauma.

Table 9-4 Characteristics of Respirations

Normal	Breathing is neither shallow nor deep Equal chest rise and fall No use of accessory muscles
Shallow	Decreased chest or abdominal wall motion
Labored	Increased breathing effort Use of accessory muscles Possible gasping Nasal flaring, supraclavicular and intercostal retractions in infants and children
Noisy	Increase in sound of breathing, including snoring, wheezing, gurgling, crowing, grunting, and stridor

Pulse Rate. After you have determined that a pulse is present, next determine its adequacy. This is done by assessing the pulse rate, pulse quality, and pulse rhythm. For an adult, the normal resting pulse rate should be between 60 and 100 beats/min and could be as much as 100 beats/min in older patients. In pediatric patients, generally the younger the patient, the faster the pulse rate. In well-conditioned athletes or in people taking heart medications such as beta-blockers, the pulse rate may be considerably lower. Table 9-5 shows the normal ranges of pulse rates for adults and children.

To obtain the pulse rate in most patients, count the number of pulses felt in a 30-second period and then multiply by two. A pulse that is weak and difficult to palpate, irregular, or extremely slow should be palpated and counted for a full minute. A pulse rate is counted as beats per minute; however, in reporting the pulse rate, it is not necessary to state or write "beats per minute" after the number.

In an adult patient, a pulse rate that is greater than 100 beats/min is described as **tachycardia**, and a rate of less than 60 beats/min is described as **bradycardia**.

Table 9-5 Normal Ranges for Pulse Rate

Age	Range (beats/min)
Adults and children (older than 10 years)	60 to 100
Preschoolers and school-aged children (2 years to 10 years)	60 to 140
Infants and toddlers (3 months to 2 years)	100 to 190
Infants (up to 3 months of age)	85 to 205

Data From Pediatric Advanced Life Support, 2012, the American Heart Association.

Pulse Quality. Always report the pulse's quality whenever reporting or recording the pulse. The pulse is generally palpated at the radial or carotid arteries in adults and at the brachial artery in infants, because it is normally strong and easily palpable at these locations. Therefore, if the pulse feels of normal strength, describe it as being strong. Describe a stronger than normal pulse as "bounding" and a pulse that is weak and difficult to feel as "weak" or "thready." With a little experience, you will be able to easily make the necessary distinctions.

Pulse Rhythm. When you are assessing the pulse, you must also determine whether the rhythm is regular or irregular. Regardless of the rate, the interval between each contraction should be the same, and the pulse should occur at a constant, regular rhythm. Document this rhythm as regular.

The rhythm is considered irregular if the heart periodically has an early or late beat or if a pulse beat is missed. If an irregular pulse is found in a patient with signs and symptoms that suggest a cardiovascular problem, the patient likely needs advanced cardiac assessment and life support. Therefore, depending on your protocols, you should call for ALS backup, arrange for an intercept by paramedics, or initiate prompt transport to definitive care. As with any deviation from expected findings it is important to determine, if possible, if this irregular rhythm is new or if it represents either a normal or a chronic condition for the patient.

Blood Pressure. Adequate blood pressure is necessary to maintain proper circulation and perfusion of the vital organ cells. **Blood pressure** is the pressure of circulating blood against the walls of the arteries. A decrease in the blood pressure may indicate one of the following:

- Loss of blood or its fluid components
- Loss of vascular tone and sufficient arterial constriction to maintain the necessary pressure even without any actual fluid or blood loss
- A cardiac pumping problem

When any of these conditions occurs and results in a drop in circulation, the body's compensatory mechanisms are activated, resulting in an increased heart rate and constriction of the arteries. Normal blood pressure is maintained, and by decreasing the blood flow to the skin and extremities, available blood volume is temporarily redirected to the vital organs so that they remain adequately perfused. However, as shock progresses, and the body's defense mechanisms can no longer keep up, the blood pressure will fall. Decreased blood pressure is a late sign of shock and indicates that the patient is in the critical stage of decompensated shock. Any patient with a markedly low blood pressure has inadequate pressure to maintain proper perfusion of all of the vital organs and needs to have his or her blood pressure and perfusion restored immediately to a normal level.

When the blood pressure becomes elevated, the body's defenses act to reduce it. Some people have chronically high blood pressure from progressive narrowing of the arteries that occurs with age, and during an acute episode, their blood pressure may increase to even higher levels. Head injury or a number of other conditions may also cause blood pressure to rise to very high levels. Abnormally high blood pressure may result in a rupture or other critical damage in the arterial system.

Blood pressure contains two key separate components: systolic pressure and diastolic pressure. **Systolic pressure** is the increased pressure that is caused along the artery with each contraction (systole) of the ventricles and the pulse wave that it produces. **Diastolic pressure** is the residual pressure that remains in the arteries during the relaxing phase of the heart's cycle (diastole), when the left ventricle is at rest. Systolic pressure represents the maximum pressure to which the arteries are subjected, and diastolic pressure represents the minimum amount of pressure that is always present in the arteries.

Early blood pressure gauges contained a column of mercury and a linear scale that was graduated in millimeters. Even though different gauges are used today, the blood pressure is still measured in millimeters of mercury (mm Hg). Blood pressure is reported as a fraction in the form of systolic pressure over diastolic pressure. Therefore, if the patient's systolic pressure is 120 and the diastolic pressure is 78, you would record it as "BP 120/78 mm Hg." You would report the patient's blood pressure verbally as "BP is 120 over 78."

Avoid taking a blood pressure on an arm if the patient has an intravenous site or other medical device in place such as an indwelling catheter or dialysis fistula; has had a mastectomy on that side; or has an injury to that arm. You can ask the patient if any of these exist if they are not visible, for example, a mastectomy. If a patient has chronic renal failure and is undergoing dialysis, ask if the patient has a fistula or any other reason that you should not take a blood pressure using that arm.

A blood pressure cuff with gauge (sphygmomanometer) contains the following components **Figure 9-24**:

- A wide outer cuff designed to be fastened snugly around the entire arm or leg
- An inflatable wide bladder sewn into a portion of the cuff
- A ball-pump with a one-way valve that allows air to enter and a turn-valve that can be closed or, when opened, will allow air to be released at a controlled speed from the cuff
- A pressure gauge calibrated in millimeters of mercury, which indicates the pressure that exists in the cuff that is being applied against the underlying artery

Most agencies carry at least three sizes of blood pressure cuffs: thigh, adult, and pediatric **Figure 9-25**. A large adult cuff is also available. You must be sure to select the appropriately sized cuff. A cuff that is too small may result in falsely high readings; a cuff that is too large may result in falsely low readings. The normal size cuff is designed to wrap around the arm 1 to 1.5 times and take up two-thirds the length from the armpit to the crease in the elbow of most adults. Use a thigh cuff with patients who are obese or have exceptionally well-developed arm muscles or to take the blood pressure of the thigh in patients who have injuries in both arms. Use a small pediatric cuff with children and exceptionally small adults. Measure blood pressure in all patients older than 3 years.

Figure 9-24

A sphygmomanometer.

Figure 9-25 Three sizes of blood pressure cuffs: thigh, adult, and pediatric.

Auscultation is the most common means of measuring a patient's blood pressure. A blood pressure cuff is applied to a patient's upper arm, allowing for the compression of the brachial artery when inflated. This compression creates turbulence and arterial vibrations that make sounds that can be heard using a stethoscope. These sounds are known as Korotkoff sounds. As the cuff is released, the blood flow returns to the artery, and Korotkoff sounds will be heard, denoting the systolic pressure. The disappearance of Korotkoff sounds indicates the diastolic pressure reading.

Follow the steps in Skill Drill 9-3 to measure blood pressure by auscultation:

1. Follow standard precautions. Explain the procedure to the patient. Examine for a dialysis fistula, central lines, mastectomy, injury to the arm, or other reason to not use this arm to take a blood pressure. If any are present, use the other arm.
2. With the patient's arm exposed, extended, and with the palm up, place the appropriately sized cuff so that it lies across the upper arm and is located with its distal edge about 1 inch (2.5 cm) above the antecubital space (the crease at the inside of the patient's elbow). Make sure the center of the inflatable bladder, which is usually marked by an arrow on the cuff, lies over the brachial artery. Next, wrap the ends so that the cuff surrounds the upper arm snugly but not tightly. Secure the cuff with the Velcro, making sure to rub your hand over the entire area where the two sides of the Velcro are in contact Step 1.

YOU are the Provider — PART 5

Following the appropriate interventions, your patient's oxygenation and ventilation status have improved; however, he is still bradycardic, hypotensive, and unresponsive. Because there was no one at the scene to provide information regarding his medical history, you continue to treat him based on his signs and symptoms, perform a reassessment, and call in your radio report to the receiving facility.

Recording Time: 20 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	6 breaths/min (baseline); ventilations are being assisted

Pulse	38 beats/min; weak and regular
Skin	Pale and cool; cyanosis has resolved
Blood pressure	84/56 mm Hg
Spo_2	95% (with assisted ventilation)

You reassess the patient again just before arriving at the ED and note that his condition is unchanged. He is immediately evaluated by the staff physician, who determines that he has overdosed on numerous drugs—including narcotics. After further treatment in the ED, he was admitted to the intensive care unit for close observation.

9. What components of the SAMPLE history, if any, can you obtain when your patient is unresponsive? How would you obtain the information?

10. Why is reassessing your interventions so important?

3. Once the cuff has been properly secured around the upper arm, the arm should be held at about the same level as the heart. With your nondominant hand, palpate the brachial artery (in the antecubital fossa, the anterior aspect of the elbow) to determine where to place the stethoscope Step 2.
4. Place the bell (if one is present) of the stethoscope over the artery, and hold it firmly against the artery with the fingers of your nondominant hand. Hold the rubber ball-pump in the palm of your other hand and the turn-valve between your thumb and first finger Step 3.
5. Close the valve tightly, and pump the ball-pump until you no longer hear pulse sounds. Continue pumping to increase the cuff's pressure by an additional 30 mm Hg. Next, slowly turn the valve, opening it until air is steadily escaping from the cuff and you see the needle of the gauge slowly drop. Watch the gauge, and listen carefully. Note the patient's systolic pressure as the reading on the gauge at which the "taps" or "thumps" of the pulse waves can first be heard clearly. As the pressure in the cuff is progressively reduced, pulse sounds will continue for a time, then suddenly disappear. Note the patient's diastolic pressure as the reading on the gauge at which the sounds stopped Step 4.
6. As soon as the pulse sounds stop, open the valve, and release the remaining air quickly. Once you have finished measuring the blood pressure, document your findings and the time at which the blood pressure was taken. Blood pressure is most often measured by auscultation with the patient in a sitting or semisitting position. Be sure to note whether a different method or position was used. Occasionally, when a patient's blood pressure is very low, you will continue to hear pulse sounds from the reading at which they started all the way until the gauge has reached 0. When this occurs, you should record the diastolic pressure as "0" or "all the way down" to indicate that it was heard until the gauge read 0 Step 5.

Skill Drill 9-3 Obtaining Blood Pressure by Auscultation

Step 1

Follow standard precautions. Check for a dialysis fistula, central line, previous mastectomy, and injury to the arm. If any are present, use the brachial artery on the other arm. Apply the cuff snugly. The lower border of the cuff should be about 1 inch (2.5 cm) above the antecubital space.

Step 2

Support the exposed arm at the level of the heart. Palpate the brachial artery.

Step 3

Place the stethoscope over the brachial artery, and grasp the ball-pump and turn-valve.

Step 4

Close the valve, and pump to 30 mm Hg above the point at which you stop hearing pulse sounds. Note the systolic and diastolic pressures as you let air escape slowly.

Step 5

Open the valve, and quickly release remaining air.

Obtaining a patient's blood pressure accurately by auscultation may be difficult at times. Noisy environments, patient movement from tremors or seizures, external vibrations from the EMS vehicle, and excessive noises may produce sounds that mimic Korotkoff sounds and provide inaccurate readings. Other variables that may make obtaining an accurate blood pressure reading nearly impossible are uncooperative adults, infants and children, and patients who are hypotensive with poor perfusion. In these cases, measure blood pressure by palpation.

The palpation (feeling) method does not depend on your ability to hear sounds and should be used in these cases to obtain a patient's blood pressure. If possible, it is preferable that you first obtain a baseline auscultated blood pressure.

Follow the steps in **Skill Drill 9-4** to measure blood pressure by palpation:

1. Secure the appropriately sized cuff around the patient's upper arm in the manner previously described Step 1.
2. With your nondominant hand, palpate the patient's radial pulse on the same arm as the cuff Step 2. Once you have located it, do not move your fingertips until you have completed taking the blood pressure.
3. While holding the ball-pump in your other hand, close the turn-valve and slowly inflate the cuff until the pulse

disappears and then continue to inflate another 30 mm Hg Step 3. As the cuff inflates, you will no longer feel the pulse under your fingertips.

4. Open the turn-valve so that air slowly escapes from the cuff, and carefully observe the gauge Step 4. When you can again feel the radial pulse under your fingertips, note the reading on the gauge as the patient's systolic blood pressure. You will not be able to determine the diastolic pressure with this method.

5. Next, open the turn-valve further, and completely deflate the cuff Step 5. Document your findings, including the time, and note that the pressure was taken by palpation. On your patient care report, record the blood pressure as "120/P" and verbalize it as "120 palpated."

Normal Blood Pressure. Blood pressure levels vary with age and sex. Table 9-6 serves as a guideline for normal blood pressure ranges.

A patient has **hypotension** when the blood pressure is lower than the normal range and **hypertension** when the blood pressure is higher than the normal range.

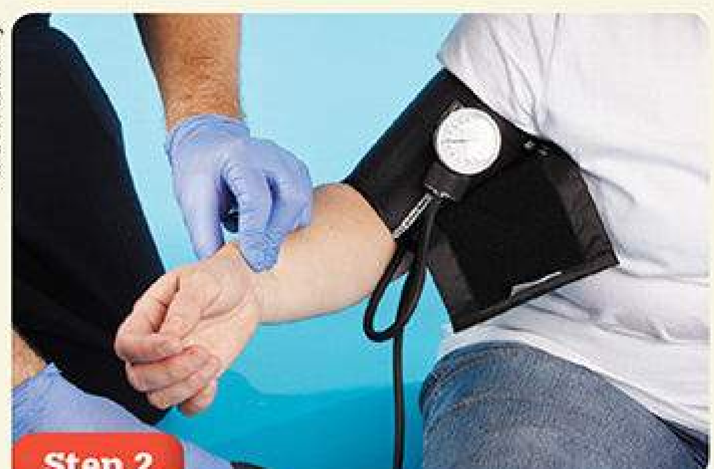
Typically, you will see children less frequently than adults; therefore, you might not remember the normal ranges for the various age groups. It is a good idea to carry a chart with you that lists normal blood pressure ranges and other vital signs. Remember, however, that blood pressure will vary somewhat with different patients and how they react to the environment around them. Often the most important information associated with the blood pressure is not the absolute value at any one point but the trend in the pressure over the course of time you are caring for a patient.

When assessing the patient's general circulation, the blood pressure, pulse, skin temperature, and capillary refill should not be assessed in an injured limb. However, once you have obtained these vital signs from an uninjured limb, you might want to compare the distal skin temperature, quality of the distal pulse, and/or capillary refill time in the injured limb with those found on the uninjured side. This information is useful in evaluating whether the injury may have compromised the circulation in the injured limb.

Skill Drill 9-4 Obtaining Blood Pressure by Palpation

Step 1

Follow standard precautions. Secure the appropriately sized cuff around the patient's upper arm.



Step 2

With your nondominant hand, palpate the patient's radial pulse on the same arm as the cuff. Once you have located it, do not move your fingertips until you have completed taking the blood pressure.

Step 3

While holding the ball-pump in your other hand, close the turn-valve and slowly inflate the cuff until the pulse disappears and then continue to inflate another 30 mm Hg. As the cuff inflates, you will no longer feel the pulse under your fingertips.

Step 4

Open the turn-valve so that air slowly escapes from the cuff, and carefully observe the gauge. When you can again feel the radial pulse under your fingertips, note the reading on the gauge as the patient's systolic blood pressure.

Step 5

Next, open the turn-valve further, and completely deflate the cuff. Document your findings, including the time, and note that the pressure was taken by palpation.

Neurologic System

Assessment of a patient's neurologic system can be very time consuming and detailed. A neurologic assessment should be performed any time you are confronted with a patient who has changes in mental status, a possible head injury, stupor, dizziness, drowsiness, or syncope. A neurologic assessment begins before you even touch the patient. It can be as simple as talking with the patient, asking questions, and receiving an appropriate reply from the patient during the primary assessment.

Evaluate the level of consciousness and orientation to determine the patient's ability to think. Use the AVPU scale if appropriate to determine the patient's mental status. Is the patient alert, oriented to person, place, time, and events? Is the patient responsive or unresponsive? Does the patient respond to verbal and painful stimuli? If the patient is responsive, evaluate speech for clarity, speed, organization, and logic. What is the patient's activity level? What are the patient's mood and thought content? What do the patient's facial expressions tell you? Is the patient angry, fearful, depressed, anxious, or restless? Does the patient appear uncomfortable? Does the patient make incomprehensible or understandable statements? Is the patient's memory affected? What is the patient's perception or view on what is happening? These are all important considerations when beginning to assess the neurologic system.

Use of the Glasgow Coma Scale (GCS) score can be helpful in providing additional information on patients with changes in mental status. The GCS (discussed further in Chapter 17, *Neurologic Emergencies*) uses parameters that test a patient's eye opening, best verbal response, and best motor response. The scale provides a numeric score that is associated with the relative severity of a patient's brain dysfunction Table 9-7. This information provides baseline data on the patient's overall neurologic status and can be used to help determine if that status is changing for better or worse. A modified GCS is used for children and infants, who respond differently from adults. When you are reporting the GCS score, document or report each section (eg, Eye opening: 3, Verbal response: 4, Motor response: 5 = GCS score of 12) to describe baseline function in each area.

Table 9-6 Normal Range for Blood Pressure

Age	Range, mm Hg
Adults	90 to 130 (systolic)
Adolescent (15 years)	110 to 131 (systolic)
Child (7 years)	96 to 115 (systolic)
Child (2 years)	88 to 106 (systolic)
Infant (1 year)	85 to 104 (systolic)
Neonate	60 to 84 (systolic)

Data Adapted From: Pediatric Advanced Life Support, 2012, the American Heart Association.

Table 9-7 Glasgow Coma Scale

Eye Opening		Best Verbal Response		Best Motor Response	
Spontaneous	4	Oriented conversation	5	Obeys commands	6
In response to speech	3	Confused conversation	4	Localizes pain	5
In response to pain	2	Inappropriate words	3	Withdraws to pain	4
None	1	Incomprehensible sounds	2	Abnormal flexion	3
		None	1	Abnormal extension	2
				None	1

Score: 13-15 may indicate mild dysfunction, although 15 is the score a person without neurologic impairment would receive.

Score: 9-12 may indicate moderate dysfunction.

Score: 8 or less is indicative of severe dysfunction.

Pupils

The pupil is the black center portion of the eye. The pupils are normally round, of approximately equal size, and adjust their size depending on the available light. The diameter and reactivity to light of the patient's pupils can reflect the status of the brain's perfusion, oxygenation, and condition. In normal room light, the pupil should appear to be about midsize. With less light, the pupils dilate to allow more light to enter the eye. When a bright light is shined near the eye, the pupils constrict **Figure 9-26A**. When a brighter light is introduced into one eye, both pupils should constrict equally to the appropriate size for the pupil receiving the most light.

In the absence of light, the pupils will become fully relaxed and dilated **Figure 9-26B**. When light is introduced, each eye sends sensory signals to the brain indicating the level of light it is receiving. Pupil size is regulated by a series of continuous motor commands that the brain automatically sends through the oculomotor nerves to each eye, causing both pupils to constrict to the same appropriate size. Normally, pupil size changes instantly with any change in light level.

Some patients normally have pupils that do not react properly to changes in light as a result of eye surgery or other conditions. A small number of patients exhibit normally unequal pupils (anisocoria) **Figure 9-26C**. If the patient or family member cannot confirm the presence of these conditions, you should presume that abnormal pupillary response indicates altered brain function as a result of central nervous system depression or injury. Specifically, evaluate if the pupils react in any of the following ways:

- Become fixed (either dilated or constricted) with no reaction to changes in light
- Dilate with introduction of a bright light and constrict when the light is removed
- React sluggishly instead of briskly
- Become unequal in size
- Become unequal in size when a bright light is introduced into or removed from one eye

Some of the causes of depressed brain function include the following:

- Injury of the brain or brain stem
- Trauma or stroke
- Brain tumor
- Inadequate oxygenation or perfusion
- Drugs or toxins (central nervous system depressants)

The mnemonic PEARRL is a useful guide in assessing the pupils. The letters stand for the following:

P Pupils
E Equal
A And
R Round
R Regular in size
L React to Light

For patients with normal pupils, you can report “Pupils are Equal And Round, Regular in size, and react properly to Light” or “Pupils = PEARRL.” Describe any abnormal findings using the longer form, such as “Pupils are equal and round, the left pupil is fixed and dilated, the right pupil is regular in size and reacts to light.”

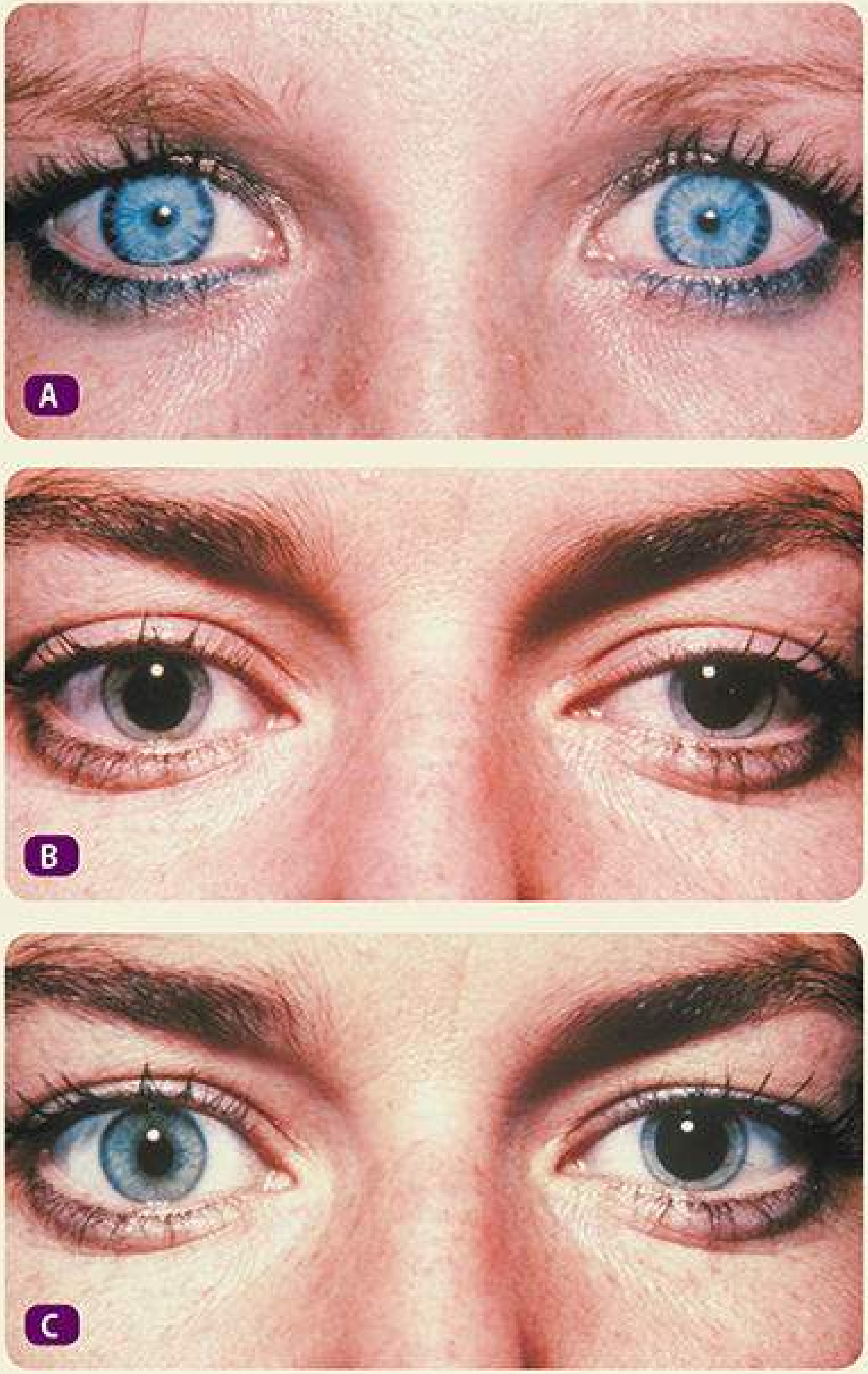


Figure 9-26 **A.** Constricted pupils. **B.** Dilated pupils. **C.** Unequal pupils.

Now perform a hands-on assessment to determine sensory and motor response. How does the patient move? Check for bilateral muscle strength and weaknesses. Complete a thorough sensory assessment. Test for pain, sensations, and position, and compare distal and proximal sensory and motor responses and one side with the other. Remember that a physical examination that deals with a specific chief complaint can be streamlined to assess a specific area of concern.

To assess neurovascular status in a conscious patient, follow the steps in **Skill Drill 9-5**:

1. **Pulse.** Palpate the pulse distal to the point of injury. First, palpate the radial pulse in the upper extremity Step 1. Second, in the lower extremity, palpate the posterior tibial and dorsalis pedis pulses Step 2.
2. **Capillary refill.** Note and record the skin color, identifying any pallor or cyanosis. Then apply firm pressure to the tip of the fingernail or toenail, which will cause the skin to blanch (turn white). If normal color does not return within 2 seconds after you release the nail, you can assume that circulation is impaired. This test is typically recommended for use in children, although it can be used in adults also Step 3.
3. **Sensation.** In the hand, check the feeling on the flesh near the tip of the index finger and thumb, as well as the little finger Step 4. In the foot, check the sensation on the flesh of the big toe Step 5 and on the lateral side of the foot Step 6. The patient's ability to sense light touch in the fingers or toes distal to the site of a fracture is a good indication that the nerve supply is intact.
4. **Motor function.** Evaluate muscular activity when the injury is proximal to the patient's hand or foot. Ask the patient to open and close a fist for an upper extremity injury and to wiggle the toes and move the foot up and down for a lower extremity injury. Sometimes, an attempt at motion will produce pain at the injury site. If this happens, do not continue this part of the examination. To avoid causing pain, do not perform this test at all if the injury involves the hand or foot itself Steps 7 through 10.

Because many of the steps require patient cooperation, you will not be able to assess sensory and motor functions in an unconscious patient.

Anatomic Regions

Head, Neck, and Cervical Spine. Inspect for abnormalities of the head, neck, and cervical spine. Gently palpate the scalp and skull for any pain, deformity, tenderness, crepitus, and bleeding **Figure 9-27**. Ask a responsive patient if he or she feels any pain or tenderness. Look at the patient's face. Is it symmetrical? Is there evidence of trauma, such as ecchymoses or hematomas? Does the patient have any facial expressions such as a smile or grimace? Check the patient's eyes, and assess pupillary function, shape, and response. Are the pupils equal in size and reactive to light, or are they constricted, dilated, or unequal? Check the color of the sclera. Assess the patient's cheek bones (zygomas) for possible injury. Check the patient's ears and nose for fluid. Next, before opening the patient's mouth, check the upper (maxillae) and lower (mandible) jaw. Once the patient's jaws have been assessed and it has been determined that movement will not create any additional pain or injury, open the patient's mouth, looking for any broken or missing teeth. If blood and secretions have impaired the airway, this should have been corrected during the primary assessment. Before moving on to the neck, note any unusual odors that may be present in the patient's mouth. This may give an indication of what type of emergency you may be dealing with.

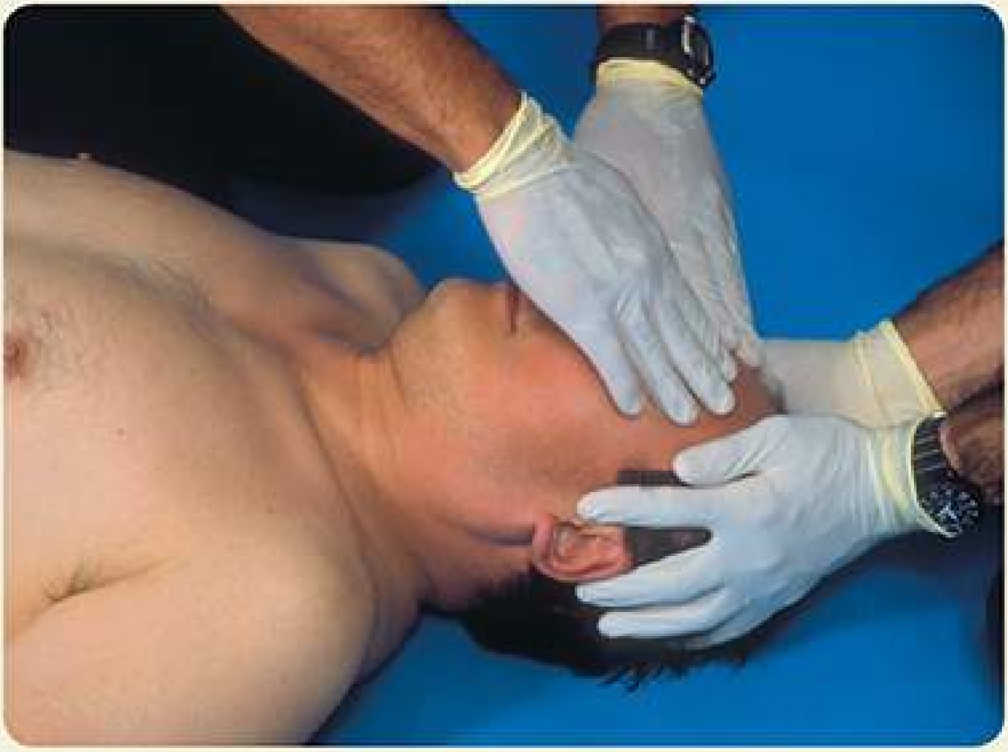


Figure 9-27 Gently palpate the head for any pain, deformity, tenderness, crepitus, and bleeding.

Skill Drill 9-5 Assessing Neurovascular Status

Step 1

Palpate the radial pulse in the upper extremity.

Step 2

Palpate the posterior tibial and dorsalis pedis pulses in the lower extremity.

Step 3

Assess capillary refill by blanching a fingernail or toenail.

Step 4

Assess sensation on the flesh near the tip of the index finger and thumb, as well as the little finger.

Step 5

On the foot, first check sensation on the flesh near the tip of the big toe.

Step 6

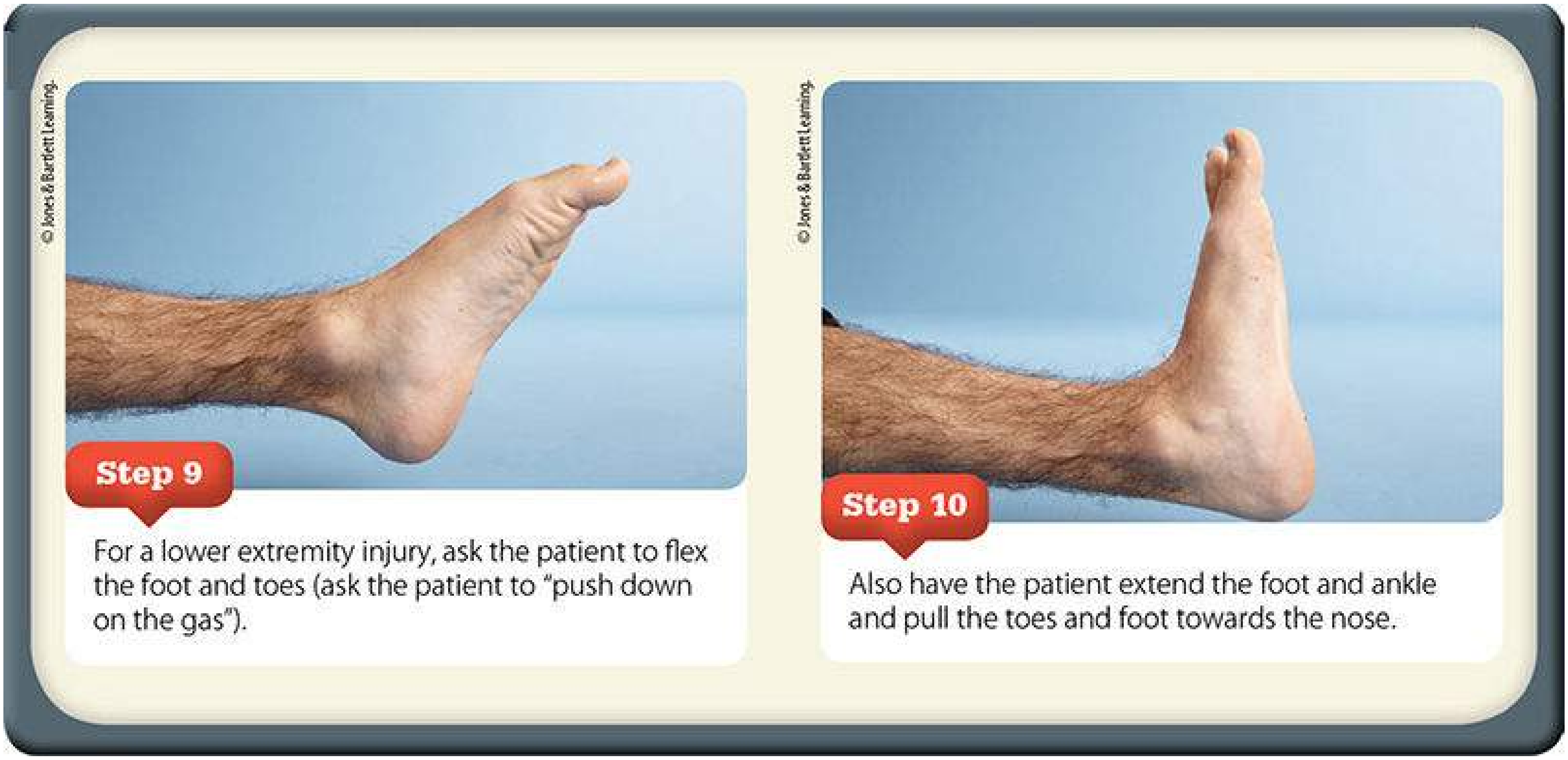
Also check sensation on the side of the foot.

Step 7

For an upper extremity injury, evaluate motor function by asking the patient to open the hand. (Perform motor tests only if the hand or foot is not injured. Stop a test if it causes pain.)

Step 8

Also ask the patient to make a fist.



Next, check the neck for signs of swelling or bleeding. Palpate the neck for signs of trauma, such as deformities, bumps, swelling, bruising, and bleeding, as well as a crackling sound produced by air bubbles under the skin, also known as **subcutaneous emphysema** **Figure 9-28**. Also, in patients in whom spinal injury is not suspected, inspect for pronounced or distended jugular veins with the patient sitting at a 45-degree angle. This is a normal finding in a person who is lying down; however, jugular venous distention in a patient who is sitting up suggests a problem with blood returning to the heart. Report and record your findings carefully.

Figure 9-28 Gently palpate the neck.

Chest. When assessing the chest, inspect, visualize, and palpate over the chest area for injury and signs of trauma, including bruising, tenderness, and swelling **Figure 9-29**.

Figure 9-29 Inspect, visualize, and palpate over the chest area for injury and signs of trauma.

When assessing breathing, watch for both sides of the chest to rise and fall together with normal breathing. Observe for abnormal breathing signs, including retractions or **paradoxical motion** (when only one section of the chest rises on inspiration while another area of the chest falls).

Retractions indicate the patient has some condition, usually medical, that is impairing the flow of air into and out of the lungs. Paradoxical motion is associated with a fracture of several ribs (flail), causing a section of the chest to move independently from the rest of the chest wall. Feel for grating of the bones as the patient breathes. Crepitus is often associated with rib fractures. Palpate the chest for subcutaneous emphysema, especially in cases of severe blunt chest trauma, as this could indicate a pneumothorax.

If the patient reports difficulty breathing or has evidence of trauma to the chest, auscultate breath sounds. This helps you to evaluate air movement in and out of the lungs. To auscultate, you need a stethoscope. The position of the patient will determine the way you proceed to check for breathing.

The goal is to hear and document the presence or absence of breath sounds. It is important to compare one side with the other. If you believe the patient's breathing is abnormal, reassess breathing and, if appropriate, assist with ventilations.

Abdomen. Look for trauma to the abdomen and for distention. Palpate the abdomen for tenderness, rigidity, and patient **guarding** Figure 9-30. As you palpate the abdomen, use "firm," "soft," "tender," or "distended" (swollen) to report your findings. If the patient is awake and alert, ask about pain as you perform the examination. The abdomen is divided into four quadrants: left upper quadrant (LUQ), left lower quadrant (LLQ), right upper quadrant (RUQ), and right lower quadrant (RLQ). Always start the palpation of the abdomen in the quadrant that is farthest from the patient's pain. Do not palpate obvious soft-tissue injuries, and be careful not to palpate too firmly. Assess for the presence of rebound tenderness, which is pain created when pressure is released.

Figure 9-30 Palpate the abdomen, evaluating for tenderness and bleeding.

Pelvis. Inspect the pelvis for symmetry and any obvious signs of injury, bleeding, and deformity **Figure 9-31**. If the patient reports no pain, gently press downward and inward on the pelvic bones. Do not rock the pelvis; this action may result in exacerbation of damage to any unstable bones. If you feel any movement or crepitus or the patient reports pain or tenderness, severe injury may be present. Injuries to the pelvis and surrounding abdomen may bleed profusely without any obvious external signs, so continue to monitor the patient's mental status, skin condition, and vital signs.

Extremities. An assessment of the patient's musculoskeletal system typically is done because of a chief complaint associated with some type of trauma. Do all extremities appear to be properly positioned, and do all extremities appear to be functioning normally? Assess for posture if standing, and look at joints, checking for range of motion. This should be done by asking the patient how much he or she can move the extremity or joint. Never force a painful joint to move. Always compare the right side with the left side, looking for weakness or atrophy, and assess equality of grip strength.

Figure 9-31 Inspect the pelvis for any obvious signs of injury, bleeding, and deformity.

Inspect each extremity for symmetry, cuts, bruises, swelling, obvious injuries, and bleeding **Figure 9-32**. Also palpate along each extremity for deformities. Ask the patient about any tenderness or pain. As you evaluate the extremities, check for pulses, motor function, and sensory function:

- **Pulse.** Check the distal pulses on the foot (dorsalis pedis or posterior tibial) **Figures 9-33** and **Figures 9-34** and wrist. Assess the pulses in the lower extremities for rate, quality, and rhythm. Is the pulse fast, slow, or irregular? Is the pulse weak, thready, or bounding? Also check circulation. Evaluate the skin color and temperature in the hands and feet. Is it normal? How does it compare with the skin color and temperature of the other extremities? Pale or cyanotic skin may indicate poor circulation in that extremity.
- **Motor function.** Ask the patient to wiggle his or her fingers and toes. An inability to move a single extremity can be the result of a bone, muscle, or nerve injury. An inability to move several extremities may be a sign of a brain abnormality or spinal cord injury. Verify that you are maintaining spinal immobilization if indicated.
- **Sensory function.** Evaluate sensory function in the extremity by asking the patient to close his or her eyes. Gently squeeze or pinch a finger or toe, and ask the patient to identify what you are doing. The inability to feel sensation in the extremity may indicate a local nerve injury. The inability to feel in several extremities may be a sign of a spinal cord injury. Ensure that you are maintaining spinal immobilization.

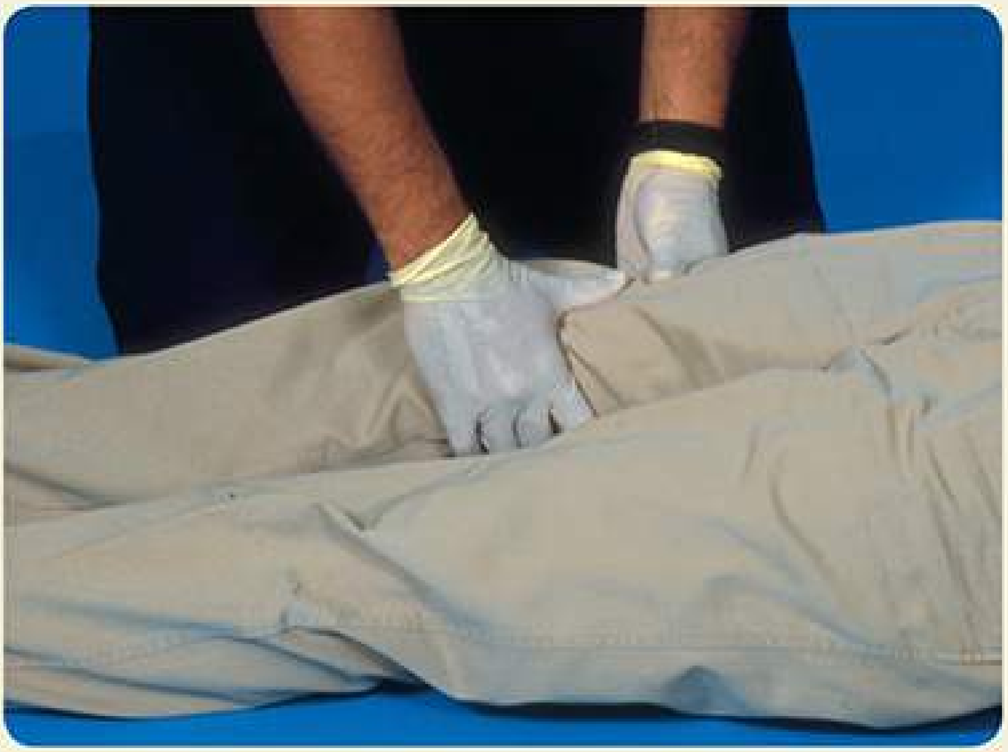


Figure 9-32 Inspect each extremity for cuts, bruises, swelling, obvious injuries, and bleeding.

Figure 9-33 Palpation of the posterior tibial pulse.

Posterior Body. Inspect the back for DCAP-BTLS, symmetry, and open wounds **Figure 9-35**. Carefully palpate the spine from the neck to the pelvis for tenderness and deformity.

Assess Vital Signs Using the Appropriate Monitoring Device

The use of monitoring equipment in the prehospital setting has continued to expand. EMTs at all levels use a wide variety of devices in the continuous monitoring of patients. It is important to remember that these devices are manufactured and subject to limitations and failures. These devices should never be used to replace your comprehensive assessment of your patient; think of these devices as simply adjuncts to the assessment and treatment of your patient. Obtaining and using information from patient monitoring devices includes, but is not limited to, data from pulse oximetry and noninvasive blood pressure monitoring.

Figure 9-34 Palpation of the dorsalis pedis pulse.

Pulse Oximetry

Pulse oximetry is an assessment tool used to evaluate the effectiveness of oxygenation. The pulse oximeter is a photoelectric device that monitors the oxygen saturation of hemoglobin (the iron-containing portion of the red blood cell to which oxygen attaches) in the capillary beds Figure 9-36. The parts that make up the pulse oximeter include a monitor and a sensing probe. The sensing probe clips onto a finger or ear lobe. The light source must have unobstructed access to a capillary bed, so dark fingernail polish might need to be removed. Results appear as a percentage on the display screen. Normally, pulse oximetry values in ambient air will vary depending on the altitude, with the majority of values falling between 95% and 99%.

The goal of applying oxygen therapy is to increase oxygen saturation to a normal level. This device is a useful assessment tool to determine the effectiveness of oxygen therapy, bronchodilator therapy, and artificial ventilations. However, the pulse oximeter does not take the place of good assessment skills and should not prevent the application of oxygen to any patient who reports difficulty breathing regardless of the pulse oximetry value seen on the monitor.

Because the device functions properly only with adequate perfusion and numbers of red blood cells, any situation that causes vasoconstriction (such as hypothermia or shock) or loss of red blood cells (such as bleeding or anemia) will result in inaccurate or misleading values. The device also presumes that oxygen is saturating the hemoglobin. Therefore, any chemical that displaces oxygen (such as carbon monoxide) may also cause misleading values.

Figure 9-35 Feel the back for tenderness, deformity, and open wounds. Carefully palpate the spine from the neck to the pelvis for tenderness and deformity. Look under the clothing for obvious injuries, including bruising and bleeding.

Figure 9-36 The pulse oximeter is a device that measures the saturation of oxygen in the blood as a percentage.

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The pulse oximeter is a useful tool as long as you remember that the device is only a tool, not a substitute for a good assessment.

Capnography

Metabolism refers to the chemical reactions that occur in the body or cells to maintain life. To get an idea about the patient's metabolism, you can measure carbon dioxide (CO_2) levels in the air that the patient exhales. Pulse oximetry can measure the amount of oxygen available to the patient's cells for cellular metabolism, but it does not measure how much of that oxygen is being used. **Carbon dioxide** is the by-product of aerobic cellular metabolism and reflects the amount of oxygen being consumed during the process. Think of the oxygen as helping to burn the fuel in metabolism, and the carbon dioxide is the exhaust. You can learn a great deal by measuring this "exhaust" from a patient.

When you are working with ALS providers, there will be times when they may employ certain techniques to measure the amount of carbon dioxide in exhaled air to help understand the degree to which a patient is adequately perfused and ventilated. For example, **capnography** is a noninvasive method that can quickly and efficiently provide information on a patient's ventilation, circulation, and metabolism. Waveform capnography shows a graph that indicates how easily, how frequently, and how much the patient is exhaling carbon dioxide **Figure 9-37**.

Blood Glucometry

Measuring the blood glucose level of a patient who has altered mental status can prove invaluable. Blood glucometry measures the level of glucose in the patient's bloodstream. If the glucose level is low, this can help you identify the reason a patient is unresponsive. If the level is high in a patient with nausea, vomiting, abdominal pain, and a change in mental status, it may signal dangerous complications of high blood glucose.

Blood glucose should be assessed in all known diabetic patients, all patients who are unresponsive for unknown reasons, and patients with generalized malaise or weakness. In addition, a blood glucose level can be assessed on any patient whom you feel has a poor general impression.

Figure 9-37 This device is capable of monitoring multiple functions simultaneously, including continuous capnography (bottom tracing).

The LIFEPAK 15 defibrillator monitor courtesy of Physio-Control. Used with permission of Physio-Control, Inc., and according to the Material Release Form provided by Physio-Control.

To obtain a blood glucose measurement, you will need to use a lancet needle to obtain a drop of blood. Follow the steps in **Skill Drill 9-6** to assess blood glucose level:

1. Take standard precautions. Cleanse the site (finger) with antiseptic Step 1.
2. Puncture the site with the lancet needle Step 2.
3. Immediately dispose of the needle in a sharps container Step 3.
4. Obtain a drop of blood on the test strip. Insert the test strip into the glucometer and activate the device per manufacturer's instructions Step 4.
5. When finished, place a bandage over the puncture site Step 5.

Make sure you have prepped the site adequately and that the finger is clean. Do not squeeze, or "milk," the puncture site to obtain enough blood for the test strip. This process may cause changes in the blood that you obtain that result in an inaccurate reading on the meter.

Most newer glucometers take only a few seconds to give you a reading. Rapid does not always equal accurate. Glucometers should be calibrated on a regular basis to maintain accuracy. In addition, you should verify that the test strips match the glucometer you are using and that they have not expired.

Noninvasive Blood Pressure Measurement

Auscultation with a sphygmomanometer is the most common means of measuring a patient's blood pressure. Electronic measurement is another method of obtaining blood pressure readings on patients. An electronic device measures changes in pressure oscillations that occur during cuff inflation or deflation and are related to systolic, mean, and diastolic pressures. Several different types of electronic devices are used in the prehospital setting; the blood pressure cuff deflates differently in each device.

Standard noninvasive blood pressure monitoring, whether through a manual sphygmomanometer or through an electronic, automatic blood pressure cuff, is easy to use and does not involve any advanced or invasive procedures. However, these methods are prone to very inaccurate readings in moving vehicles, noisy environments, or if the cuff is not correctly sized or properly placed on the patient. When faced with readings that do not match the clinical presentation of the patient, obtain manual readings to confirm.

Skill Drill 9-6 Assessing Blood Glucose Level

Step 1

Take standard precautions. Cleanse the site (finger) with antiseptic.

Step 2

Puncture the site with the lancet needle.

Step 3

Dispose of the needle in a sharps container.

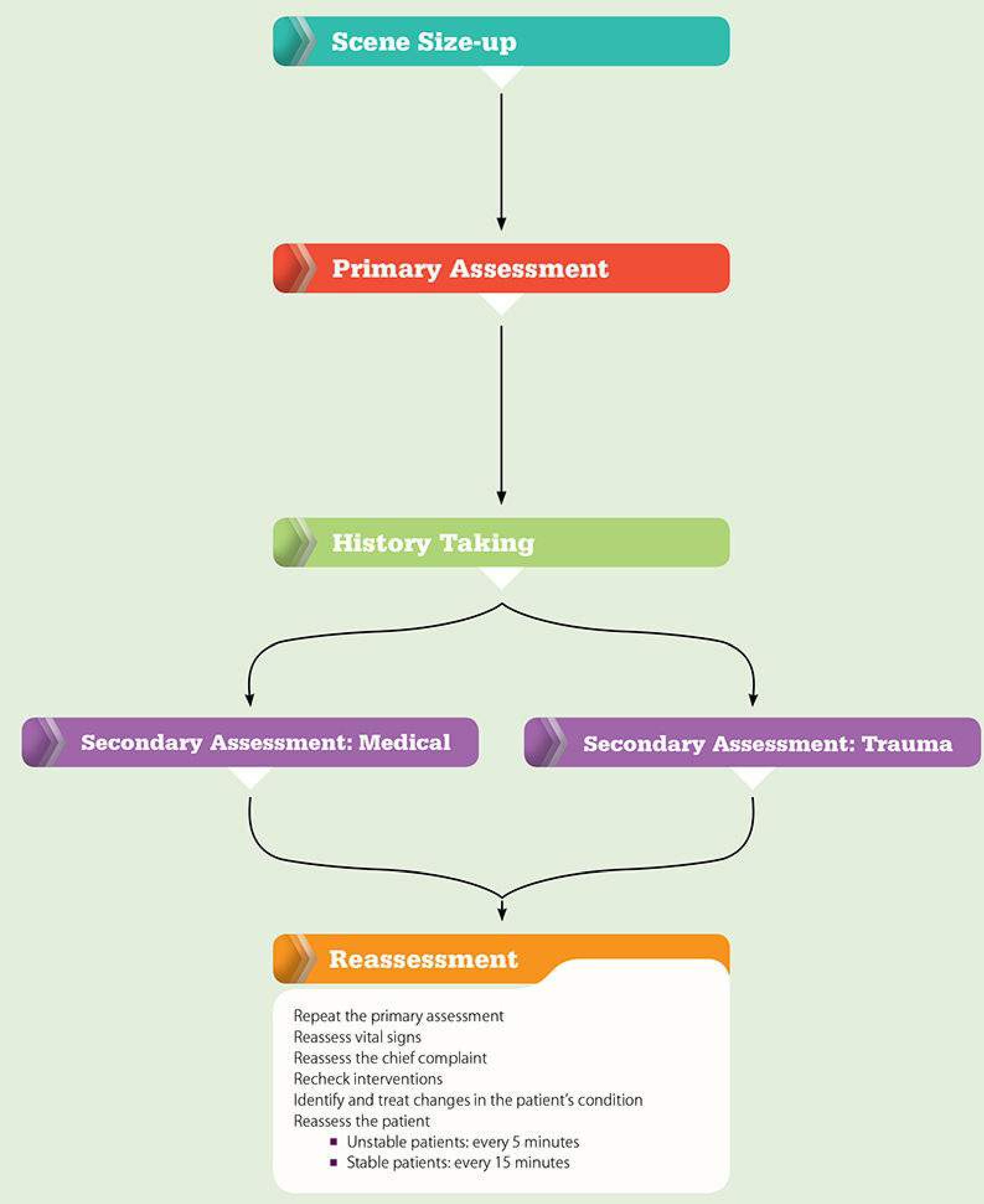
Step 4

Obtain a drop of blood on the test strip. Insert the test strip into the glucometer and activate the device per manufacturer's instructions.

Step 5

Place a bandage over the puncture site.

Patient Assessment



Reassessment

A reassessment is performed at regular intervals during the assessment process, and its purpose is to identify and treat changes in a patient's condition.

Words of Wisdom

Reassessment should take place:

- Every 5 minutes for patients in unstable condition
- Every 15 minutes for patients in stable condition

Repeat the Primary Assessment

The reassessment procedure is to simply repeat the primary assessment to identify and treat any life-threatening changes in the patient's condition.

Reassess Vital Signs

Reassess and record vital signs. Compare the baseline vital signs obtained during the primary assessment with any and all subsequent vital signs. Look for trends. Have they increased, declined, or stayed the same? If so, how fast? Reassess the mental status, airway, breathing, and circulation. Monitor skin color and temperature.

Reassess the Chief Complaint

With all emergency medical services, a reassessment must be completed to determine if the patient care plan is effective. The purpose is to ask and answer the following questions about the patient's chief complaint:

- Is the current treatment improving the patient's condition?
- Has an already identified problem gotten better?
- Has an already identified problem gotten worse?
- What is the nature of any newly identified problems?

Recheck Interventions

In the reassessment process, reevaluate everything that has been done to this point in the patient assessment process. Check all interventions. Most important are the patient's ABCs. In addition, are the bandages, spinal immobilization devices, extrication equipment, and patient securing instruments in place and appropriate for transport? Ensure management of bleeding. Ensure adequacy of other interventions, and consider the need for new interventions.

Identify and Treat Changes in the Patient's Condition

No matter what the patient's condition was prior to your arrival, which interventions were used, or which decisions on treatment and transport priorities were made, a reassessment is necessary to help monitor changes in the patient's condition. If the changes in the patient's condition are improved, simply continue whatever treatments you are providing. If the patient's condition deteriorates, prepare to modify treatments as appropriate. Document any changes, whether negative or positive.

Reassess Patient

How and when to perform a reassessment depends on the patient's condition. A patient in unstable condition should be reassessed approximately every 5 minutes, whereas a patient in stable condition should be reassessed approximately every 15 minutes.

YOU are the Provider — SUMMARY

1. What are the components of patient assessment?

There are five components in the assessment process: scene size-up, primary assessment, history taking, secondary assessment, and reassessment. Each component has an integral role in your overall treatment of the patient. The steps of assessment represent a logical approach to evaluation of a patient, but the order in which they are performed is determined by the patient's condition and the environment in which you are working.

2. Will your assessment of the patient differ if he is injured versus ill? If so, how?

The same components of patient assessment used to evaluate a medical patient are used to assess a trauma patient. The differences lie in what you find and how you treat it. For example, during the scene size-up of a trauma patient, you will evaluate the MOI to help focus your assessment of the type and severity of injuries your patient may have; you will also consider spinal immobilization. In medical patients, the NOI is assessed to help determine what category of medical condition you are dealing with (eg, cardiac, respiratory, endocrine), which will help guide your assessment in the appropriate direction.

Whether you are assessing a medical patient or a trauma patient, the key is to remain organized. Furthermore, you should assess the patient for medical conditions *and* injuries, especially if you suspect that the patient's injury was preceded by a medical condition.

3. Is spinal immobilization indicated? Why or why not?

Local protocols for spinal immobilization vary. Follow local protocols when making decisions about spinal immobilization. If you are unsure, err on the side of caution, and protect the patient's spine.

If you find that spinal immobilization is indicated, keep this in mind throughout your assessment process, modifying your assessment as appropriate to ensure that you are not unnecessarily risking additional spinal injury. Remember, however, that any life-threatening injuries must be addressed *immediately*, regardless of your suspicion of a possible spinal injury.

4. Which of these assessment findings requires your most immediate attention?

The patient's airway, which contains bloody secretions and vomitus, is in *immediate* jeopardy! Immediately use suction to clear his airway. Suction for up to 10 seconds, and then reassess his airway status. If you hear gurgling, think suction!

After ensuring that his airway is clear of secretions and vomitus, insert a simple airway adjunct—while keeping the airway open manually—to further help maintain airway patency. The airway adjunct you use depends on the patient's level of consciousness and the presence or absence of a gag reflex. The patient is responsive to pain; however, this does not always indicate an absent gag reflex. If there is no response to the test for painful stimulus, carefully insert an oropharyngeal airway, but be ready to quickly remove it if he begins to gag.

5. Does the patient require further treatment at the scene? If so, what?

At this point, you should continue to support his airway and breathing, monitor his circulatory status (ie, his pulse, which is slow), keep him warm, and be prepared to begin CPR and apply the AED. Apply spinal immobilization as directed by local protocol and prepare for immediate transport. Remember, there were no witnesses to this event; err on the side of caution and protect the patient's spine.

6. Should you remain at the scene and wait for the paramedic unit? Why or why not?

No, do not remain at the scene! Eighteen minutes is too long to remain at the scene with a patient in unstable condition, not to mention one who still needs to be moved from a second floor apartment. You should advise the paramedic ambulance of the situation, but do so while you are preparing for immediate transport. The longer you remain at the scene, the greater the chance that the patient's condition will further deteriorate.

If the paramedic ambulance arrives before you depart the scene, it would clearly be prudent to transfer care to them.

Consider an intercept with the paramedic unit at a designated location. Your EMS system protocols should have a plan for coordinating a paramedic intercept when transporting a patient in unstable condition or a patient who requires care that is beyond your level of training.

7. How has your patient's condition changed from the previous assessments?

Your patient's condition has obviously deteriorated. Compared with earlier assessments, which revealed that he was responsive to pain, he is now unconscious and unresponsive. Furthermore, his oxygen saturation is declining despite assisted ventilation with high-flow oxygen, and cyanosis is developing around his mouth (perioral/circumoral cyanosis).

His heart rate and blood pressure—although still unstable—are essentially unchanged compared with previous assessments. However, they must still be closely monitored for further deterioration.

The findings of your reassessment (eg, unresponsive, low Spo_2 level, cyanosis) point to a problem with his oxygenation and ventilation status that may be caused by more than one factor. His head may not be properly positioned, the simple airway adjunct may need to be repositioned, his airway may be filling with blood or vomitus, or he is not being adequately ventilated.

8. What should you do in response to the patient's change in condition?

Deterioration of a patient's condition should immediately prompt you to repeat the primary assessment, which begins by reassessing airway, breathing, and circulation.

Make sure his head is correctly positioned. Look in his mouth for secretions, and remove them with suction if present. Reassess the position of the simple airway adjunct; is the nasal airway protruding from his nose? If an oral airway is in place, is it protruding from his mouth? Reassess the mask-to-face seal of the bag-valve mask (BVM); is it adequate, or is there air leaking in all directions? Are you ventilating at the appropriate rate (10 to 12 breaths/min in an adult) with the appropriate volume (each breath delivered over 1 second—just enough to cause visible chest rise)?

A rapid, yet careful reassessment of the ABCs will often reveal the cause of the patient's status change, thus allowing you to rapidly correct it.

9. What components of the SAMPLE history, if any, can you obtain when your patient is unresponsive? How would you obtain the information?

In the absence of any family members, caregivers, or bystanders who know the patient, it may not be possible to obtain a complete and accurate SAMPLE history; however, it may be possible to obtain certain components of the SAMPLE history. Obtaining this information relies on your good assessment skills and "thinking outside the box."

Signs and symptoms can be established by simply assessing the patient; although signs and symptoms alone will not tell you what the patient's underlying problem is, they will enable you to direct your initial treatment accordingly.

Look for a medical alert bracelet, a medical alert card, or medical information posted in the patient's home. Are there any prescription medication bottles present? Is there medical equipment present (eg, home oxygen, nebulizer) that indicates an underlying condition? Although an unresponsive patient cannot speak, you can learn something about his or her conditions based on the medications found at the scene.

10. Why is reassessing your interventions so important?

The main purpose of reassessing the interventions you have performed on a patient is to determine their effectiveness. If your intervention has been effective, you should see an improvement in the patient's condition. If your intervention has not been effective, the patient's condition will have remained unchanged or will have deteriorated. Intervention reassessment also enables you to determine if you need to make modifications to existing interventions, cease an intervention, or perform another intervention.

For example, if a conscious patient is receiving oxygen via a nonrebreathing mask, and your reassessment reveals that he is now unresponsive, you may need to ensure that the airway is clear of secretions, or modify the way you are oxygenating the patient.

The mere performance of an intervention does not mean that it will cause your patient's condition to improve, nor does it mean that it will not cause his or her condition to deteriorate. Reassess, reassess, reassess!

EMS Patient Care Report (PCR)

Date: 7-20-16	**Incident No.:** 010809	**Nature of Call:** Man down		**Location:** 1326 South Main St.	
Dispatched: 1815	**En Route:** 1816	**At Scene:** 1820	**Transport:** 1838	**At Hospital:** 1904	**In Service:** 1923

Patient Information

Age: 25 **Sex:** M **Weight (in kg [lb]):** 70 kg estimated (155 lb)	**Allergies:** Unknown **Medications:** Unknown **Past Medical History:** Unknown **Chief Complaint:** Unresponsive; unknown circumstances

Vital Signs

Time: 1825	**BP:** 76/58	**Pulse:** 42	**Respirations:** 8	**Spo_2:** 95%
Time: 1832	**BP:** 78/54	**Pulse:** 44	**Respirations:** 6	**Spo_2:** 88%
Time: 1840	**BP:** 84/56	**Pulse:** 38	**Respirations:** 6	**Spo_2:** 95%
Time: 1851	**BP:** 82/64	**Pulse:** 40	**Respirations:** 6	**Spo_2:** 96%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Suctioning, spinal precautions, blanket

Narrative

9-1-1 dispatch for a "man down." Law enforcement personnel responded and ensured the scene was secure prior to EMS arrival. On arrival at the scene, found the patient, a 25-year-old man, lying prone on the kitchen floor of his second-floor apartment. A neighbor was present but did not know what happened and has no knowledge of the patient's medical history. The patient was responsive to pain. Manually stabilized the patient's head, and rolled him to a supine position to provide immediate care. Opened his airway with the jaw-thrust maneuver, and noted bloody secretions and vomitus coming from his mouth. Immediately suctioned his oropharynx until clear of debris, and inserted a nasal airway. Assessment of his breathing revealed it to be slow and shallow; began assisting ventilations with a BVM attached to high-flow oxygen. Secondary assessment revealed no obvious signs of trauma, and law enforcement's search of the patient's apartment revealed no medical records, medication bottles, drug paraphernalia, or anything else suspicious. Unable to obtain SAMPLE history. Blood glucose level was assessed and read 108 mg/dL. A paramedic unit was available but was 18 minutes away from our location, so decision was made to continue treatment and begin immediate transport. Applied spinal immobilization, applied a blanket for warmth, moved the patient down a flight of stairs with the assistance of Engine Company 13, and loaded him into the ambulance. Began transport to hospital; EMT Jones from Engine Company 13 accompanied us with the patient to provide assistance. Reassessment revealed that the patient was now completely unresponsive, his oxygen saturation had declined, and cyanosis was developing around his mouth. EMS used suction to clear his oropharynx, inserted an oral airway, and continued to assist ventilations. Intervention reassessment revealed improvement in the patient's oxygenation status; however, he remained unresponsive, bradycardic, and hypotensive. Continued to assist patient's ventilations, and reassessed his condition approximately every 5 minutes as treatment would allow. Patient's condition remained unchanged throughout transport. Delivered him to the emergency department staff without incident, and gave verbal report to attending physician. Medic 80 returned to service at 1923.**End of report**

Prep Kit

Ready for Review

- The assessment process begins with the scene size-up, which identifies real or potential hazards. The patient should not be approached until these hazards have been dealt with in a way that eliminates or minimizes risk to the EMTs and the patient(s).
- The primary assessment is performed on all patients. It includes forming an initial general impression of the patient, including the level of consciousness, and identifies any life-threatening conditions to the ABCs. A primary assessment is performed to assist in prioritizing time and mode of transport. Any life threats identified must be treated before moving on to the next step of the assessment.
- Airway, breathing, and circulation are assessed to evaluate the patient's general condition.
- History taking includes an investigation of the patient's chief complaint or history of present illness. A SAMPLE history is generally taken during this step of the assessment process. This information may be obtained from the patient, family, friends, bystanders, caregivers, or medical alert devices or documentation.
- By using the SAMPLE mnemonic, you will be able to determine the patient's signs and symptoms, allergies, medications, pertinent past history, last oral intake, and events leading up to the illness or injury.
- The secondary assessment is a systematic physical examination of the patient. The secondary assessment may be a systematic head-to-toe physical examination or an assessment that focuses on a certain area or region of the body, often determined through the chief complaint. Circumstances will dictate which aspects of the physical examination will be used. The secondary assessment is performed on scene or, more often, in the back of the ambulance en route to the hospital. If the patient has serious life threats, you may not have time to perform a secondary assessment.
- The reassessment is performed on all patients. It gives you an opportunity to reevaluate the chief complaint and to reassess interventions to ensure that they are still being delivered correctly. Information from the reassessment may be used to identify and treat changes in the patient's condition.
- A patient in stable condition should be reassessed every 15 minutes, whereas a patient in unstable condition should be reassessed every 5 minutes.
- The assessment process is systematic and dynamic. Each assessment you perform will be slightly different, depending on the needs of the patient. The result will be a process that will enable you to quickly identify and treat the needs of all patients, both medical and trauma related, in a way that meets their unique needs.

Vital Vocabulary

accessory muscles The secondary muscles of respiration. They include the neck muscles (sternocleidomastoids), the chest pectoralis major muscles, and the abdominal muscles.

altered mental status Any deviation from alert and oriented to person, place, time, and event, or any deviation from a patient's normal baseline mental status.

auscultate To listen to sounds within an organ with a stethoscope.

AVPU scale A method of assessing the level of consciousness by determining whether the patient is awake and alert, responsive to verbal stimuli or pain, or unresponsive; used principally early in the assessment process.

blood pressure The pressure that the blood exerts against the walls of the arteries as it passes through them.

bradycardia A slow heart rate, less than 60 beats/ min.

breath sounds An indication of air movement in the lungs, usually assessed with a stethoscope.

capillary refill A test that evaluates distal circulatory system function by squeezing (blanching) blood from an area such as a nail bed and watching the speed of its return after releasing the pressure.

capnography A noninvasive method to quickly and efficiently provide information on a patient's ventilatory status, circulation, and metabolism; effectively measures the concentration of carbon dioxide in expired air over time.

carbon dioxide Carbon dioxide is a component of air and typically makes up 0.3% of air at sea level; also a waste product exhaled during expiration by the respiratory system.

chief complaint The reason a patient called for help; also, the patient's response to questions such as "What's wrong?" or "What happened?"

coagulate To form a clot to plug an opening in an injured blood vessel and stop bleeding.

conjunctiva The delicate membrane that lines the eyelids and covers the exposed surface of the eye.

crackles A crackling, rattling breath sound that signals fluid in the air spaces of the lungs.

crepitus A grating or grinding sensation caused by fractured bone ends or joints rubbing together; also air bubbles under the skin that produce a crackling sound or crinkly feeling.

cyanosis A blue-gray skin color that is caused by a reduced level of oxygen in the blood.

DCAP-BTLS A mnemonic for assessment in which each area of the body is evaluated for Deformities, Contusions, Abrasions, Punctures/penetrations, Burns, Tenderness, Lacerations, and Swelling.

diaphoretic Characterized by light or profuse sweating.

diastolic pressure The pressure that remains in the arteries during the relaxing phase of the heart's cycle (diastole) when the left ventricle is at rest.

distracting injury Any injury that prevents the patient from noticing other injuries he or she may have, even severe injuries; for example, a painful femur or tibia fracture that prevents the patient from noticing back pain associated with a spinal fracture.

focused assessment A type of physical assessment typically performed on patients who have sustained nonsignificant mechanisms of injury or on responsive medical patients. This type of examination is based on the chief complaint and focuses on one body system or part.

frostbite Damage to tissues as the result of exposure to cold; frozen or partially frozen body parts are frostbitten.

general impression The overall initial impression that determines the priority for patient care; based on the patient's surroundings, the mechanism of injury, signs and symptoms, and the chief complaint.

Golden Hour The time from injury to definitive care, during which treatment of shock and traumatic injuries should occur because survival potential is best; also called the Golden Period.

guarding Involuntary muscle contractions of the abdominal wall to minimize the pain of abdominal movement; a sign of peritonitis.

history taking A step within the patient assessment process that provides detail about the patient's chief complaint and an account of the patient's signs and symptoms.

hypertension Blood pressure that is higher than the normal range.

hypotension Blood pressure that is lower than the normal range.

hypothermia A condition in which the internal body temperature falls below 95°F (35°C) after exposure to a cold environment.

incident command system A system implemented to manage disasters and mass- and multiple-casualty incidents in which section chiefs, including finance, logistics, operations, and planning, report to the incident commander. Also referred to as the incident management system.

jaundice Yellow skin or sclera that is caused by liver disease or dysfunction.

labored breathing Breathing that requires greater than normal effort; may be slower or faster than normal and characterized by grunting, stridor, and use of accessory muscles.

mechanism of injury (MOI) The forces, or energy transmission, applied to the body that cause injury.

metabolism The biochemical processes that result in production of energy from nutrients within the cells.

nasal flaring Widening of the nostrils, indicating that there is an airway obstruction.

nature of illness (NOI) The general type of illness a patient is experiencing.

OPQRST A mnemonic used in evaluating a patient's pain: Onset, Provocation/palliation, Quality, Region/radiation, Severity, and Timing.

orientation The mental status of a patient as measured by memory of person (name), place (current location), time (current year, month, and approximate date), and event (what happened).

palpate To examine by touch.

paradoxical motion The motion of the portion of the chest wall that is detached in a flail chest; the motion—in during inhalation, out during exhalation—is exactly the opposite of normal chest wall motion during breathing.

perfusion The flow of blood through body tissues and vessels.

personal protective equipment (PPE) Protective equipment that blocks exposure to a pathogen or a hazardous material.

pertinent negatives Negative findings that warrant no care or intervention.

priapism A painful, tender, persistent erection of the penis; can result from spinal cord injury, erectile dysfunction drugs, or sickle cell disease.

primary assessment A step within the patient assessment process that identifies and initiates treatment of immediate and potential life threats.

pulse The pressure wave that occurs as each heartbeat causes a surge in the blood circulating through the arteries.

pulse oximetry An assessment tool that measures oxygen saturation of hemoglobin in the capillary beds.

reassessment A step within the patient assessment process performed at regular intervals during the assessment process to identify and treat changes in a patient's condition. A patient in unstable condition should be reassessed every 5 minutes, whereas a patient in stable condition should be reassessed every 15 minutes.

responsiveness The way in which a patient responds to external stimuli, including verbal stimuli (sound), tactile stimuli (touch), and painful stimuli.

retractions Movements in which the skin pulls in around the ribs during inspiration.

rhonchi Coarse, low-pitched breath sounds heard in patients with chronic mucus in the upper airways.

SAMPLE history A brief history of a patient's condition to determine signs and symptoms, allergies, medications, pertinent past history, last oral intake, and events leading to the injury or illness.

scene size-up A step within the patient assessment process that involves a quick assessment of the scene and the surroundings to provide information about scene safety and the mechanism of injury or nature of illness before you enter and begin patient care.

sclera The tough, fibrous, white portion of the eye that protects the more delicate inner structures.

secondary assessment A step within the patient assessment process in which a systematic physical examination of the patient is performed. The examination may be a systematic exam or an assessment that focuses on a certain area or region of the body, often determined through the chief complaint.

shallow respirations Respirations characterized by little movement of the chest wall (reduced tidal volume) or poor chest excursion.

sign Objective findings that can be seen, heard, felt, smelled, or measured.

situational awareness Knowledge and understanding of your surroundings and situation and the risk they potentially pose to your safety or the safety of the EMS team.

sniffing position An upright position in which the patient's head and chin are thrust slightly forward to keep the airway open.

spontaneous respirations Breathing that occurs without assistance.

standard precautions Protective measures that have traditionally been developed by the Centers for Disease Control and Prevention (CDC) for use in dealing with objects, blood, body fluids, and other potential exposure risks of communicable disease.

stridor A harsh, high-pitched, breath sound, generally heard during inspiration, that is caused by partial blockage or narrowing of the upper airway; may be audible without a stethoscope.

subcutaneous emphysema A characteristic crackling sensation felt on palpation of the skin, caused by the presence of air in soft tissues.

symptom Subjective findings that the patient feels but that can be identified only by the patient.

systolic pressure The increased pressure in an artery with each contraction of the ventricles (systole).

tachycardia A rapid heart rate, more than 100 beats/min.

tidal volume The amount of air (in milliliters) that is moved in or out of the lungs during one breath.

triage The process of establishing treatment and transportation priorities according to severity of injury and medical need.

tripod position An upright position in which the patient leans forward onto two arms stretched forward and thrusts the head and chin forward.

two- to three-word dyspnea A severe breathing problem in which a patient can speak only two to three words at a time without pausing to take a breath.

vasoconstriction Narrowing of a blood vessel.

vital signs The key signs that are used to evaluate the patient's overall condition, including respirations, pulse, blood pressure, level of consciousness, and skin characteristics.

wheezing A high-pitched, whistling breath sound that is most prominent on expiration, and which suggests an obstruction or narrowing of the lower airways; occurs in asthma and bronchiolitis.

Assessment *in Action*

You are dispatched to a motel for an unknown medical emergency. The room is small with two beds and two occupants. The patient is a 33-year-old woman lying supine on the bed. She opens her eyes when you speak to her but is lethargic and reports fever, chills, vomiting, and diarrhea. The man in the room tells you she has been sick for several days and has not eaten in the past 2 days. Your assessment reveals pain and tenderness in the right lower abdominal quadrant. Her vital signs are a blood pressure level of 100/60 mm Hg; a pulse rate of 140 beats/min, strong and bounding; and a respiratory rate of 24 breaths/min and shallow. Her skin is flushed and hot to the touch. The patient reports no significant medical history and does not take any medications.

1. What is the first concern when entering this room?

   A. ABCs
   B. Physical assessment
   C. Scene safety
   D. Vital signs

2. What is this patient responsive to?

   A. Verbal stimuli
   B. Painful stimuli
   C. Noxious stimuli
   D. Unresponsive

3. What is this patient's chief complaint?

   A. Lower right quadrant pain
   B. Fever and chills
   C. Dyspnea
   D. Palpitations

4. Which of the following terms would be used to describe the patient's pulse rate of 140 beats/min?

   A. Bradycardia
   B. Dyspnea
   C. Tachycardia
   D. Tachypnea

5. What is a pertinent negative?

   A. A negative finding that requires further care and/or intervention
   B. A negative finding that requires advanced life support
   C. A negative finding that implies another condition may be present
   D. A negative finding that requires no further care or intervention

6. What is a primary assessment?

   A. A systematic physical examination
   B. Physical examination performed at regular intervals
   C. A process that identifies life threats
   D. A process that identifies the nature of illness

7. How would you proceed if you found an unsafe condition on scene?

8. Describe an objective finding for the patient.

9. Describe a subjective finding for the patient.

10. How does the mnemonic SAMPLE assist you in assessing the patient?

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SECTION
3

Airway

10 Airway Management

CHAPTER
10

Airway Management

National EMS Education Standard Competencies

Airway Management, Respiration, and Artificial Ventilation

Applies knowledge of general anatomy and physiology to patient assessment and management in order to assure a patent airway, adequate mechanical ventilation, and respiration for patients of all ages.

Airway Management

› Airway anatomy (pp 388–392)
› Airway assessment (pp 400–405)
› Techniques of assuring a patent airway (pp 405–408)

Respiration

› Anatomy of the respiratory system (pp 388–392)
› Physiology and pathophysiology of respiration
- Pulmonary ventilation (pp 393–395)
- Oxygenation (pp 395–396)
- Respiration (pp 396–397)
  - External (p 396)
  - Internal (pp 396–397)
  - Cellular (pp 396–397)

› Assessment and management of adequate and inadequate ventilation (pp 402–405)
› Supplemental oxygen therapy (pp 416–425)

Artificial Ventilation

› Assessment and management of adequate and inadequate ventilation (pp 425–435)
› Artificial ventilation (pp 426–435)

› Minute ventilation (pp 393–394)
› Alveolar ventilation (pp 393–394)
› Effect of artificial ventilation on cardiac output (p 427)

Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Knowledge Objectives

1. Describe the major structures of the respiratory system. (pp 387–392)
2. Discuss the physiology of breathing. (pp 392–397)
3. Give the signs of adequate breathing. (p 400)
4. Give the signs of inadequate breathing. (p 401)
5. Describe the assessment and care of a patient with apnea. (p 402)
6. Explain how to assess for adequate and inadequate respiration, including the use of pulse oximetry. (pp 402–405)
7. Explain how to assess for a patent airway. (p 405)
8. Describe how to perform the head tilt–chin lift maneuver. (pp 405–406)
9. Describe how to perform the jaw-thrust maneuver. (pp 406–407)
10. Explain the importance of and techniques for suctioning. (pp 408–411)
11. Explain how to measure and insert an oropharyngeal (oral) airway. (pp 411–413)
12. Describe how to measure and insert a nasopharyngeal (nasal) airway. (pp 413–416)
13. Explain the use of the recovery position to maintain a clear airway. (p 416)
14. Describe the importance of giving supplemental oxygen to patients who are hypoxic. (p 416)
15. Discuss the basics of how oxygen is stored and the various hazards associated with its use. (pp 416–422)
16. Explain the use of a nonrebreathing mask and the oxygen flow requirements for its use. (p 423)
17. Describe the indications for using a nasal cannula rather than a nonrebreathing face mask. (p 423)
18. Describe the indications for using a humidifier during supplemental oxygen therapy. (p 425)
19. Describe how to perform mouth-to-mouth or mouth-to-mask ventilation. (pp 427–428)
20. Describe the use of a one- or two-person bag-valve mask (BVM) and a manually triggered ventilation (MTV) device. (pp 428–435)
21. Describe the signs associated with adequate and inadequate artificial ventilation. (p 434)
22. Describe the use of continuous positive airway pressure (CPAP). (pp 435–439)
23. Explain how to recognize and care for a foreign body airway obstruction. (pp 440–442)

Skills Objectives

1. Demonstrate use of pulse oximetry. (pp 403–404, Skill Drill 10-1)
2. Demonstrate how to position the unconscious patient. (pp 405–406, Skill Drill 10-2)
3. Demonstrate how to perform the head tilt–chin lift maneuver. (pp 405–406)
4. Demonstrate how to perform the jaw-thrust maneuver. (pp 406–407)
5. Demonstrate how to operate a suction unit. (p 410)
6. Demonstrate how to suction a patient’s airway. (pp 410–411, Skill Drill 10-3)
7. Demonstrate the insertion of an oral airway. (pp 411–413, Skill Drill 10-4)
8. Demonstrate the insertion of an oral airway with a 90-degree rotation. (pp 412–414, Skill Drill 10-5)
9. Demonstrate the insertion of a nasal airway. (pp 413–416, Skill Drill 10-6)
10. Demonstrate how to place a patient in the recovery position. (p 416)
11. Demonstrate how to place an oxygen cylinder into service. (pp 421–422, Skill Drill 10-7)
12. Demonstrate the use of a partial rebreathing mask in providing supplemental oxygen therapy to patients. (p 424)
13. Demonstrate the use of a Venturi mask in providing supplemental oxygen therapy to patients. (p 424)
14. Demonstrate the use of a humidifier in providing supplemental oxygen therapy to patients. (p 425)
15. Demonstrate mouth-to-mask ventilation. (pp 427–429, Skill Drill 10-8)
16. Demonstrate how to assist a patient with ventilations using the BVM. (pp 431–433, Skill Drill 10-9)
17. Demonstrate the use of a manually triggered ventilation device to assist in delivering artificial ventilation to the patient.

(pp 434–435)
18. Demonstrate the use of an automatic transport ventilator to assist in delivering artificial ventilation to the patient. (p 435)
s
19. Demonstrate the use of CPAP. (pp 435–439, Skill Drill 10-10)

Introduction

The single most important step in caring for patients is to make sure that life threats are addressed. A primary component of that is to ensure that patients can breathe adequately. When the ability to breathe is disrupted, oxygen delivery to the body tissues and cells is compromised. Cells require a constant supply of oxygen to survive. Within seconds of being deprived of oxygen, vital organs such as the heart and brain may not function normally. Therefore, it is imperative that you recognize airway and breathing inadequacies and correct them immediately. Brain tissue will begin to die within 4 to 6 minutes without oxygen.

Oxygen reaches body tissues and cells through two separate but related processes: breathing and circulation. During inhalation, oxygen moves from the atmosphere into the lungs, then crosses the alveolar membrane onto hemoglobin by a process called **diffusion**. Diffusion is a process in which molecules move from an area of higher concentration to an area of lower concentration. Next, red blood cells carry the hemoglobin, and therefore oxygen, through the body, ultimately delivering it to the capillaries to oxygenate the body's cells. At the same time, carbon dioxide, produced by cells in the tissues of the body, moves from the blood into the air sacs by diffusion. The blood, enriched with oxygen, travels through the body by the pumping action of the heart. The carbon dioxide then leaves the body during exhalation.

As an EMT, you must be able to locate the parts of the respiratory system, understand how the system works, and be able to recognize which patients are breathing adequately and which patients are breathing inadequately. This will enable you to determine how best to treat your patients.

This chapter reviews the anatomy, physiology, and pathophysiology of the respiratory system. It describes how to assess patients quickly and to carefully determine their airway and ventilation status. The equipment, procedures, and guidelines that you will need to manage a patient's airway and breathing are described in detail. You will learn several ways to open a patient's airway and specific techniques for removing foreign objects or fluids that may be blocking the airway. Because airway management equipment can be dangerous if used improperly, the chapter thoroughly discusses airway adjuncts, oxygen therapy devices, and artificial ventilation methods.

YOU are the Provider — PART 1

You and your partner are dispatched to a residence at 145 Landa Street for a man with trouble breathing. The patient's wife, who called 9-1-1, told the dispatcher that her husband is "breathing funny" and is not responding to her appropriately. The time is 1510 hours, the temperature outside is 39°F (4°C), and a fine mist is falling.

1. What is the function of the respiratory system?
2. What is the difference between ventilation and respiration?
3. How often should you assess a patient's airway and breathing status?

Anatomy of the Respiratory System

The respiratory system consists of all the structures in the body that make up the **airway** and help us breathe, or ventilate **Figure 10-1**. The airway is divided into the upper and lower airway. Structures that help us breathe include the diaphragm, the muscles of the chest wall, the accessory muscles of breathing, and the nerves from the brain and spinal cord to those muscles. Ventilation is the exchange of air between the lungs and environment. The diaphragm and muscles of the chest wall are responsible for the regular rise and fall of the chest that accompany normal breathing.

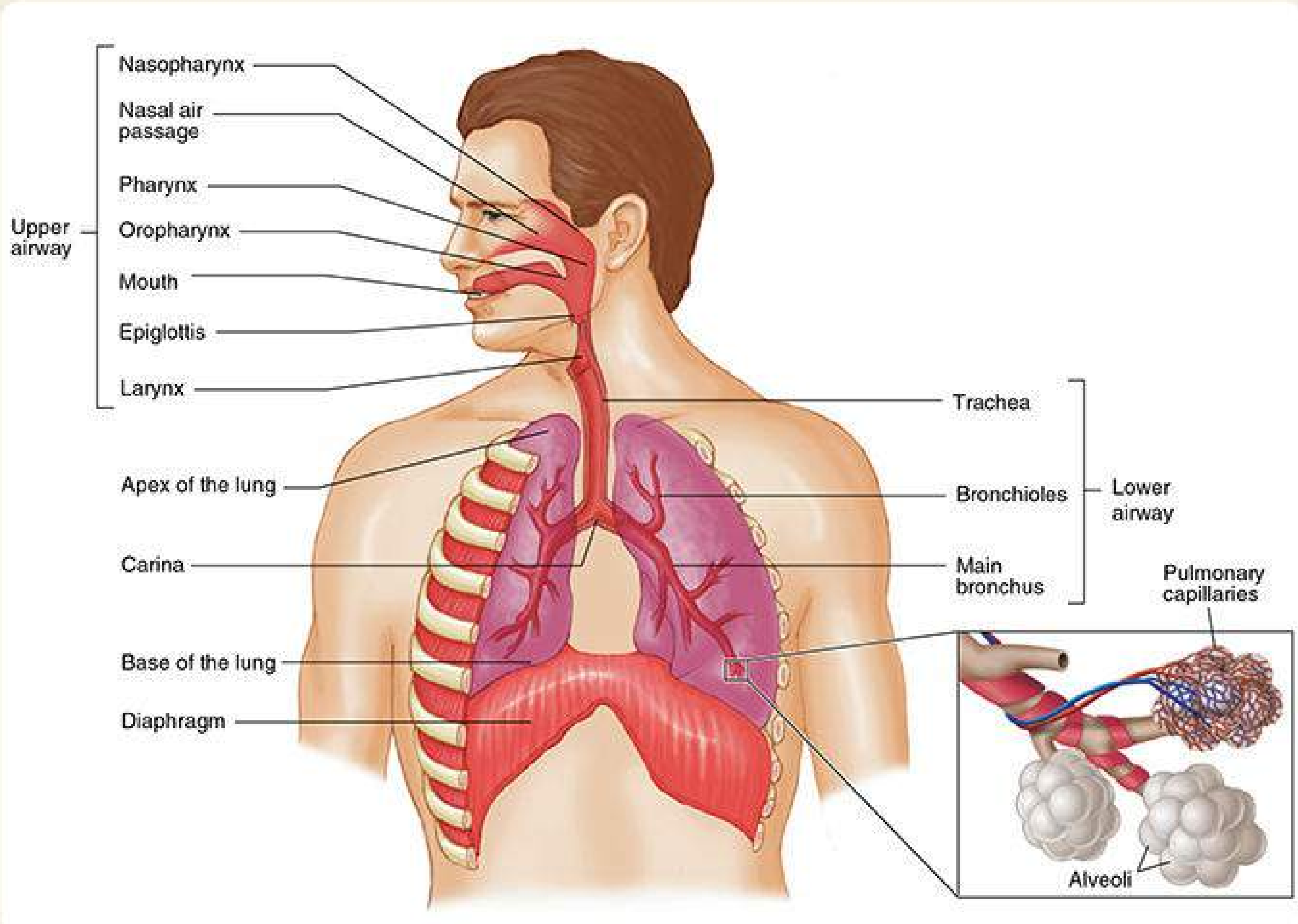

Figure 10-1 The upper and lower airways contain the structures in the body that help us breathe.

Anatomy of the Upper Airway

The upper airway consists of all anatomic airway structures above the level of the vocal cords. These include the nose, mouth, jaw, oral cavity, pharynx, and larynx. Its major functions are to warm, filter, and humidify air as it enters the body through the nose and mouth. The pharynx (throat) is a muscular tube that extends from the nose and mouth to the level of the esophagus and trachea. The pharynx is composed of the nasopharynx, oropharynx, and the laryngopharynx (also called the hypopharynx) **Figure 10-2**. The laryngopharynx is the lowest portion of the pharynx. At the base, it splits into two lumens, the larynx anteriorly and the esophagus posteriorly.

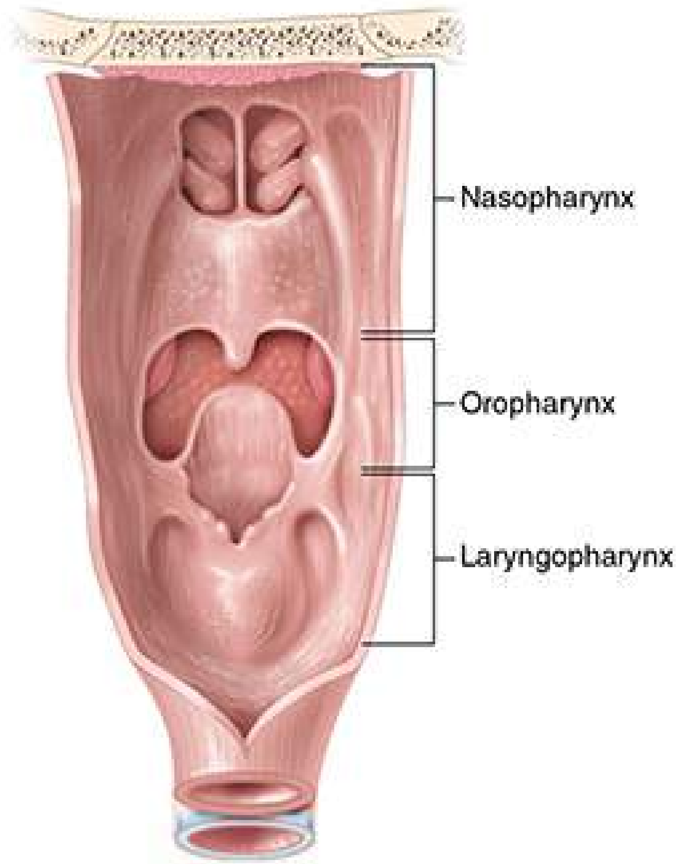

Figure 10-2 The pharynx.

Nasopharynx

During inhalation, air typically enters the body through the nose and passes into the **nasopharynx**. The nasopharynx is lined with a ciliated mucous membrane that keeps contaminants such as dust and other small particles out of the respiratory tract. In addition, the mucous membrane warms and humidifies air as it enters the body.

Oropharynx

The **oropharynx** forms the posterior portion of the oral cavity, which is bordered superiorly by the hard and soft palates, laterally by the cheeks, and inferiorly by the tongue **Figure 10-3**. Superior to the larynx, the epiglottis helps separate the digestive system from the respiratory system. Its function is to prevent food and liquid from entering the larynx during swallowing. When swallowing occurs, the larynx is elevated and the epiglottis folds over the glottis to prevent **aspiration** of contents into the trachea.

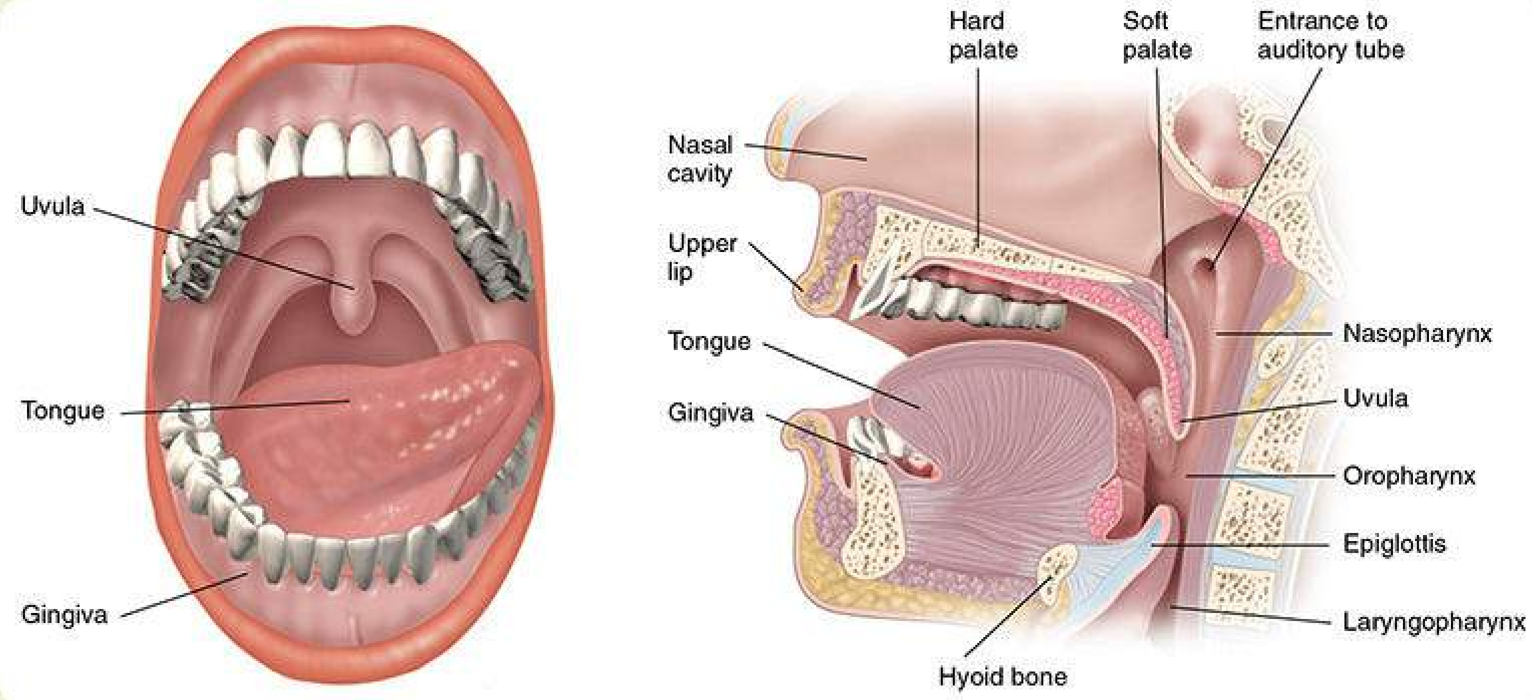

Figure 10-3 The oral cavity.

Larynx

The **larynx** is a complex structure formed by many independent cartilaginous structures **Figure 10-6**. It marks where the upper airway ends and the lower airway begins.

Special Populations

Although the maneuvers, techniques, and indications for airway management are essentially the same in children as they are in adults, several anatomic differences in the child make mastery of these techniques difficult.

Infants and small children have a proportionately larger occiput (posterior portion of the cranium), which causes the head to flex when the child lies supine; this position itself can cause an airway obstruction. When positioning the airway of an infant or child, place a folded towel under the child's shoulders to maintain a neutral position of the head.

Compared with adults, children have a proportionately smaller mandible and a proportionately larger tongue **Figure 10-4**. Both factors increase the incidence of airway obstruction in children.

The child's epiglottis is more floppy and omega-shaped than an adult's **Figure 10-5**.

In general, the infant's and the child's airway is smaller and narrower at all levels. The larynx lies more superior and anterior than an adult's. The larynx is also funnel-shaped due to the narrow, underdeveloped cricoid cartilage. In children younger than 8 years, the narrowest portion of the airway is at the cricoid ring. Further narrowing of the child's inherently narrow airway, such as that caused by soft-tissue swelling or foreign body aspiration, can result in a major increase in airway resistance and breathing inadequacy.

Children do not have well-developed chest musculature, and their ribs and cartilage are softer and more pliable than an adult's. As a result, the thoracic cavity cannot optimally contribute to lung expansion. Children rely heavily on their diaphragm for breathing, which moves their abdomen in and out. For this reason, infants and children are commonly referred to as "belly breathers." The child's epiglottis and surrounding structures.

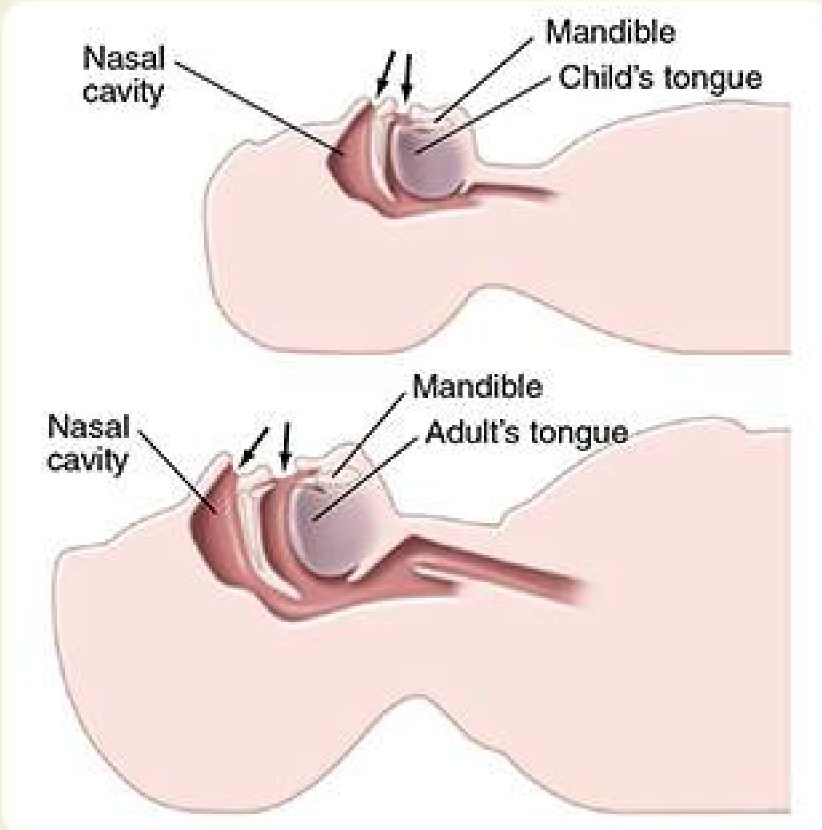

Figure 10-4 In children, the mandible is proportionately smaller and the tongue is proportionately larger than in an adult.

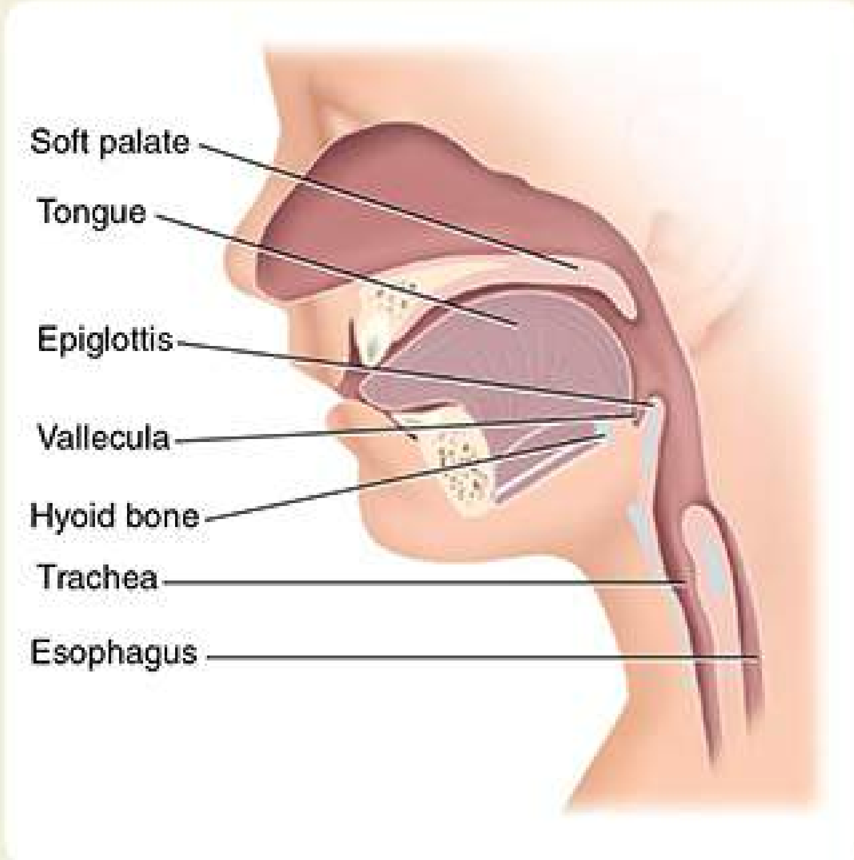

Figure 10-5 The child's epiglottis and surrounding structures.

The thyroid cartilage is a shield-shaped structure formed by two plates that join in a V shape anteriorly to form the laryngeal prominence known as the Adam's apple.

The cricoid cartilage, or cricoid ring, lies inferiorly to the thyroid cartilage; it forms the lowest portion of the larynx. The cricoid cartilage is the first ring of the trachea and the only lower airway structure that forms a complete ring. The cricothyroid membrane is the elastic tissue that connects the thyroid cartilage superiorly to the cricoid ring inferiorly.

The **glottis**, also called the glottic opening, is the space between the vocal cords and the narrowest portion of the adult's airway. The lateral borders of the glottis are the **vocal cords**. These white bands of thin muscle tissue are partially separated at rest and serve as the primary center for speech production. In addition, the vocal cords contain defense reflexes that protect the lower airway, causing a spasmodic closure to the lower airway to prevent substances from entering the trachea (eg, water, vomitus).

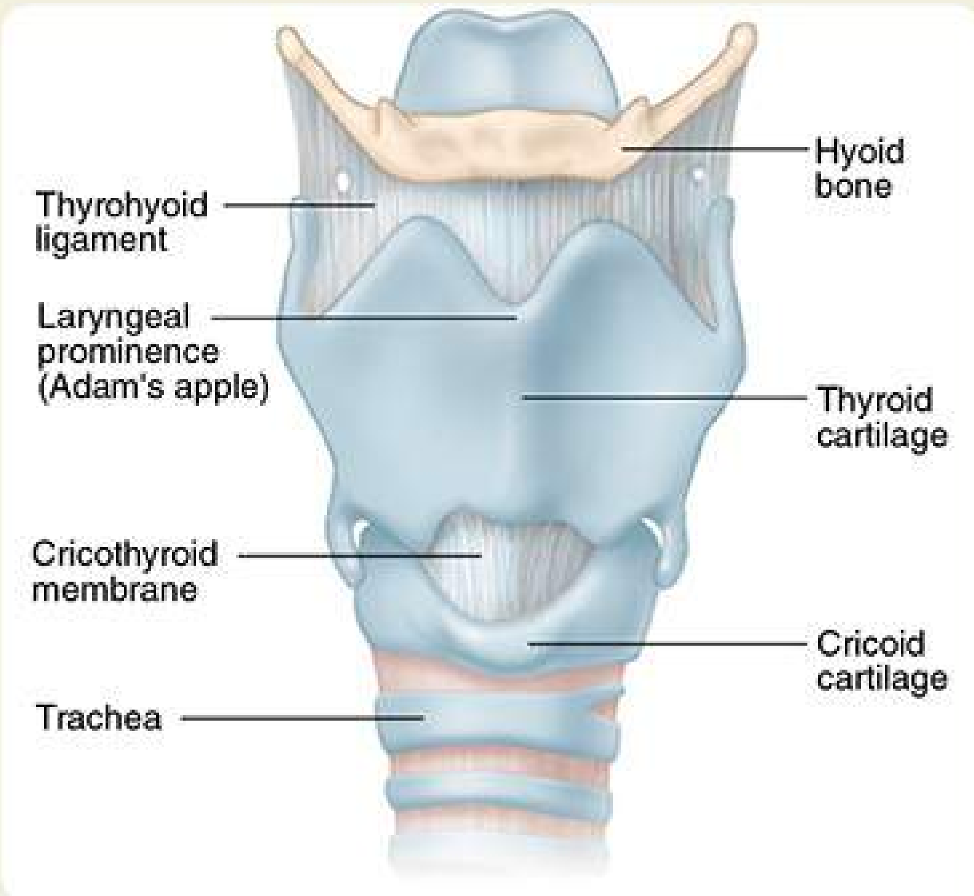

Figure 10-6 The larynx.

Anatomy of the Lower Airway

The function of the lower airway is to deliver oxygen to the alveoli. Its external boundaries are the fourth cervical vertebra and the xiphoid process, which is the narrow, cartilaginous, lower tip of the sternum. Internally, the lower airway spans the glottis to the pulmonary capillary membrane.

The trachea, or windpipe, is the conduit for air entry into the lungs. This tubular structure is approximately 10 to 12 cm in length and consists of C-shaped cartilaginous rings. The trachea begins directly below the cricoid cartilage and descends anteriorly down the midline of the neck into the thoracic cavity. Once in the thoracic cavity, the trachea divides at the level of the carina into the two mainstem bronchi (right and left). The hollow bronchi are supported by cartilage and distribute air into the right and left lungs.

The lungs consist of the entire mass of tissue that includes the smaller bronchi, bronchioles, and alveoli Figure 10-7. The lungs are surrounded by a serous membrane called the pleura. All lung tissue is covered with a thin, slippery outer membrane called the visceral pleura. The parietal pleura lines the inside of the thoracic cavity. A small amount of fluid is found between these two layers and serves as a lubricant to prevent friction during breathing.

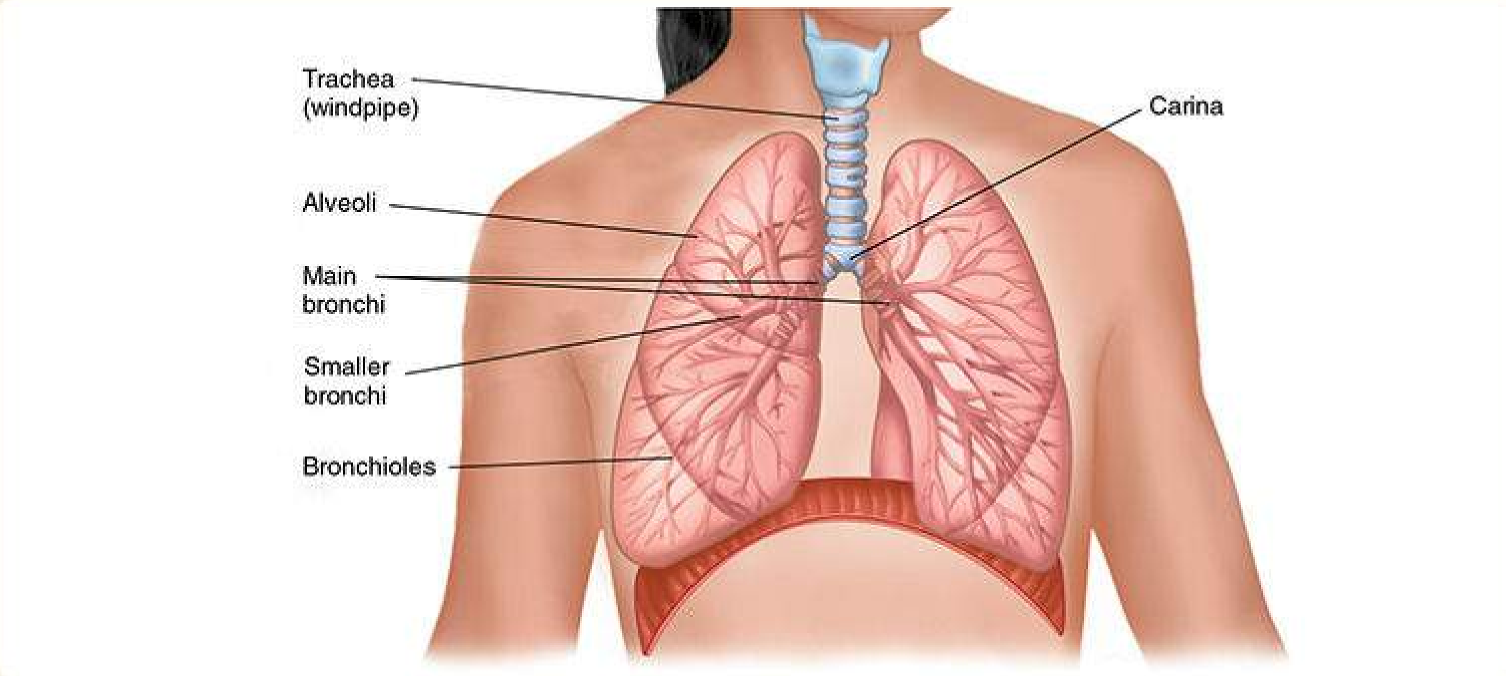

Figure 10-7 The trachea and the lungs are lower airway structures.

On entering the lungs, each bronchus divides into increasingly smaller bronchi, which in turn subdivide into bronchioles. The **bronchioles** are thin, hollow tubes made of smooth muscle. The tone of these smooth muscles allows the bronchioles to dilate or constrict in response to various stimuli. The smaller bronchioles branch into alveolar ducts that end at the alveolar sacs.

The alveoli, located at the end of the airway, are millions of thin-walled, balloonlike sacs that serve as the functional site for the exchange of oxygen and carbon dioxide. Surrounding each of these sacs is an intricate bed of blood vessels, known as pulmonary capillaries. Oxygen diffuses through the lining of the alveoli into the pulmonary capillaries where, depending on adequate blood volume and pressure, it is carried back to the heart for distribution to the rest of the body. At the same time, carbon dioxide (waste) diffuses from the pulmonary capillaries into the alveoli, where it is exhaled and removed from the body.

The chest cage (thoracic cavity) contains the lungs, one on each side **Figure 10-8**. The boundaries of the thorax are the rib cage anteriorly, superiorly, and posteriorly and the diaphragm inferiorly. Each individual rib plays a part in the overall protection of the thorax. In between each rib are intercostal muscles that can assist with breathing; however, they generally are not used unless the patient is in respiratory distress. Within the chest cage, you will find the lungs, which hang freely within the chest cavity. Between the lungs is a space called the **mediastinum**, which is surrounded by tough connective tissue. This space contains the heart, the great vessels, the esophagus, the trachea, the major bronchi, and many nerves. The mediastinum effectively separates the right lung space from the left lung space. In addition to the respiratory and circulatory structures found in the chest cage, an important structure of the nervous system is also found in the thorax—the **phrenic nerve**. The phrenic nerve innervates the diaphragm muscle, allowing it to contract. Contraction of the diaphragm occurs in a downward direction and is necessary for adequate breathing to occur.

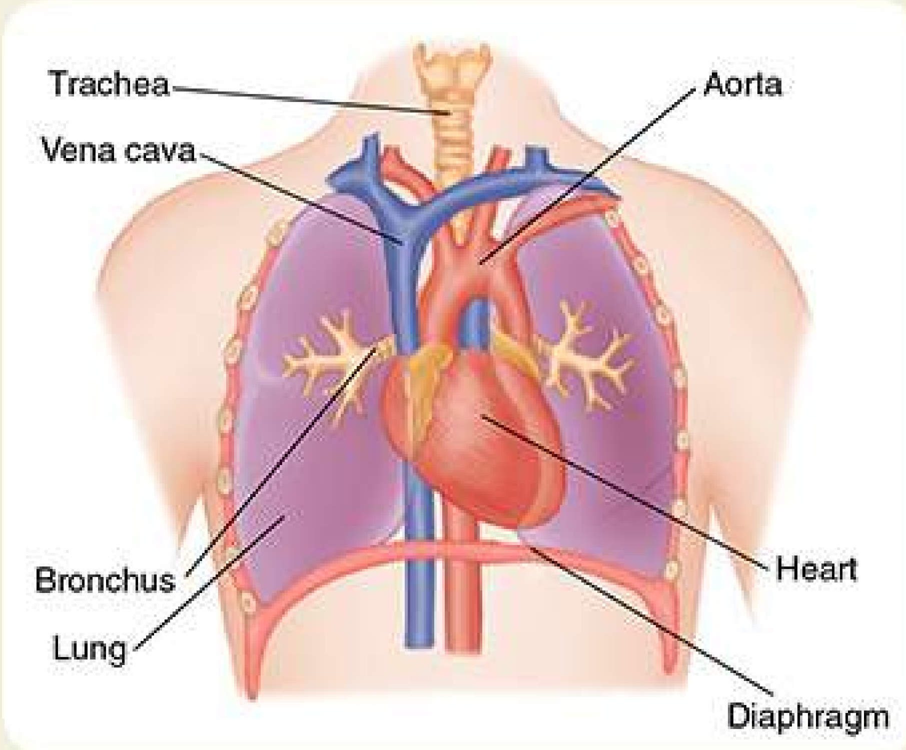

Figure 10-8 The thoracic cavity contains important anatomic structures for respiration, including the lungs and bronchi, heart, great vessels (the vena cava and aorta), and trachea.

Physiology of Breathing

The respiratory and cardiovascular systems work together to ensure that a constant supply of oxygen and nutrients is delivered to every cell in the body and carbon dioxide and waste products are removed from every cell. The following sections will describe the process of ventilation, oxygenation, and respiration; however, you first need to understand how the processes of breathing and circulation are connected.

As described earlier, air enters the body through the oral and nasal cavities and travels into the lungs. This occurs because a negative pressure is created in the chest. Eventually the air reaches the alveolar sacs where oxygen diffuses across the alveolar membrane and enters the bloodstream. At the same time, carbon dioxide diffuses from the bloodstream into the alveoli. The carbon dioxide is exhaled from the lungs, and the oxygen is transported back to the heart, where it is distributed to the rest of the body.

The heart pumps blood to the tissues of the body through a series of arteries and veins. Arteries carry blood away from the heart and eventually branch into capillaries. Once in the capillaries, the exchange of nutrients and waste products takes place. Oxygen and nutrients leave the capillaries and enter the cells. At the same time, waste products, such as carbon dioxide, diffuse from the cells back into the blood of the capillaries. From here, the deoxygenated blood travels back to the heart. The deoxygenated blood enters the right side of the heart through the right atrium. The right ventricle then pumps the blood to the lungs for oxygenation and removal of carbon dioxide. The oxygenated blood then travels back to the heart and into the left atrium. The left ventricle then pumps the oxygenated blood to the rest of the body. Refer back to Chapter 6, *The Human Body*, for an illustration of this process.

It is important to understand that the respiratory and circulatory systems work together to facilitate oxygen delivery to the tissues of the body **Table 10-1**. When one of these systems is compromised, oxygen delivery is not effective and cellular death could result.

Table 10-1 Ventilation, Oxygenation, and Respiration

Function	Definition
Ventilation	The physical act of moving air into and out of the lungs.
Oxygenation	The process of loading oxygen molecules onto hemoglobin molecules in the bloodstream.
Respiration	The actual exchange of oxygen and carbon dioxide in the alveoli as well as the tissues of the body.

Words of Wisdom

Ventilation is the physical act of moving air in and out of the lungs. Ventilation is required for adequate respiration. If ventilation is adequate, other problems may hinder respiration. Examples of interruptions of ventilation include trauma such as flail chest, foreign body airway obstruction, or an injury to the spinal cord that disrupts the phrenic nerve, which innervates the diaphragm.

Ventilation

Pulmonary ventilation, the process of moving air into and out of the lungs, is necessary for oxygenation and respiration to occur. Adequate, continuous ventilation is essential for life and therefore is one of the highest priorities in treating any patient. If a patient is not breathing or is breathing inadequately, you must immediately intervene to ensure adequate ventilation.

Inhalation

The active, muscular part of breathing is called **inhalation**. When a person inhales, the diaphragm and intercostal muscles contract, allowing air to enter the body and travel to the lungs. When it contracts, the diaphragm moves down slightly, enlarging the thoracic cage from top to bottom. When the intercostal muscles contract, they lift the ribs up and out. The combined actions of these structures enlarge the thorax in all directions. Take a deep breath to see how your chest expands.

The lungs have no muscle tissue; therefore, they cannot move on their own. They need the help of other structures to be able to expand and contract during inhalation and exhalation. Therefore, the ability of the lungs to function properly is dependent on the movement of the chest and supporting structures. These structures include the thorax, the thoracic cage (chest), the diaphragm, the intercostal muscles, and the accessory muscles of breathing. Accessory muscles are secondary muscles of respiration.

Partial pressure is the term used to describe the amount of gas in air or dissolved in fluid, such as blood. Partial pressure is measured in millimeters of mercury (mm Hg). The partial pressure of oxygen in air residing in the alveoli (Pao_2) is 104 mm Hg. Carbon dioxide (co_2) enters the alveoli from the blood and causes a partial pressure of 40 mm Hg.

Deoxygenated arterial blood from the right side of the heart has lower levels of oxygen (Pao_2) than carbon dioxide

($Paco_2$). The body attempts to equalize the two, which results in oxygen diffusion across the membrane into the blood and carbon dioxide diffusion in the opposite direction. The carbon dioxide is then eliminated from the lungs as waste during exhalation. This process occurs in reverse when the arterial blood reaches the tissues. Oxygen diffuses into the tissue fluid and then into the cells, and carbon dioxide diffuses out of the cells into the tissue fluid and blood.

The air pressure outside the body, called the atmospheric pressure, is normally higher than the air pressure within the thorax. During inhalation, the thoracic cage expands and the air pressure within the thorax decreases, creating a slight vacuum. This pulls air in through the trachea, causing the lungs to fill. When the air pressure outside equals the air pressure inside, air stops moving. Gases, such as oxygen, will move from an area of higher pressure to an area of lower pressure until the pressures are equal. At this point, the air stops moving, and inhalation stops.

It may help you to understand this if you think of the thoracic cage as a bell jar in which balloons are suspended. In this example, the balloons are the lungs. The base of the jar is the diaphragm, which moves up and down slightly with each breath. The ribs, which are the sides of the jar, maintain the shape of the chest. The only opening into the jar is a small tube at the top, similar to the trachea. During inhalation, the bottom of the jar moves down slightly, causing a decrease in pressure in the jar and creating a slight vacuum. As a result, the balloons fill with air **Figure 10-9**.

The entire process of inspiration is focused on delivering oxygen to the alveoli. However, not all of the air you breathe actually reaches the alveoli. **Table 10-2** reviews terminology discussed in Chapter 6, *The Human Body*, as it relates to the processes of inspiration and ventilation. The average tidal volume, the amount of air in milliliters (mL) moved into or out of the lung during a single breath, for an average adult man is approximately 500 mL. Breathing becomes deeper as the tidal volume responds to the increased metabolic demand for oxygen. However, as noted previously, not all inspired air reaches the alveoli for gas exchange. Dead space is described as the portion of inspired air that fails to reach the alveoli.

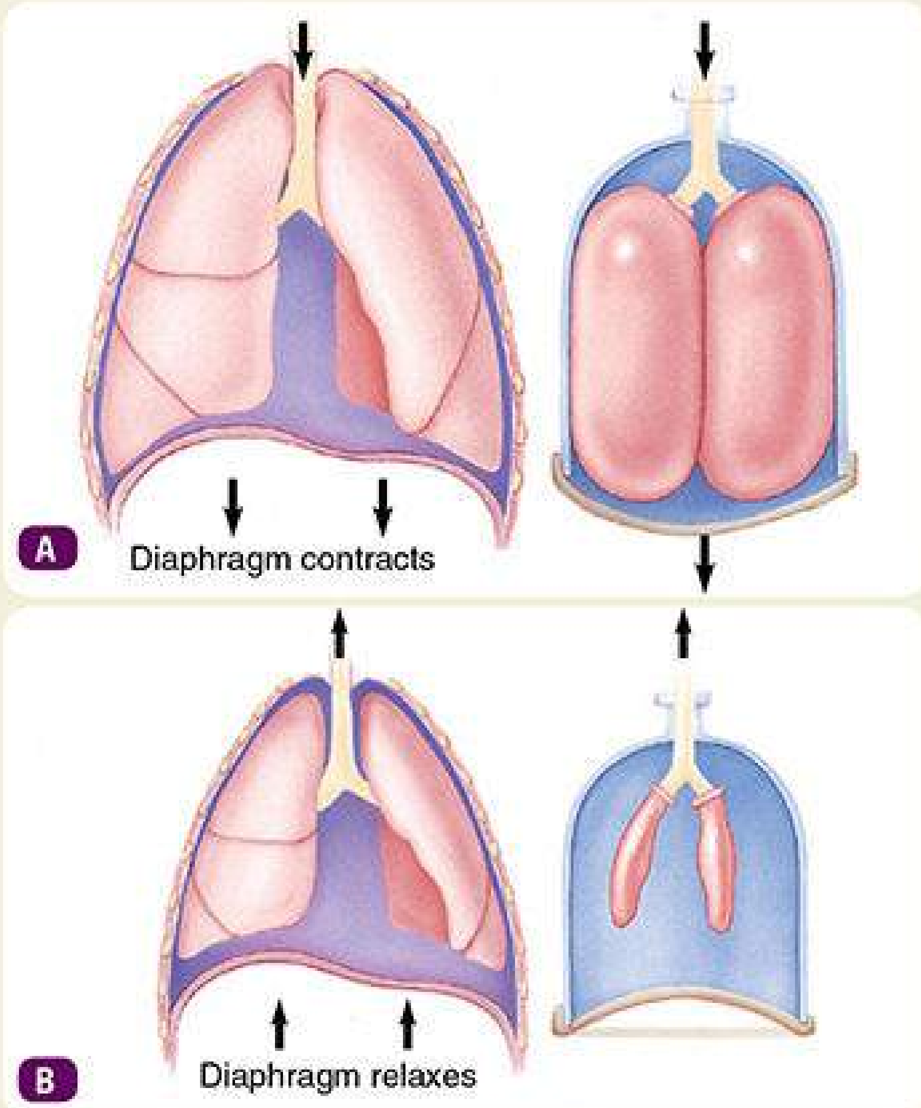

Figure 10-9 The mechanism of ventilation can be illustrated by using a bell jar. **A.** Inhalation and chest expansion, anatomic (left) and bell jar (right). **B.** Exhalation and chest contraction, anatomic (left) and bell jar (right).

Exhalation

Unlike inhalation, **exhalation** does not normally require muscular effort; therefore, it is a passive process. During exhalation, the diaphragm and the intercostal muscles relax. In response, the thorax decreases in size, and the ribs and muscles assume a normal resting position. When the size of the thoracic cage decreases, air in the lungs is compressed into a smaller space. The air pressure within the thorax then becomes higher than the outside pressure, and the air is pushed out through the trachea.

Remember that air will reach the lungs only if it travels through the trachea. This is why clearing and maintaining an open airway is so important. Clearing the airway means removing obstructing material, tissue, or fluids from the nose, mouth, and throat. Maintaining the airway means keeping the airway **patent** so that air can enter and leave the lungs freely **Figure 10-10**.

Table 10-2 Ventilation Terminology

Term	Definition
Tidal volume	The amount of air (in mL) that is moved in or out of the lungs during one breath.
Residual volume	The air that remains in the lungs after maximal expiration.
Alveolar ventilation	The volume of air that reaches the alveoli; calculated by subtracting the amount of dead space air from the tidal volume.
Minute volume	The volume of air moved through the lungs in 1 minute; calculated by multiplying tidal volume and respiratory rate.
Alveolar minute volume	The volume of air moved through the lungs in 1 minute minus the dead space; calculated by multiplying tidal volume (minus dead space) and respiratory rate.
Vital capacity	The amount of air that can be forcibly expelled from the lungs after breathing in as deeply as possible.
Dead space	The portion of the tidal volume that does not reach alveoli and thus does not participate in gas exchange.

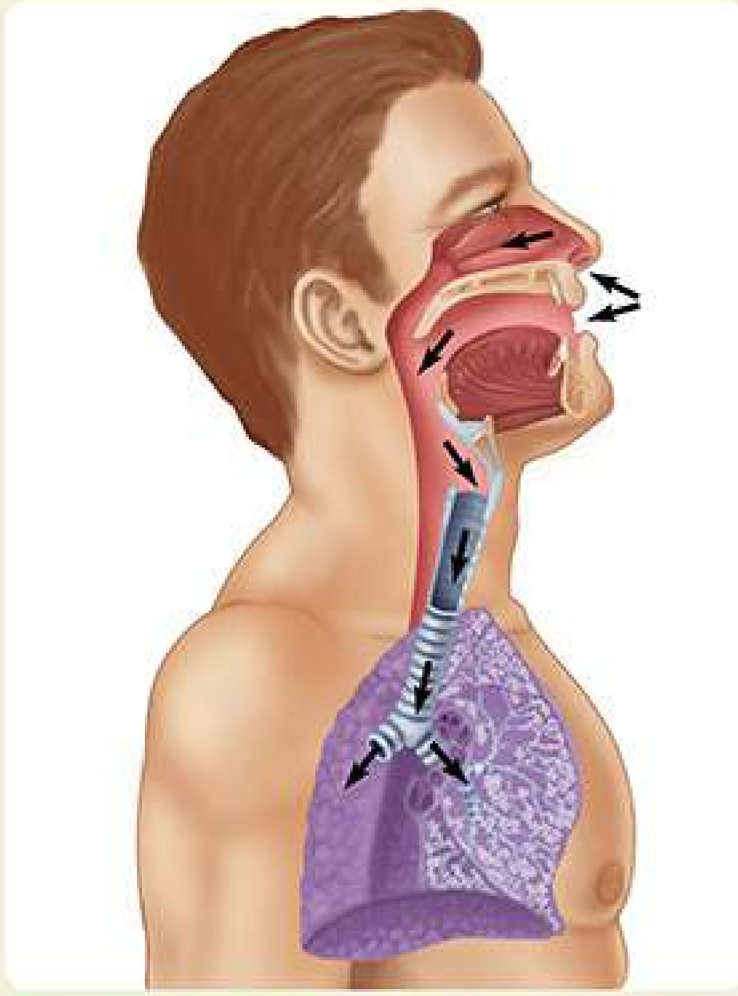

Figure 10-10 Air reaches the lungs only if it travels through the trachea. Maintaining the airway means keeping the airway patent so that air can enter and leave the lungs freely.

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Air may also pass into the chest cavity through an abnormal opening in the throat or chest wall as a result of trauma, remaining outside the bronchi and never reaching the alveoli. In later chapters, you will learn how to recognize and manage these potentially life-threatening conditions.

Regulation of Ventilation

The body’s need for oxygen is constantly changing. The respiratory system must be able to accommodate the changes in oxygen demand by altering the rate and depth of ventilation. The regulation of ventilation involves a complex series of receptors and feedback loops that sense gas concentrations in the body fluids and send messages to the respiratory center in the brain to adjust the rate and depth of ventilation accordingly. Failure to meet the body’s needs for oxygen may result in **hypoxia**. Hypoxia is an extremely dangerous condition in which the tissues and cells of the body do not get enough oxygen. If this process is not corrected, patients may die quickly.

For most people, the drive to breathe is based on pH changes (related to carbon dioxide levels) in the blood and cerebrospinal fluid. However, patients with chronic obstructive pulmonary diseases (COPD) have difficulty eliminating carbon dioxide through exhalation; thus, they always have higher levels of carbon dioxide. This condition potentially alters their drive for breathing. The theory is that respiratory centers in the brain gradually adjust to accommodate high levels of carbon dioxide. In patients with COPD, the body uses a “backup system” to control breathing. This theory of secondary control of breathing, called **hypoxic drive**, is based on levels of oxygen dissolved in plasma. This is different from the primary control of breathing that uses carbon dioxide as the driving force. Hypoxic drive is typically found in end-stage COPD. Providing high concentrations of oxygen over time will increase the amount of oxygen dissolved in plasma.

However, many believe this could potentially negatively affect the body's drive to breathe.

Regardless of the current research, it still remains certain that caution should be taken when administering high concentrations of oxygen to patients with obstructive pulmonary disease. However, it is important to remember that high concentrations of oxygen should never be withheld from any patient who needs it. Patients with severe respiratory and/ or circulatory compromise should receive high concentrations of oxygen regardless of their underlying medical conditions.

Patients who are breathing inadequately will show varying signs and symptoms of hypoxia. The onset and degree of tissue damage caused by hypoxia often depend on the quality of ventilations. Early signs of hypoxia include restlessness, irritability, apprehension, fast heart rate (tachycardia), and anxiety. Late signs of hypoxia include mental status changes, a weak (thready) pulse, and cyanosis. Conscious patients will complain of shortness of breath (**dyspnea**) and may not be able to talk in complete sentences. The best time to give a patient oxygen is before signs and symptoms of hypoxia appear.

Oxygenation

Oxygenation is the process of loading oxygen molecules onto hemoglobin molecules in the bloodstream. Adequate oxygenation is required for internal respiration to take place; however, it does not guarantee internal respiration is taking place. Oxygenation requires that the air used for ventilation contains an adequate percentage of oxygen. Ventilation without oxygenation can occur in places where oxygen levels in the breathing air have been depleted, such as in mines and confined spaces. Ventilation without adequate oxygenation also occurs in climbers who ascend too quickly to an altitude of lower atmospheric pressure. At high altitudes, the percentage of oxygen remains the same, but the atmospheric pressure makes it difficult to adequately bring sufficient amounts of oxygen into the body.

Words of Wisdom

Oxygenation can be disrupted through carbon monoxide poisoning. Carbon monoxide has a much greater affinity for hemoglobin than oxygen (250 times more), which makes proper transport of oxygen to tissues difficult.

Respiration

All living cells perform a specific function and need energy to survive. Cells take energy from nutrients through a series of chemical processes. The name given to these processes as a whole is **metabolism (cellular respiration)**. During metabolism, each cell combines nutrients (such as sugar) and oxygen and produces energy and waste products, primarily water and carbon dioxide. Each cell in the body requires a continuous supply of oxygen and a regular means of disposing of waste (carbon dioxide). The body provides for these requirements through respiration.

Respiration is the process of exchanging oxygen and carbon dioxide. This exchange occurs by diffusion, a process in which a gas moves from an area of greater concentration to an area of lower concentration. In the body, gases diffuse rapidly across a short distance of only micrometers, and the diffusion occurs rapidly.

External Respiration

External respiration (pulmonary respiration) is the process of breathing fresh air into the respiratory system and exchanging oxygen and carbon dioxide between the alveoli and the blood in the pulmonary capillaries **Figure 10-11**.

Fresh air that is inspired into the lungs contains about 21% oxygen, 78% nitrogen, and 0.3% carbon dioxide. As this air reaches the alveoli, it comes into contact with a fluid called **surfactant**. Surfactant reduces surface tension within the alveoli and keeps them expanded, thus making it easier for the gas exchange between oxygen and carbon dioxide to take place. It is important to remember that while adequate ventilation is necessary for external respiration to take place, it does not guarantee that external respiration is being achieved.

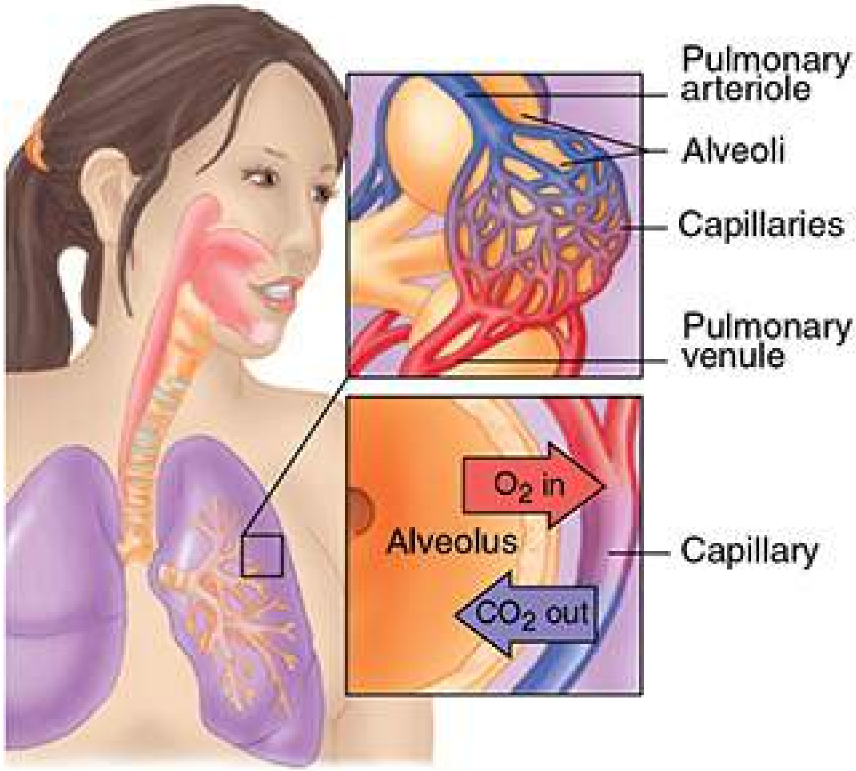


Figure 10-11 External respiration.

Once the oxygen crosses the alveolar membrane, it is bound to hemoglobin, an iron-containing molecule that has a great affinity for oxygen molecules. Found in red blood cells, hemoglobin molecules low in oxygen concentration are pumped from the right side of the heart into the capillaries of the pulmonary circulation. The capillaries surround alveoli containing high concentrations of oxygen (from inspired air). The hemoglobin molecules pick up fresh oxygen as it crosses the alveolar membrane and transport it back to the left side of the heart, where it is pumped out to the rest of the body. Under normal conditions, 96% to 100% of the hemoglobin receptor sites contain oxygen.

Internal Respiration

The exchange of oxygen and carbon dioxide between the systemic circulatory system and the cells of the body is called **internal respiration**. As blood travels through the body, it supplies oxygen and nutrients to various tissues and cells. Oxygen passes from the blood in the capillaries to the cells within the body's tissues. At the same time, carbon dioxide and cell waste pass from the cells into the capillaries, where they are then transported in the venous system back to the lungs **Figure 10-12**.

Every cell in the body needs a constant supply of oxygen to survive. Whereas some tissues are more resilient than others, eventually all cells will die if deprived of oxygen **Figure 10-13**. To deliver adequate amounts of oxygen to the tissues of the body, sufficient levels of external ventilation and perfusion must take place.

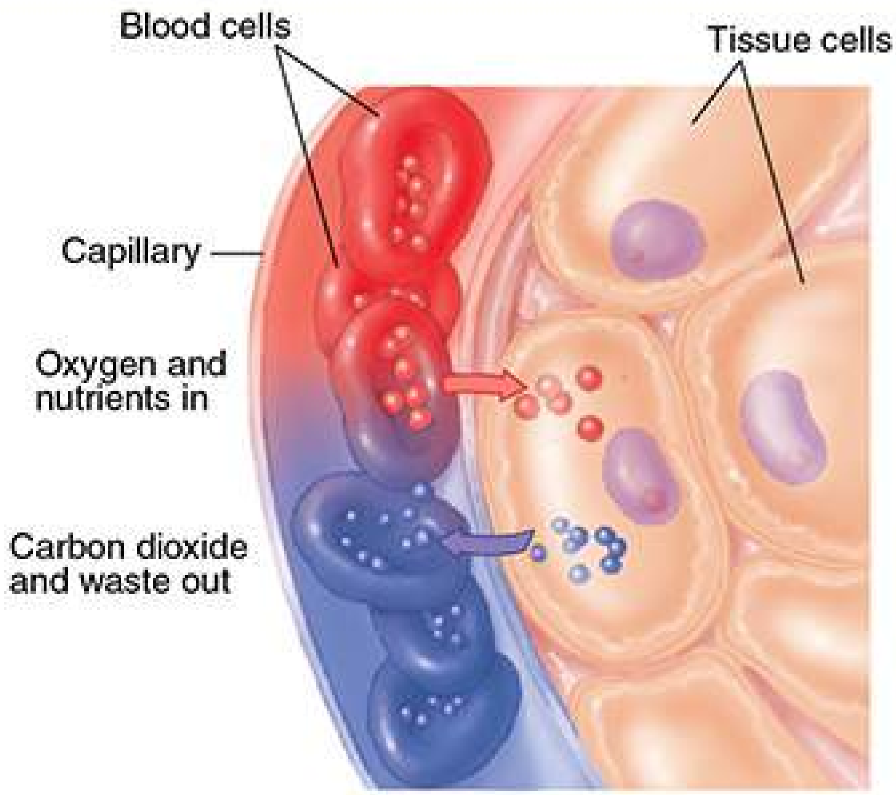


Figure 10-12 Internal respiration.

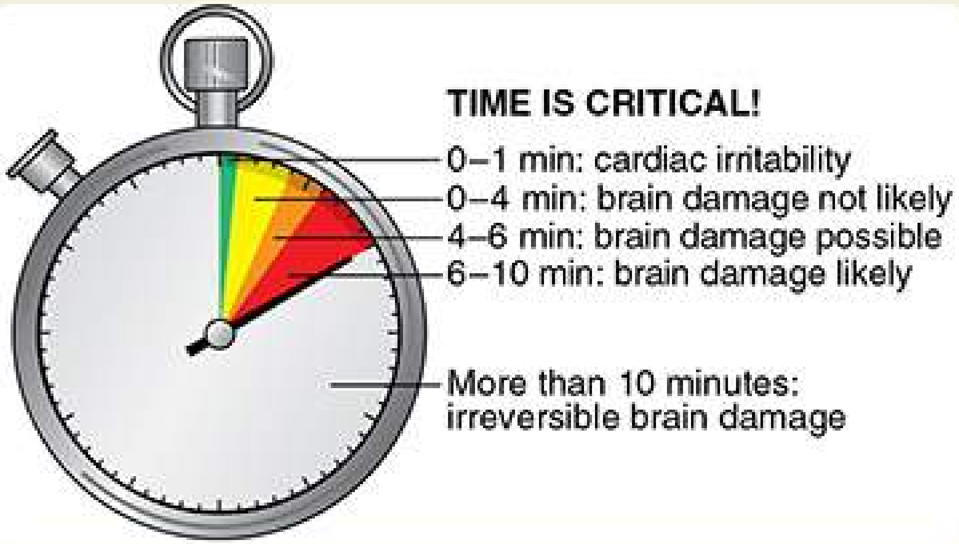


Figure 10-13 Cells need a constant supply of oxygen to survive. Some cells may be severely or permanently damaged after 4 to 6 minutes without oxygen.

In the presence of oxygen, cells convert glucose into energy through a process known as **aerobic metabolism**. Energy is produced through a series of biochemical reactions. Without adequate oxygen, the cells do not completely convert glucose into energy, and lactic acid and other toxins accumulate in the cell. This process, **anaerobic metabolism**, cannot meet the metabolic demands of the cell. If this process is not corrected, the cells will eventually die. This is why adequate levels of perfusion (circulation of blood within an organ or tissue) and external ventilation must be present for aerobic internal respiration to take place. However, while these elements are necessary for internal respiration, they do not guarantee that aerobic internal respiration will take place.

When cells use oxygen to convert glucose to energy, carbon dioxide, the main waste product, accumulates in the cell. Carbon dioxide is then transported through the circulatory system and back to the lungs for exhalation.

It is important to understand the processes of ventilation, oxygenation, and respiration. The overall goal of these mechanisms is to deliver an adequate supply of oxygen to the cells of the body. When one of these processes fails or becomes disrupted, cells are going to die. By recognizing the signs and symptoms of inadequate tissue perfusion and oxygenation, you can immediately intervene and correct a potentially life-threatening condition.

Pathophysiology of Respiration

Multiple conditions inhibit the body's ability to effectively deliver oxygen to the cells. Disruption of pulmonary ventilation, oxygenation, and respiration will cause immediate effects on the body. As an EMT, you need to recognize these conditions and correct them immediately.

Factors in the Nervous System

Chemical factors are commonly involved in respiratory control issues because of the level of complexity of the human body. A complex series of chemical reactions are constantly taking place. For example, **chemoreceptors** monitor the levels of oxygen, carbon dioxide, hydrogen ions, and the pH of the cerebro-spinal fluid and then provide feedback to the respiratory centers to modify the rate and depth of breathing based on the body's needs at any given time. Central chemoreceptors in the medulla respond quickly to slight elevations in carbon dioxide or a decrease in the pH of the cerebrospinal fluid. The peripheral chemoreceptors, located in the carotid arteries and the aortic arch, are sensitive to decreased levels of oxygen in arterial blood as well as to low pH levels.

When serum carbon dioxide or hydrogen ion levels increase because of medical or traumatic conditions involving the respiratory system, chemoreceptors stimulate the medulla to increase the respiratory rate, thus removing more carbon dioxide or acid from the body. One area in the medulla is responsible for initiating inspiration based on the information received from the chemoreceptors. Another area in the medulla is primarily responsible for motor control of the inspiratory and expiratory muscles.

In addition, stimulation from the pons affects the rate and depth of respirations. If one item in this process is disrupted, then the respiratory process will be affected.

Ventilation/Perfusion Ratio and Mismatch

The lung has a functional role of placing ambient air in proximity to circulating blood to permit gas exchange by simple diffusion. To accomplish this action, air and blood flow must be directed to the same place at the same time. In other words, ventilation (air flow, V) and perfusion (blood flow, Q) must be matched. A failure to match ventilation and perfusion lies behind most abnormalities in oxygen and carbon dioxide exchange.

When ventilation is compromised but perfusion continues, blood passes over some alveolar membranes without gas exchange taking place. This, in turn, results in a lack of oxygen diffusing across the membrane and into blood circulation. Carbon dioxide is also not able to diffuse across the membrane into the lungs and is therefore recirculated within the bloodstream. This condition could lead to severe hypoxemia if this problem is not recognized and treated.

Similar problems can occur when perfusion across the alveolar membrane is disrupted. Even though the alveoli are filled with fresh oxygen, disruption in blood flow does not allow for optimal exchange of gases across the membrane. This results in less oxygen absorption in the bloodstream and less carbon dioxide removal. This can also lead to hypoxemia, and you need to provide immediate intervention to prevent further cellular damage or death.

Factors Affecting Pulmonary Ventilation

Maintaining a patent airway is critical to the delivery of oxygen to the tissues of the body. There are many intrinsic and extrinsic factors that cause airway obstructions.

Intrinsic Factors

Intrinsic conditions such as infections, allergic reactions, and unresponsiveness (tongue obstruction) can cause significant restrictions on the ability to maintain an open airway. Swelling from infections and allergic reactions can be fatal if not aggressively managed with medications and possibly advanced airway maneuvers.

Some factors affecting pulmonary ventilation are not necessarily directly part of the respiratory system. The central and peripheral nervous systems play key roles in the regulation of breathing. Interruptions to these systems can have a drastic effect on the ability to breathe efficiently. Medications that depress the central nervous system lower the respiratory rate and tidal volume. This lower rate and volume will decrease minute volume as well as alveolar volume. As a result, this increases the amount of carbon dioxide in the respiratory and circulatory systems, resulting in an overall increase of carbon dioxide levels in the bloodstream, known as **hypercarbia**. Trauma to the head and spinal cord can also interrupt nervous control of ventilation, resulting in decreased respiratory function and even failure. In addition to medications and trauma, conditions such as muscular dystrophy can also affect nervous control. This disease causes degeneration of muscle fibers resulting in a gradual weakening of muscles, slowing motor development, and loss of muscle contractility. Curvature of the spine is also likely in patients with muscular dystrophy and can impair pulmonary function.

The tongue is the most common airway obstruction in the unresponsive patient. This airway obstruction, while easily corrected, can result in hypoxia and hinder adequate tissue perfusion. Obstruction of the airway by the tongue is also associated with hypercarbia. Snoring respirations and the position of the head and/or neck are good indicators that the tongue may be obstructing the airway. Prompt correction of this obstruction is necessary for adequate oxygenation.

Patients with allergic reactions not only suffer from a potential airway obstruction from swelling, but may also have a decrease in pulmonary ventilation from bronchoconstriction. As the bronchioles constrict, air is forced through smaller lumens resulting in decreased ventilation. This condition is also found in patients suffering from COPD, such as emphysema.

Extrinsic Factors

Extrinsic factors affecting pulmonary ventilation can include trauma or foreign body airway obstruction. Trauma to the airway or chest requires immediate evaluation and intervention. The impact of an injury such as a broken jaw is often overlooked. Patients with a fracture to the mandible, especially unconscious patients, may not be able to maintain an open airway on their own and may require the insertion of an airway adjunct. Blunt or penetrating trauma and burns can disrupt airflow through the trachea and into the lungs, quickly resulting in oxygenation deficiencies. In addition, trauma to the chest wall can result in structural damage to the thorax, leading to inadequate pulmonary ventilation. Swelling, punctures, and bruising have a tremendous effect on the ability to deliver oxygen to the alveoli and into the bloodstream. Proper airway management and high concentrations of oxygen are crucial to the outcome in these situations.

Factors Affecting Respiration

External elements in the environment can affect the overall process of respiration. For proper respiration to take place at the cellular level, both oxygenation and perfusion need to function efficiently.

External Factors

Adequate respiration requires proper ventilation and oxygenation. Here, external factors such as atmospheric pressure and the partial pressure of oxygen in the ambient air play a key role in the overall process of respiration. At high altitudes, the percentage of oxygen remains the same, but the partial pressure decreases because the total atmospheric pressure decreases. The low partial pressure of oxygen can make it difficult (or impossible) to adequately oxygenate tissue, thus interrupting internal respiration. In addition, closed environments, such as mines and trenches, may also have decreases in ambient oxygen, resulting in poor oxygenation and respiration.

Carbon monoxide, along with other toxic and poisonous gases, displaces oxygen in the environment and makes proper oxygenation and respiration difficult. Carbon monoxide, in particular, has a much greater affinity for hemoglobin than oxygen (250 times more), and occupies all the sites on hemoglobin that are normally occupied by oxygen. Loading the hemoglobin with carbon monoxide instead of oxygen prohibits oxygen delivery to the tissues. This results in severe hypoxemia which, if uncorrected, can rapidly lead to death.

Internal Factors

Conditions that reduce the surface area for gas exchange also decrease the body’s oxygen supply, leading to inadequate tissue perfusion. Medical conditions such as pneumonia, pulmonary edema, and COPD/emphysema may also result in a disturbance of cellular metabolism. These conditions decrease the surface area of the alveoli either by damaging the alveoli or by leading to an accumulation of fluid in the lungs.

Nonfunctional alveoli inhibit the diffusion of oxygen and carbon dioxide. As a result, blood entering the lungs from the right side of the heart bypasses the alveoli and returns to the left side of the heart in an unoxygenated state, a condition called **intrapulmonary shunting**.

Drowning victims and/or patients with pulmonary edema have fluid in the alveoli. This accumulation of fluid inhibits adequate gas exchange at the alveolar membrane and results in decreased oxygenation and respiration. In addition, exposure to certain environmental conditions, like high altitudes, or occupational hazards, such as epoxy resins, over time can result in fluid accumulation or other abnormal conditions, resulting in impaired oxygenation. These conditions can interrupt the process of aerobic respiration at the cellular level, resulting in anaerobic respiration and an increase in lactic acid accumulation.

Other conditions affecting cells of the body include hypoxia, hypoglycemia (low blood glucose), and infection. As oxygen and glucose levels decrease, the body is unable to maintain a homeostatic balance with regard to energy production. At this point, the energy production cannot meet the needs of the body, and cellular death is likely if the condition is not corrected. Infection also increases the metabolic needs of the body and disrupts homeostasis. If not corrected, the cells will die as well.

Circulatory Compromise

For respiration to take place, the circulatory system must function efficiently to deliver oxygen to the tissues of the body. When this system becomes compromised, the perfusion of oxygen is not enough to meet the oxygen demands of the tissues.

Obstruction of blood flow to individual cells and tissue is typically related to trauma emergencies you may encounter. These conditions include pulmonary embolism, a simple or **tension pneumothorax**, open pneumothorax (sucking chest wound), hemothorax, and hemopneumothorax. All of these conditions limit the ability for gas exchange at the tissue level as a result of their effects on the respiratory and circulatory systems. In addition, conditions such as heart failure and cardiac tamponade inhibit the ability of the heart to effectively pump oxygenated blood to the tissues.

Blood loss and anemia, a deficiency of red blood cells, result in a decreased ability of blood to carry oxygen. Without sufficient circulating red blood cells, there is not enough hemoglobin to carry oxygen to the tissues.

When the body is in a state of shock, oxygen is not being delivered to the cells efficiently. Hypovolemic shock is an abnormal decrease in blood volume that causes inadequate oxygen delivery to the body. In contrast, vasodilatory shock is not determined by the amount of circulating blood, but by the size of the blood vessels. As the diameter of the blood vessels increases, the blood pressure in the circulatory system decreases. As the systemic blood pressure falls, oxygen is not delivered effectively to the tissues. Both forms of shock result in poor tissue perfusion that leads to anaerobic metabolism. Any patient suspected of being in shock should be treated aggressively to prevent further interruptions to tissue perfusion.

Patient Assessment

Recognizing Adequate Breathing

Breathing is something that all people do every day; yet, most of the time, you are not aware of your own breathing or the breathing of others around you. Breathing should be a smooth flow of air moving into and out of the lungs. As a general rule, unless you are directly assessing the patient's airway, you should not be able to see or hear a patient breathe. Signs of normal (adequate) breathing for adult patients are as follows:

- A normal rate (between 12 and 20 breaths/min)
- A regular pattern of inhalation and exhalation
- Clear and equal lung sounds on both sides of the chest (**bilateral**)
- Regular and equal chest rise and fall (chest expansion)
- Adequate depth (tidal volume)

Recognizing Abnormal Breathing

An adult who is awake, alert, and talking to you generally has no immediate airway or breathing problems. However, you should always have supplemental oxygen and a **bag-valve mask (BVM)** or pocket mask close at hand to assist with breathing if necessary. An adult who is breathing normally will have respirations of 12 to 20 breaths/min **Table 10-3**.

Adult patients who are breathing slower (fewer than 12 breaths/min) than normal should be evaluated for inadequate breathing by assessing the depth of respirations. Patients with shallow depth of breathing (reduced tidal volume) may require assisted ventilations, even if the respiratory rate is within normal limits.

YOU are the Provider — PART 2

You arrive at the patient's residence, enter his home, and find him sitting on the couch. He is a 55-year-old man with a history of congestive heart failure and high blood pressure. He is conscious, but appears sleepy, and can only speak in two-word sentences before stopping to catch his breath. As your partner opens the jump kit, you assess the patient.

Recording Time: 0 Minutes	
Appearance	Obvious breathing difficulty; skin is moist
Level of consciousness	Conscious; appears sleepy
Airway	Open; no secretions or foreign bodies
Breathing	Labored breathing; rapid respiratory rate
Circulation	Skin, cool and moist; radial pulse, rapid and weak

4. Is this patient's airway patent?
5. Is he breathing adequately? Why or why not?
6. How should you manage his present airway and breathing status?

Table 10-3 Normal Respiratory Rate Ranges

Adults	12 to 20 breaths/min
Children	15 to 30 breaths/min
Infants	25 to 50 breaths/min

Note: These ranges are per the NHTSA 2009 EMT National EMS Education Standards. Ranges presented in other courses may vary.

Words of Wisdom

The respiratory status of a patient is so important that it should be noted at the beginning of your radio report, after mental status. Any changes during treatment or transport should be immediately reported to the receiving hospital. Respiratory status, along with any changes, should also be clearly documented in your patient care report.

A patient with inadequate breathing may appear to be working hard to breathe, which is called **labored breathing**. It requires effort and, especially among children, may involve the use of accessory muscles, including the neck muscles (sternocleidomastoid), the chest pectoralis major muscles, and the abdominal muscles **Figure 10-14**.

Accessory muscles are not used during normal breathing. More information about recognizing labored breathing and respiratory distress in children is found in later chapters. Signs of inadequate breathing in adult patients are as follows:

- Respiratory rate of fewer than 12 breaths/min or more than 20 breaths/min in the presence of shortness of breath (dyspnea)
- Irregular rhythm, such as a patient taking a series of deep breaths followed by periods of apnea
- Diminished, absent, or noisy auscultated breath sounds
- Reduced flow of expired air at the nose and mouth
- Unequal or inadequate chest expansion, resulting in reduced tidal volume
- Increased effort of breathing (use of accessory muscles)
- Shallow depth (reduced tidal volume)

Figure 10-14 The accessory muscles of breathing are used when a patient is having difficulty breathing, but not during normal breathing. The accessory muscles include the sternocleidomastoid, pectoralis major, and abdominal muscles.

- Skin that is pale, cyanotic (blue), cool, or moist (clammy)
- Skin pulling in around the ribs or above the clavicles during inspiration (**retractions**)

When you are assessing a patient with a potential airway compromise, pay particular attention to the external environment. Conditions such as high altitude and enclosed spaces alter the partial pressure of oxygen in the environment, making the process of oxygenation difficult for the patient. In addition, poisonous gases, such as carbon monoxide, displace oxygen in the environment and alter the overall metabolism of the patient. The external environment should be taken into consideration when deciding on the appropriate treatment.

You should be aware that a patient may appear to be breathing after his or her heart has stopped. These occasional, gasping breaths are called **agonal gasps**. They occur when the respiratory center in the brain continues to send signals to the respiratory muscles. These gasps do not provide adequate oxygen because they are infrequent, gasping respiratory efforts. In patients with agonal gasps, you will need to provide artificial ventilations and, most likely, chest compressions.

Some patients may have irregular respiratory breathing patterns that are related to a specific condition. For example, Cheyne-Stokes respirations are often seen in patients with stroke and patients with serious head injuries **Figure 10-15**.

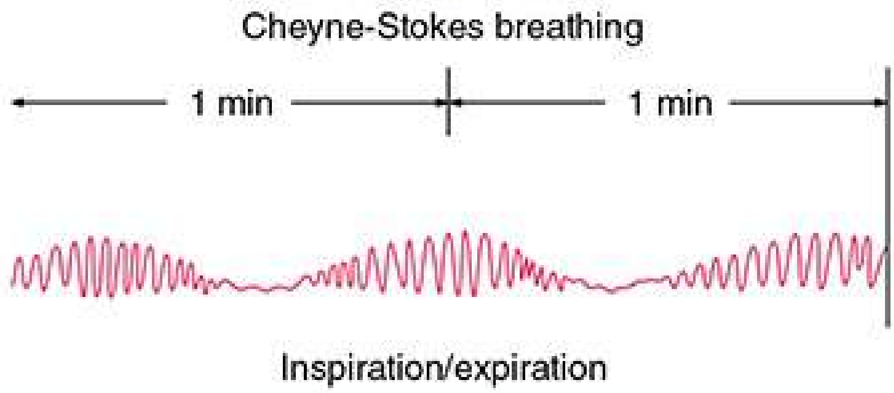


Figure 10-15 Cheyne-Stokes breathing shows irregular respirations followed by a period of apnea.

Cheyne-Stokes respirations are an irregular respiratory pattern in which the patient breathes with an increasing rate and depth of respirations that is followed by a period of **apnea**, or lack of spontaneous breathing, followed again by a pattern of increasing rate and depth of respiration. Serious head injuries may also cause changes in the normal respiratory rate and pattern of breathing. The result may be irregular, ineffective respirations that may or may not have an identifiable pattern (**ataxic respirations**). Patients experiencing a metabolic or toxic disorder may display other abnormal respiratory patterns such as Kussmaul respirations. Kussmaul respirations are characterized as deep, rapid respirations commonly seen in patients with metabolic acidosis.

Whereas rapid breathing is a compensatory mechanism to help patients in respiratory distress, some patients are so ill that their bodies are unable to compensate for their respiratory distress. You need to be vigilant when monitoring patients in respiratory distress because their condition may decline rapidly.

Patients with inadequate breathing have inadequate minute volume and need to be treated immediately. This condition is most easily recognized in patients who are unable to speak in complete sentences when at rest or who have a fast or slow respiratory rate, both of which may result in a reduction in tidal volume. Emergency medical care includes airway management, supplemental oxygen, and ventilatory support.

Assessment of Respiration

Even though a patient may be ventilating appropriately, the actual exchange of oxygen and carbon dioxide at the tissue level may be compromised. You must assess for signs of adequate and inadequate respiration in all patients.

As stated earlier, there are external factors that may disrupt the process of respiration. Be aware of the patient's environment and assess the quality of ambient air when approaching the patient. High altitudes and poisonous gases should always be considered when assessing respiration. Environmental factors can dramatically affect respiration and alter metabolism in your patient. If there is more than one patient with similar symptoms, consider the presence of poisonous or toxic gases. If your EMS unit carries a handheld carbon monoxide detector, assess ambient air before entering the location. However, if you enter a space and suspect the quality of the ambient air is not safe, remove yourself and the patient (if possible) from the scene immediately and contact the appropriate resource.

A patient's level of consciousness and skin color are excellent indicators of respiration. During normal respiration, oxygen and carbon dioxide diffuse in and out of tissues. When you are assessing the brain and skin tissues, it will be apparent if the patient has adequate oxygen levels reaching these areas. A patient with an altered level of consciousness may not have adequate oxygen levels reaching the brain. This lack of oxygen can cause rapid changes in the patient's mental status. Therefore, when treating patients with an altered mental status, always consider the possibility that these patients may not be getting adequate oxygen levels to their brain and that you need to consider the possible underlying causes. Be sure to determine a baseline mental status on the patient. The baseline mental status of some patients is abnormal because of a medical condition. Ask family members to describe the patient's normal mental status.

Poor skin color indicates inadequate respiration, just as an altered level of consciousness does. As oxygen fails to reach the skin tissue of the body, either from a lack of perfusion or poor oxygenation, the color of the skin changes to reflect the low level of oxygenation. Pale skin and mucous membranes, commonly referred to as pallor, are typically associated with poor perfusion caused by illness or shock. As this condition worsens, cyanosis becomes noticeable first peripherally, in the fingertips, and then centrally, in the mucous membranes and around the lips. Eventually, if the poor perfusion or oxygenation is not corrected, anaerobic metabolism will take place. This could cause the skin to become marked with blotches of different colors, commonly referred to as mottling.

Several methods can be used to assess proper oxygenation, including the use of **pulse oximetry**.

Oxygen saturation (Spo_2) is the measure of the percentage of hemoglobin molecules that are bound in arterial blood. Because hemoglobin delivers 97% of the oxygen delivered to the body's tissues, oxygen saturation is an excellent indication of the amount of oxygen available to the end organs. Oxygen dissolved in plasma delivers the other 3% to the body's tissues.

Within the past few years the pulse oximeter has become standard equipment in the treatment of emergency patients **Figure 10-16**. The pulse oximeter provides a rapid, reliable, noninvasive, real-time indication of a patient's oxygenation status. A pulse oximetry reading should not be the sole determinant of a patient's respiratory status. This value should be interpreted together with a full clinical assessment of the patient. This device can be used to assess the adequacy of oxygenation during positive-pressure ventilation and assess the overall impact of interventions on your patient.

A pulse oximeter measures the percentage of hemoglobin saturation. Under normal conditions, the Spo_2 should be 98% to 100% while breathing room air. Although no definitive threshold for normal values exists, an Spo_2 of less than 96% in a non-smoker may indicate hypoxemia. An Spo_2 of 90% or lower generally requires treatment unless the patient has a chronic condition causing perpetually low oxygen saturations. In conditions such as stroke or heart attack, oxygen is applied when the Spo_2 drops below 94%. Pulse oximeters are highly reliable in Spo_2 readings above 85%; however, readings below that are less reliable but certainly indicate profound hypoxemia. Pulse oximeters can take as long as 60 seconds to reflect changes in a patient's oxygenation status. More simply stated, a pulse oximeter placed on a patient's finger typically reflects a patient's oxygenation status one minute ago. This time delay is important to understand as respiratory insufficiency can develop in a patient well before the pulse oximetry values begin to decline. It is critical to monitor the patient and supplement your assessment with the information from the pulse oximeter.

Figure 10-16 A pulse oximeter.

Pulse oximetry is considered a routine vital sign and can be used as part of any patient assessment. Whereas there are no true contraindications to using pulse oximetry, you must be aware of the limitations associated with this device. To function properly, the pulse oximeter must find a pulsation in the selected tissue. The most commonly used site is a finger. Follow the steps in **Skill Drill 10-1** to measure pulse oximetry:

1. Clean the patient's finger, and remove nail polish as needed. Place the index or middle finger into the pulse oximeter probe. Turn on the pulse oximeter, and note the LED reading of the Sp_2 **Step 1**.

2. Palpate the radial pulse to ensure that it correlates with the LED display on the pulse oximeter **Step 2**.

In patients with significant vasoconstriction or very low perfusion states (including cardiac arrest), there may not be enough peripheral perfusion to be detected by the sensor. In these cases, move the sensor to a more central location (bridge of the nose or earlobe). Always consult the manufacturer's guidelines for proper placement and troubleshooting of these devices. An inaccurate pulse oximetry reading may be caused by the following:

- Hypovolemia
- Severe peripheral vasoconstriction (chronic hypoxia, smoking, or hypothermia)
- Time delay in detecting respiratory insufficiency
- Dark or metallic nail polish
- Dirty fingers
- Carbon monoxide poisoning

When carbon monoxide is present in the inspired gas, it displaces oxygen from the hemoglobin. Pulse oximetry measures hemoglobin saturation, but it is unable to distinguish between oxygen saturation and carbon monoxide saturation. Therefore, in cases of carbon monoxide poisoning, the Spo_2 can be normal in the context of hypoxia.

The pulse oximeter is a valuable adjunct to aid in decision making, but is not a replacement for a complete assessment. Because of many factors, the pulse oximeter may give falsely high or low readings. When you are conducting a complete patient assessment, consider using pulse oximetry readings as one additional measure while obtaining all of the other comprehensive information you need. Assess the patient for signs and symptoms of adequate oxygenation. If a patient has signs, such as cyanosis, pale or clammy skin, or symptoms, such as shortness of breath and normal Spo_2, treat the patient's condition, not the environment.

Skill Drill 10-1 Performing Pulse Oximetry

Step 1

Clean the patient's finger, and place the index or middle finger into the pulse oximeter probe. Turn on the pulse oximeter, and note the LED reading of the Spo$_2$.

Step 2

Palpate the radial pulse to ensure that it correlates with the LED display on the pulse oximeter.

Pulse oximetry cannot measure the effectiveness of ventilation nor provide information about cellular metabolism. To assess ventilation, you will need to measure exhaled carbon dioxide levels. Carbon dioxide is a by-product of aerobic metabolism.

End-tidal co$_2$ is the partial pressure or maximal concentration of co$_2$ at the end of an exhaled breath. When the co$_2$ level is low or absent, it indicates a decrease in the level of co$_2$ in the lungs. This may be caused by absent or decreased ventilation or from cardiac arrest, ineffective CPR, hypothermia, or shock. When cardiac output increases, end-tidal co$_2$ levels generally increase—a reflection of improved oxygen delivery.

End-tidal co$_2$ is measured by capnometry and capnography devices. **Capnometry** typically refers to a device that provides a digital numerical reading of the end-tidal co$_2$ level. **Capnography** provides both a numerical reading and a graph, or real-time image, of the end-tidal carbon dioxide levels from breath to breath. The digital display of end-tidal co$_2$ is expressed in millimeters of mercury (mm Hg) **Figure 10-17**. The normal range is 35 to 45 mm Hg. Although in the past end-tidal co$_2$ monitoring was primarily used to assess proper advanced airway placement, it is now used routinely on many respiratory distress calls. Paramedic or other ALS providers use these devices as a secondary means to determine proper placement of an advanced airway, assess a patient's ventilatory status, and avoid inadvertent hyperventilation of patients with head injuries, which has been linked to poor outcomes. Additionally, waveform capnography provides data that can be used to determine changes in cardiac output. It also offers the first indication of return of spontaneous circulation (ROSC) after cardiac arrest.

Figure 10-17 A capnometer.

Courtesy of Marianne Gausche-Hill, MD, FACEP, FAAP.

Opening the Airway

Emergency medical care begins with ensuring an open airway. If you cannot immediately open and maintain a patent airway, you cannot provide effective patient care. Regardless of the patient's condition, the airway must remain patent at all times.

When you respond to a call and find an unconscious patient, you need to quickly assess for a pulse and breathing; if the patient has a pulse, you need to determine whether breathing is adequate. Remember that airway and breathing are two separate components that are closely related to each other. However, you must understand that adequate breathing does not always equate to an adequate airway. To most effectively open the airway and assess breathing, the unresponsive patient should be in the supine position. However, if your patient is in a situation that delays placement in a supine position (for example, entrapped in a vehicle), the patient's airway must be opened and assessed in the position in which you find the patient. If your patient is found in the prone position (lying facedown), he or she must be repositioned to allow for assessment of airway and breathing and to begin CPR, should it become necessary. Today health care workers are taught to begin CPR with high-quality compressions if cardiac arrest is suspected. The patient should be log rolled as a unit so the head, neck, and spine all move together without twisting. While care should be taken to avoid injury, remember that airway management almost always takes priority and should not be delayed when caring for patients with life-threatening conditions. Unconscious patients, especially when there are no witnesses who can rule out trauma, should be moved as a unit because of the potential for spinal injury. To position the unconscious patient in order to open the airway, follow the steps in **Skill Drill 10-2**:

1. Kneel beside the patient. Make sure you kneel far enough away so that the patient, when rolled toward you, does not come to rest in your lap. Place your hands behind the patient's head and neck to provide inline stabilization of the cervical spine as your partner straightens the patient's legs **Step 1**.
2. Have your partner place his or her hands on the patient's far shoulder and hip **Step 2**.
3. As you call the count to control movement, have your partner turn the patient toward you by pulling on the far shoulder and hip. Control the head and neck so that they move as a unit with the rest of the torso. In this way, the head and neck stay in the same vertical plane as the back. This single motion will minimize aggravation of any potential

spine injury. At this point, apply a cervical collar. Place the patient's arms at his or her side **Step 3**.

4. Once the patient is positioned, maintain an open airway and check for breathing **Step 4**.

In an unconscious patient, the most common airway obstruction is the patient's tongue, which falls back into the throat when the muscles of the throat and tongue relax **Figure 10-18**. Dentures (false teeth), blood, vomitus, mucus, food, and other foreign objects may also create an airway obstruction. Therefore, always be prepared to help clear and maintain a patent airway with the use of suction and placement of an airway adjunct, such as an oral or nasal airway.

Head Tilt–Chin Lift Maneuver

Opening the airway to relieve an obstruction can often be done quickly and easily by simply tilting the patient's head back and lifting the chin in what is known as the **head tilt–chin lift maneuver**. For patients who have not sustained or are not suspected of having sustained spinal trauma, this simple maneuver is sometimes all that is needed for the patient to resume breathing.

To perform the head tilt–chin lift maneuver, follow these steps:

1. With the patient in a supine position, position yourself beside the patient's head.
2. Place the heel of one hand on the patient's forehead, and apply firm backward pressure with your palm to tilt the patient's head back. This extension of the neck will move the tongue forward, away from the back of the throat, and clear the airway if the tongue is blocking it.
3. Place the fingertips of your other hand under the lower jaw near the bony part of the chin. Do not compress the soft tissue under the chin, as this may block the airway.
4. Lift the chin upward, bringing the entire lower jaw with it, helping to tilt the head back. Do not use your thumb to lift the chin. Lift so that the teeth are nearly brought together, but avoid closing the mouth completely. Continue to hold the forehead to maintain the backward tilt of the head **Figure 10-19**.

Skill Drill 10-2 Positioning the Unconscious Patient

Step 1

Support the head while your partner straightens the patient's legs.

Step 2

Have your partner place his or her hand on the patient's far shoulder and hip.

Step 3

Roll the patient as a unit with the EMT at the patient's head calling the count to begin the move.

Step 4

Open and assess the patient's airway and breathing status.

Words of Wisdom

Causes of airway obstruction include:

- Relaxation of the tongue in an unresponsive patient
- Foreign objects (food, small toys, dentures)
- Blood clots, broken teeth, or damaged oral tissue following trauma
- Airway tissue swelling (infection, allergic reaction)
- Aspirated vomitus (stomach contents)

Jaw-Thrust Maneuver

The head tilt–chin lift maneuver will open the airway in most patients. However, if you suspect a cervical spine injury, use the jaw-thrust maneuver. The **jaw-thrust maneuver** is a technique to open the airway by placing the fingers behind the angle of the jaw and lifting the jaw upward. You can easily seal a mask around the mouth while doing the jaw-thrust maneuver. Refer to Chapter 28, *Head and Spine Injuries,* for a more detailed discussion of these types of injuries.

Perform the jaw-thrust maneuver in an adult using the following steps **Figure 10-20**:

1. Kneel above the patient's head. Place your fingers behind the angles of the lower jaw, and move the jaw upward. Use your thumbs to help position the lower jaw to allow breathing through the mouth and nose.
2. The completed maneuver should open the airway with the mouth slightly open and the jaw jutting forward.

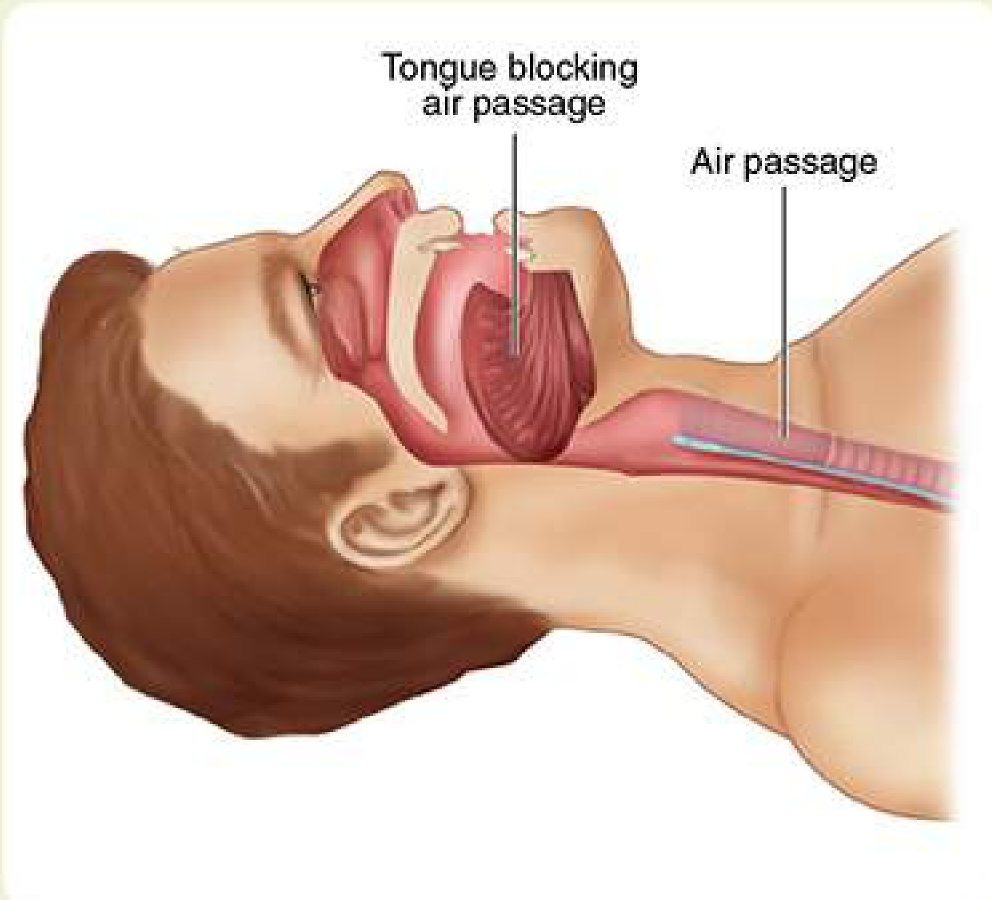


Figure 10-18 The most common airway obstruction is the patient's own tongue, which falls back into the throat when the muscles of the throat and tongue relax.

Figure 10-19 The head tilt–chin lift maneuver is a simple technique for opening the airway in a patient without a suspected cervical spine injury.

Special Populations

Patients with a history of rheumatoid arthritis or Down syndrome are predisposed to instability of the cervical spine, specifically at the first and second cervical vertebrae. The head tilt–chin lift maneuver should be avoided on these patients. Excessive force or hyperextension of the neck can cause partial dislocation of the cervical spine, which can potentially lead to paralysis. It is often better to open the airway of these patients using a jaw-thrust maneuver.

Patients who have a pulse may start to breathe on their own once the airway has been opened. Assess whether breathing has returned by quickly looking at the chest and observing for obvious movement **Figure 10-21**.

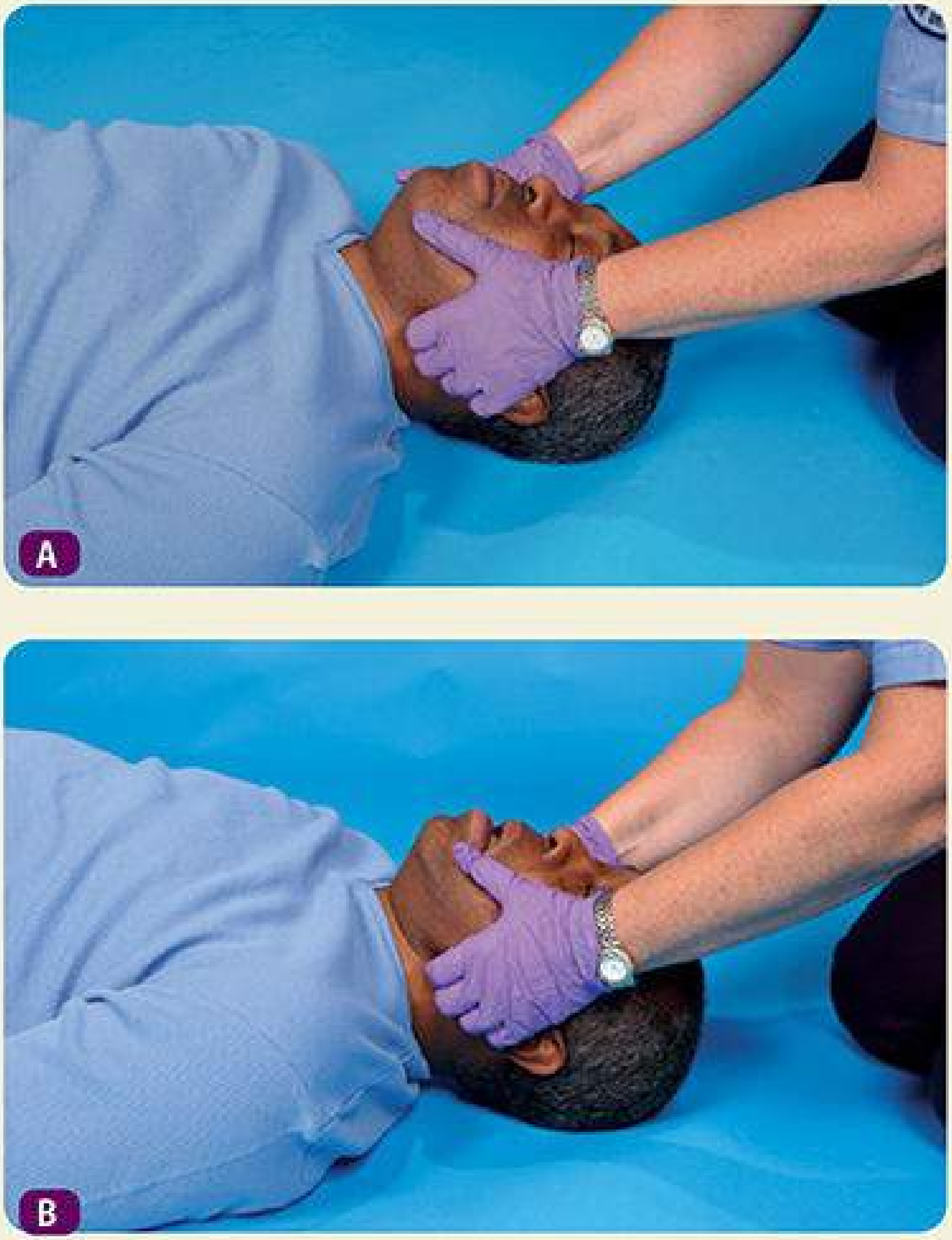


Figure 10-20 Performing the jaw-thrust maneuver. **A.** Kneeling above the patient's head, place your fingers behind the angles of the lower jaw, and move the jaw upward. Use your thumbs to help position the lower jaw. **B.** The completed maneuver should look like this.

With complete airway obstruction, there will be no movement of air. However, you may see the chest and abdomen rise and fall considerably with the patient's frantic attempts to breathe. This is why the presence of chest wall movement alone does not indicate if adequate breathing is present. Regular chest wall movement indicates a respiratory effort is present. Observing chest and abdominal movement is often difficult with a fully clothed patient. You may see little, if any, chest movement, even with normal breathing. This is particularly true in some patients with chronic lung disease if you discover that there is no movement of air.

Figure 10-21 Looking at the chest and observing for obvious movement can be used to assess whether breathing has spontaneously returned.

▶ Opening the Mouth

Even though you may have opened the airway with a head tilt–chin lift or jaw-thrust maneuver, the patient's mouth may still be closed. To open the mouth, place the tips of your index finger and thumb on the patient's teeth. Then, open the mouth by pushing your thumb on the lower teeth and index finger on the upper teeth. This pushing motion will cause the index finger and thumb to cross over each other, which is why this is called the cross-finger technique.

Suctioning

You must keep the airway clear so that you can ventilate the patient properly. If the airway is not clear, you will force the fluids and secretions into the lungs and possibly cause a complete airway obstruction. Therefore, suctioning is your next priority. If you have any doubt about the situation, remember this rule: If you hear gurgling, the patient needs suctioning!

YOU are the Provider — PART 3

Your partner begins treating the patient while you obtain his vital signs and ask his wife what he was doing when his respiratory distress began. She tells you that he began reporting slight shortness of breath the day before, but it suddenly worsened today when he was sitting on the couch reading the newspaper.

Recording Time: 2 Minutes	
Respirations	30 breaths/min, labored
Pulse	120 beats/min, weak
Skin	Cool and moist; cyanosis around the mouth
Blood pressure	126/60 mm Hg
Oxygen saturation (Spo_2)	88% (on oxygen)

7. What is cyanosis? What does it indicate?

8. What does the patient's oxygen saturation indicate?

Suctioning Equipment

Portable, hand-operated, and fixed (mounted) suctioning equipment is essential for resuscitation **Figure 10-22**.

A portable suctioning unit must provide enough vacuum pressure and flow to allow you to suction the mouth and nose effectively. Hand-operated suctioning units with disposable chambers are reliable, effective, and relatively inexpensive. A fixed suctioning unit should generate airflow of more than 40 L/ min and a vacuum of more than 300 mm Hg when the tubing is clamped.

Figure 10-22 Suctioning equipment is essential for resuscitation. **A.** Hand-operated unit. **B.** Fixed unit. **C.** Portable unit.

A portable or fixed suctioning unit should be fitted with the following:

- Wide-bore, thick-walled, nonkinking tubing
- Plastic, rigid pharyngeal suction tips, called **tonsil tips** or Yankauer tips
- Nonrigid plastic catheters, called French or whistle-tip catheters
- A nonbreakable, disposable collection bottle
- Water for rinsing the tips

A **suction catheter** is a hollow, cylindrical device that is used to remove fluids from the patient's airway. A tonsil-tip catheter is the best kind of catheter for infants and children. The plastic tips have a large diameter and are rigid, so they do not collapse **Figure 10-23**.

Tips with a curved contour allow for easy, rapid placement in the oropharynx. Nonrigid plastic catheters, sometimes called French or whistle-tip catheters, are used to suction the nose and liquid secretions in the back of the mouth and in situations in which you cannot use a rigid catheter, such as for a patient with a **stoma** **Figure 10-24**. A stoma is an opening through the skin that goes into an organ or other structure.

For example, a rigid catheter could break off a patient's tooth, whereas a flexible catheter may be inserted along the cheeks without injury. Before you insert any catheter, make sure to measure for the proper size. Use the same technique you would use when measuring for an oropharyngeal airway. Be careful not to touch the back of the airway with a suction catheter. This can activate the gag reflex, causing vomiting, and increase the possibility of aspiration.

Figure 10-23 Tonsil-tip (Yankauer tip) catheters are the best for suctioning because they have wide-diameter tips and are rigid.

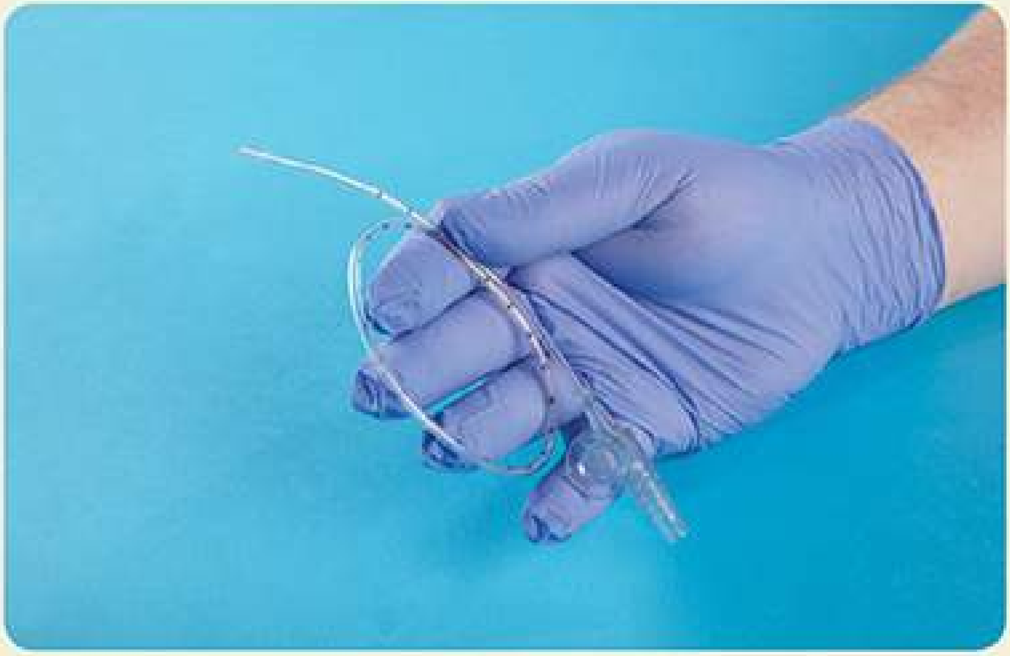


Figure 10-24 French, or whistle-tip, catheters are used in situations in which rigid catheters cannot be used, such as with a patient who has a stoma, patients whose teeth are clenched, or if suctioning the nose is necessary.

Words of Wisdom

Any time there are fluids in the airway, the risk of aspiration increases. Aspiration may increase the risk of mortality by 30% to 70%.

Techniques of Suctioning

Inspect your suctioning equipment regularly to make sure it is in proper working condition. Turn on the suction, clamp the tubing, and make sure that the unit generates a vacuum of more than 300 mm Hg. Check that a battery-charged unit has charged batteries. Ensure that your suctioning equipment is placed at the patient's head and is easily accessible. Follow these general steps to operate the suction unit:

1. Check the unit for proper assembly of all its parts.
2. Turn on the suctioning unit and test it to ensure a vacuum pressure of more than 300 mm Hg.
3. Select and attach the appropriate suction catheter to the tubing.

Never suction the mouth or nose for more than 15 seconds at one time for adult patients, 10 seconds for children, and 5 seconds for infants. Suctioning removes oxygen from the airway along with the obstructive material and can result in hypoxia. Rinse the catheter and tubing with water to prevent clogging of the tube with dried vomitus or other secretions. Repeat suctioning only after the patient has been adequately ventilated and reoxygenated.

Use extreme caution when suctioning a conscious or semiconscious patient. Put the tip of the suction catheter in only as far as you can visualize. Be aware that suctioning may induce vomiting.

To properly suction a patient, follow the steps in Skill Drill 10-3:

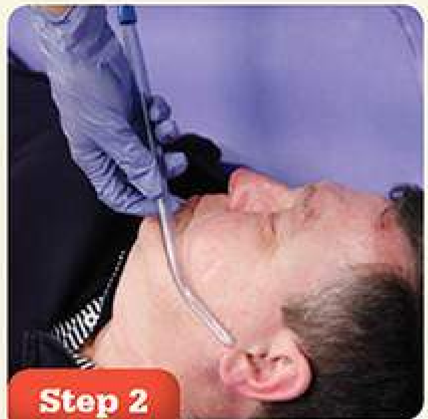
1. Turn on the assembled suction unit. To test the suction, clamp the tubing, and make sure that the unit generates a vacuum of more than 300 mm Hg **Step 1**.
2. Measure the catheter to the correct depth by measuring the catheter from the corner of the patient's mouth to the edge of the earlobe or angle of the jaw **Step 2**.
3. Before applying suction, turn the patient's head to the side (unless you suspect cervical spine injury). Open the patient's mouth using the cross-finger technique or tongue-jaw lift, and insert the tip of the catheter to the depth measured. Do not suction while inserting the catheter **Step 3**.
4. Insert the catheter to the premeasured depth and apply suction in a circular motion as you withdraw the catheter. Do not suction an adult for more than 15 seconds **Step 4**.

At times, a patient may have secretions or vomitus that cannot be suctioned quickly and easily, and some suction units cannot effectively remove solid objects such as teeth, foreign bodies, and food. In these cases, you should remove the catheter from the patient's mouth, log roll the patient to the side, and then clear the mouth carefully with your gloved finger. Only attempt to remove an object if it is visible during examination of the open mouth; blind sweeps of the back of the oropharynx may push an object farther down in the airway, making the obstruction worse. A patient who requires assisted ventilations may also produce frothy secretions as quickly as you can suction them from the airway. In this situation, suction the patient's airway for 15 seconds (less time in infants and children), and then ventilate the patient for 2 minutes. Continue this alternating pattern of suctioning and ventilating until all secretions have been cleared from the patient's airway. Continuous ventilation is not appropriate if vomitus or other particles are present in the airway.

Skill Drill 10-3 Suctioning a Patient's Airway

Step 1

Make sure the suctioning unit is properly assembled and turn it on. Clamp the tubing, and make sure that the unit generates a vacuum of more than 300 mm Hg.



Step 2

Measure the catheter from the corner of the mouth to the earlobe or angle of the jaw.

Step 3

Turn the patient's head to the side (unless you suspect cervical spine injury), open the mouth using the cross-finger technique or tongue-jaw lift, and insert the catheter to the predetermined depth without suctioning.

Step 4

Apply suction in a circular motion as you withdraw the catheter. Do not suction an adult for more than 15 seconds.

Clean and decontaminate your suctioning equipment after each use according to the manufacturer's guidelines. Place all disposable suctioning equipment (such as catheter, suction tubing) in a biohazard bag.

Words of Wisdom

Suctioning Time Limits:

Adult: 15 seconds

Child: 10 seconds

Infant: 5 seconds

Basic Airway Adjuncts

The primary function of an airway adjunct is to prevent obstruction of the upper airway by the tongue and allow the passage of air and oxygen to the lungs.

Oropharyngeal Airways

An **oropharyngeal (oral) airway** has two principal purposes. The first is to keep the tongue from blocking the upper airway. The second is to make it easier to suction the oropharynx if necessary. Suctioning is possible through an opening down the center or along either side of the oropharyngeal airway **Figure 10-25**.

Figure 10-25 An oral airway is used for unconscious patients who have no gag reflex. It keeps the tongue from blocking the airway and makes suctioning the airway easier.

Indications for the oral airway include the following:

- Unresponsive patients without a gag reflex (breathing or apneic)
- Any apneic patient being ventilated with a BVM

Contraindications for the oral airway include the following:

- Conscious patients
- Any patient (conscious or unconscious) who has an intact gag reflex

The **gag reflex** is a protective reflex mechanism that prevents food and other particles from entering the airway. If you try to insert an oral airway in a patient with an intact gag reflex, the result may be vomiting or a spasm of the vocal cords. If the patient gags while you are attempting to insert an oral airway, immediately remove the adjunct and prepare to log roll the patient and suction the oropharynx, should vomiting occur. An oral airway is also a safe, effective way to help maintain the airway of a patient with a possible spinal injury. The use of an oral airway may make manual airway maneuvers such as the head tilt–chin lift and the jaw thrust easier to maintain; however, manual maneuvers are often still needed to ensure that the airway remains open.

You must clearly understand when and how this device is used. If the oropharyngeal airway is too large, it could actually push the tongue back into the pharynx, blocking the airway. Conversely, an oral airway that is too small could block the airway directly, just like any foreign body obstruction. The following steps should be used when inserting an oropharyngeal airway **Skill Drill 10-4**:

1. To select the proper size, measure from the patient's earlobe or angle of the jaw to the corner of the mouth **Step 1**.
2. Open the patient's mouth with the cross-finger technique. Hold the airway upside down with your other hand. Insert the airway with the tip facing the roof of the mouth **Step 2**.
3. Rotate the airway 180 degrees. When inserted properly, the airway will rest in the mouth with the curvature of the airway following the contour of the anatomy. The flange should rest against the lips or teeth, with the other end opening into the pharynx **Step 3**.

Take care to avoid injuring the hard palate (roof of the mouth) as you insert the airway. Roughness can cause bleeding that may aggravate airway problems or even cause vomiting.

Special Populations

In children, the only acceptable method of inserting an oral airway is to use a tongue blade to hold the tongue down while inserting the airway. Because the airways of children are undeveloped, rotating an oropharyngeal airway in the posterior pharynx may cause damage. For more discussion on pediatric airways, see Chapter 34, *Pediatric Emergencies*.

If you encounter difficulty while inserting the oral airway, insert the airway with a 90-degree rotation **Skill Drill 10-5**:

1. Use a tongue depressor or bite stick to depress the tongue, ensuring the tongue remains forward **Step 1**.
2. Insert the oral airway sideways from the corner of the mouth, until the flange reaches the teeth **Step 2**.
3. Rotate the oral airway 90 degrees, removing the depressor or bite stick as you exert gentle backward pressure on the oral airway until it rests securely in place against the lips and teeth **Step 3**.

In some cases, a patient may become responsive and regain the gag reflex after you have inserted an oral airway. If this occurs, gently remove the airway by pulling it out, following the normal curvature of the mouth and throat. Be prepared for the patient to vomit. Have suction available, and log roll the patient onto his or her side and allow any fluids to drain out.

Skill Drill 10-4 Inserting an Oral Airway

Step 1

Size the airway by measuring from the patient's earlobe to the corner of the mouth.

Step 2

Open the patient's mouth with the cross-finger technique. Hold the airway upside down with your other hand. Insert the airway with the tip facing the roof of the mouth.

Step 3

Rotate the airway 180°. Insert the airway until the flange rests on the patient's lips and teeth. In this position, the airway will hold the tongue forward.

Nasopharyngeal Airways

A **nasopharyngeal (nasal) airway** is usually used with an unresponsive patient or a patient with an altered level of consciousness who has an intact gag reflex and is not able to maintain his or her airway spontaneously **Figure 10-26**.

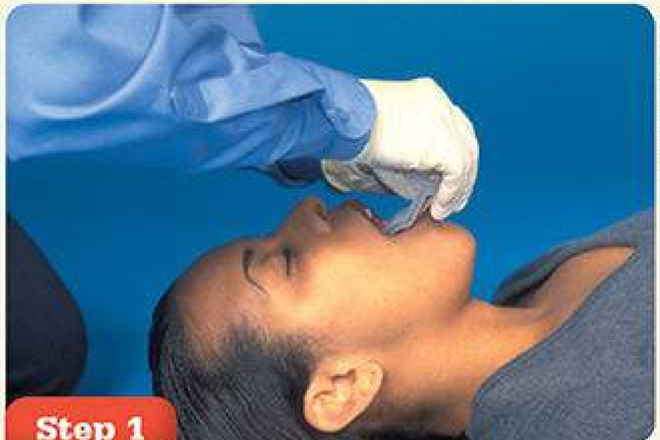
Patients with an altered mental status or who have just had a seizure may also benefit from this type of airway. If a patient has sustained severe trauma to the head or face, consult medical control before inserting a nasopharyngeal airway. Use extreme care with such trauma patients. If the nasal airway is accidentally pushed through a hole caused by a fracture of the base of the skull, it may penetrate into the brain.

Special Populations

When managing the airway of an older patient, be aware of the presence of dentures or other dental appliances. If dentures are tight-fitting and allow for effective airway management, leave them in place. However, if the dentures are loose, remove them to avoid potential airway obstruction.

Skill Drill 10-5

Inserting an Oral Airway With a 90° Rotation



Step 1

Depress the tongue so that it remains forward.

Step 2

Insert the oral airway sideways from the corner of the mouth, until the flange reaches the teeth.

Step 3

Rotate the oral airway at a 90° angle. Remove the bite stick as you exert gentle backward pressure on the oral airway until it rests securely in place against the lips and teeth.

This type of airway is usually better tolerated by patients who have an intact gag reflex. It is not as likely as the oropharyngeal airway to cause vomiting. Coat the airway well with a water-soluble lubricant before it is inserted. Be aware that slight bleeding may occur even when the airway is inserted properly. However, never force the airway into place.

Indications for the nasopharyngeal airway include the following:

- Semiconscious or unconscious patients with an intact gag reflex
- Patients who otherwise will not tolerate an oropharyngeal airway

Contraindications for the nasopharyngeal airway include the following:

- Severe head injury with blood draining from the nose
- History of fractured nasal bone

Follow these steps to ensure correct placement of the nasopharyngeal airway **Skill Drill 10-6**:

1. Before inserting the airway, be sure you have selected the proper size. Measure from the tip of the patient's nose to the earlobe. In almost all patients, one nostril is larger than the other **Step 1**.
2. The airway should be placed in the larger nostril, with the curvature of the device following the curve of the floor of the nose. If using the right nare, the bevel should face the septum **Step 2**. If using the left nare, insert the airway with the tip of the airway pointing upward, which will allow the bevel to face the septum.

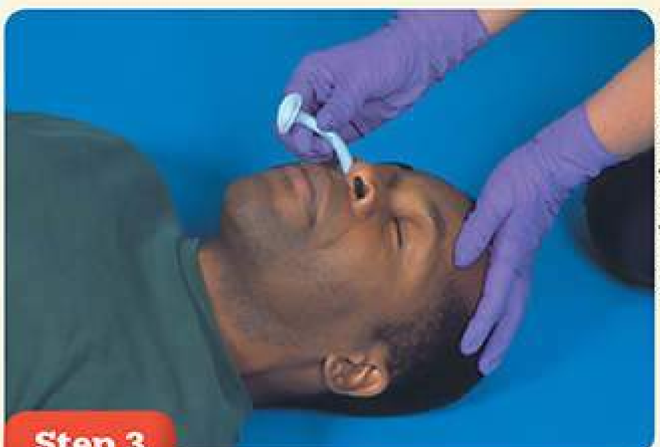
Skill Drill 10-6 Inserting a Nasal Airway

Step 1

Size the airway by measuring from the tip of the nose to the patient's earlobe. Coat the tip with a water-soluble lubricant.

Step 2

Insert the lubricated airway into the larger nostril with the curvature following the floor of the nose. If using the right nare, the bevel should face the septum. If using the left nare, insert the airway with the tip of the airway pointing upward, which will allow the bevel to face the septum.



Step 3

Gently advance the airway. If using the left nare, insert the nasopharyngeal airway until resistance is met. Then rotate the nasopharyngeal airway 180° into position. This rotation is not required if using the right nostril.

Step 4

Continue until the flange rests against the nostril. If you feel any resistance or obstruction, remove the airway and insert it into the other nostril.

3. Advance the airway gently **Step 3**. If using the left nare, insert the nasal airway until resistance is met. Then rotate the nasal airway 180^{o} into position. This rotation is not required if using the right nostril.
4. When completely inserted, the flange rests against the nostril. The other end of the airway opens into the posterior pharynx **Step 4**. If the patient becomes intolerant of the nasal airway, you may have to remove it. Gently withdraw

the airway from the nasal passage. Precautions similar to those used when removing an oral airway should be followed.

Figure 10-26 A nasal airway is better tolerated than an oral airway by patients who have an intact gag reflex.

Safety Tips

Wear a mask and protective eyewear whenever airway management involves suctioning. Body fluids can become aerosolized, and exposure to the mucous membranes of your mouth, nose, and eyes can easily occur.

Maintaining the Airway

The **recovery position** is used to help maintain a clear airway in an unconscious patient who is not injured and is breathing on his or her own with a normal respiratory rate and adequate tidal volume (depth of breathing) **Figure 10-27**.

Take the following steps to put the patient in the recovery position:

Figure 10-27 In the recovery position, the patient is rolled onto his or her left or right side.

© Jones & Bartlett Learning. Courtesy of MIEMSS.

1. Roll the patient onto either side so that the head, shoulders, and torso move at the same time without twisting.
2. Extend the patient's lower arm and place the upper hand under his or her cheek.

For patients who have resumed spontaneous breathing after being resuscitated, the recovery position will prevent the aspiration of vomitus. However, this position is not appropriate for patients with suspected spinal, hip, or pelvic injuries or for patients who are unconscious and require ventilatory assistance. Reposition such patients to provide adequate access to the airway while maintaining appropriate spinal stabilization.

Supplemental Oxygen

Always give supplemental oxygen to patients who are hypoxic because not enough oxygen is being supplied to the tissues and cells of the body.

Some tissues and organs, such as the heart, central nervous system, lungs, kidneys, and liver, need a constant supply of oxygen to function normally. *Never withhold oxygen from any patient who might benefit from it, especially if you must assist ventilations.*

When ventilating any patient in cardiac or respiratory arrest, use high-concentration supplemental oxygen.

Supplemental Oxygen Equipment

In addition to knowing when and how to give supplemental oxygen, you must understand how oxygen is stored and the various hazards associated with its use.

Oxygen Cylinders

The oxygen that you will give to patients is usually supplied as a compressed gas in green, seamless, steel or aluminum cylinders. Some cylinders may be silver or chrome with a green area around the valve stem on top. Newer cylinders are often made of lightweight aluminum or spun steel; older cylinders are much heavier.

Check to make sure that the cylinder is labeled for medical oxygen. Look for letters and numbers stamped into the metal on the collar of the cylinder **Figure 10-28**. Of particular importance are the month and year stamps, which indicate when the cylinder was last tested. Generally, aluminum cylinders are tested every 5 years; composite cylinders are tested every 3 years.

Oxygen cylinders are available in several sizes. The two sizes that you will most often use are the D (or jumbo D) and M cylinders **Figure 10-29**. The D (or jumbo D) cylinder can be carried from your unit to the patient. The M tank remains on board your unit as a main supply tank. Other sizes that you will see are A, E, G, H, and K **Table 10-4**. Another naming system for identifying the size of the oxygen cylinder has been introduced. Per this naming convention, cylinders are labeled with M (for medical), followed by a number.

The length of time you can use an oxygen cylinder depends on the pressure in the cylinder and the flow rate. A method of calculating cylinder duration is shown in Table 10-5.

Liquid Oxygen

Like all gases, oxygen changes from a gas to a liquid when cooled. Liquid oxygen is becoming more commonly used as an alternative to compressed gas oxygen. Liquid oxygen containers tend to be more expensive than compressed oxygen tanks; however, the containers hold a large volume of oxygen and do not need to be filled as often. Liquid oxygen units also weigh less than aluminum or steel tanks. For these reasons, many people who receive long-term oxygen therapy use liquid oxygen units. Unfortunately, liquid oxygen tanks generally need to be kept upright and have special requirements for filling, large-volume storage, and cylinder transfer.

Figure 10-28 Oxygen tanks for medical use have a series of letters and numbers stamped into the metal on the collar of the cylinder.

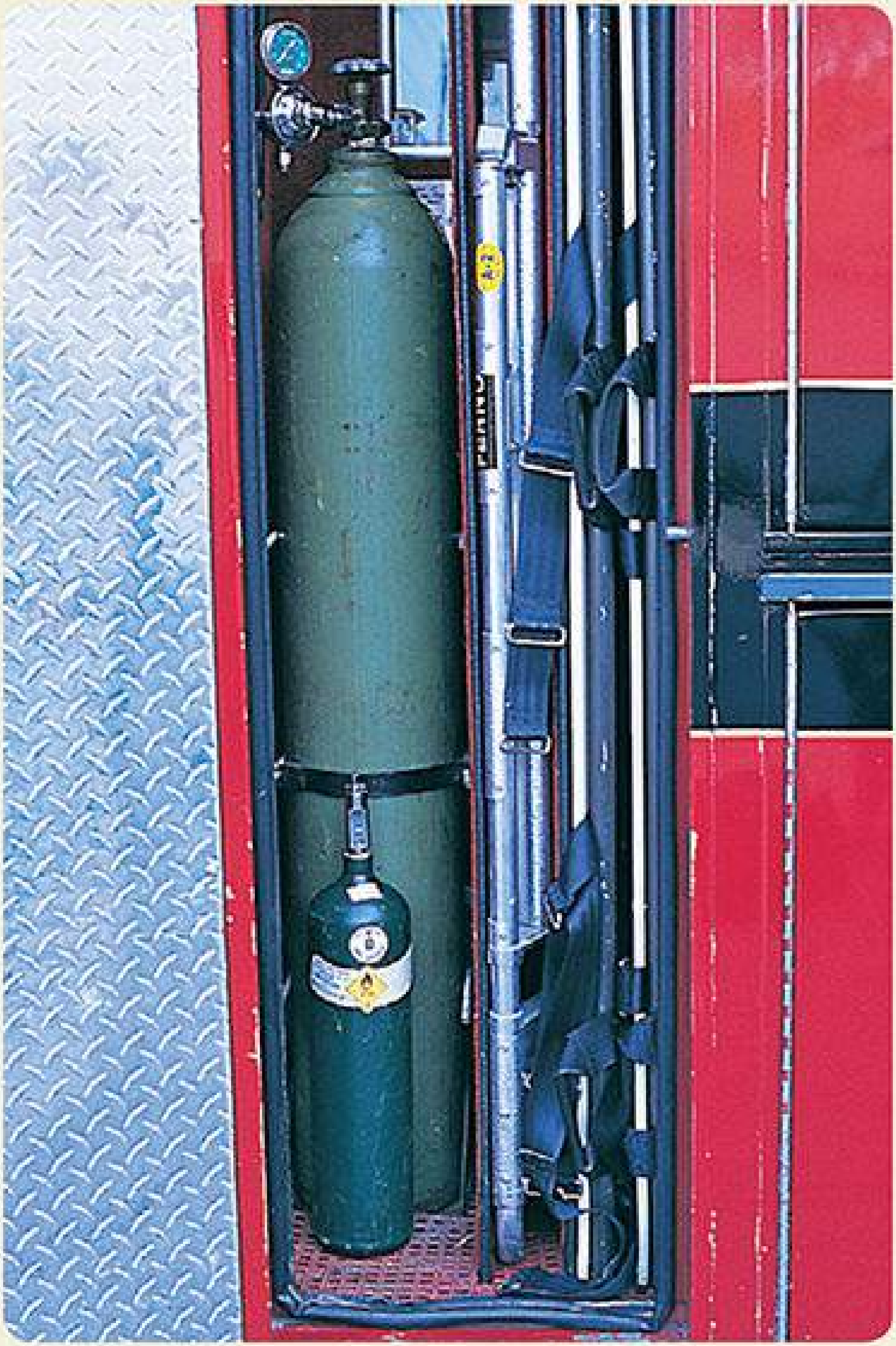


Figure 10-29 The cylinders that are most commonly found on an ambulance are the D (or jumbo D) and M size cylinders. D, Super D, and E sizes are typically portable tank systems while the M, G, H, A, and K sizes are mounted inside the ambulance.

Table 10-4 Oxygen Cylinder Sizes Carried on the Ambulance

Size	Volume, Liters
D	350
Jumbo D	500
E	625
M (MM)	3,000
G	5,300
H, A (M4), K	6,900

Table 10-5 Oxygen Cylinders: Duration of Flow

Formula
$\frac{\text{(Gauge pressure in psi – Safe residual pressure)} \times \text{Cylinder constant}}{\text{Flow rate in L/min}}$ = Duration of flow in minutes
Safe residual pressure = 200 psi
Cylinder constant for a given cylinder size: A = 3.14 G = 2.41 D = 0.16 H = 3.14 E = 0.28 K = 3.14 M = 1.56
Determine the life of an M cylinder that has a pressure of 2,000 psi and a flow rate of 10 L/min.
$\frac{(2{,}000 - 200) \times 1.56}{10} = \frac{2{,}808}{10}$ = 281 min, or 4 h 41 min
psi = pounds per square inch.

Safety Considerations

Handle compressed gas cylinders carefully because their contents are under pressure. Cylinders are fitted with pressure regulators to make sure that patients receive the right amount and type of gas. Make sure that the correct pressure regulator is firmly attached before you transport the cylinders. A puncture or hole in the tank can cause the cylinder to become a deadly missile. Do not handle a cylinder by the neck assembly alone. Secure cylinders with mounting brackets when they are stored on the ambulance. Oxygen cylinders that are in use during transport should be positioned and secured to prevent the tank from falling, damaging the valve-gauge assembly, or becoming a dangerous projectile during a collision.

Pin-Indexing System

The compressed gas industry has established a **pin-indexing system** for portable cylinders to prevent an oxygen regulator from being connected to a carbon dioxide cylinder, a carbon dioxide regulator from being connected to an oxygen cylinder, and so on. In preparing to administer oxygen, always check to be sure that the pinholes on the cylinder exactly match the corresponding pins on the regulator.

The pin-indexing system features a series of pins on a yoke that must be matched with the holes on the valve stem of the gas cylinder. The arrangement of the pins and holes varies for different gases according to accepted national standards **Figure 10-30**. Other gases that are supplied in portable cylinders, such as acetylene, carbon dioxide, and nitrogen, use regulators and flowmeters that are similar to those used with oxygen. Each cylinder of a specific gas type has a given pattern and a given number of pins. These safety measures make it impossible for you to attach a cylinder of nitrous oxide to an oxygen regulator. The oxygen regulator will not fit.

The outlet valves on portable oxygen cylinders are designed to accept yoke-type pressure-reducing gauges, which conform to the pin-indexing system **Figure 10-31**.

The safety system for the large cylinders is known as the **American Standard Safety System**. In this system, oxygen cylinders are equipped with threaded gas outlet valves. The inside and outside thread sizes of these outlets vary depending on the gas in the cylinder. The cylinder will not accept a regulator valve unless it is properly threaded to fit that regulator. The purpose of these safety devices is the same as in the pin-indexing system: to prevent the accidental attachment of a regulator to a wrong cylinder.

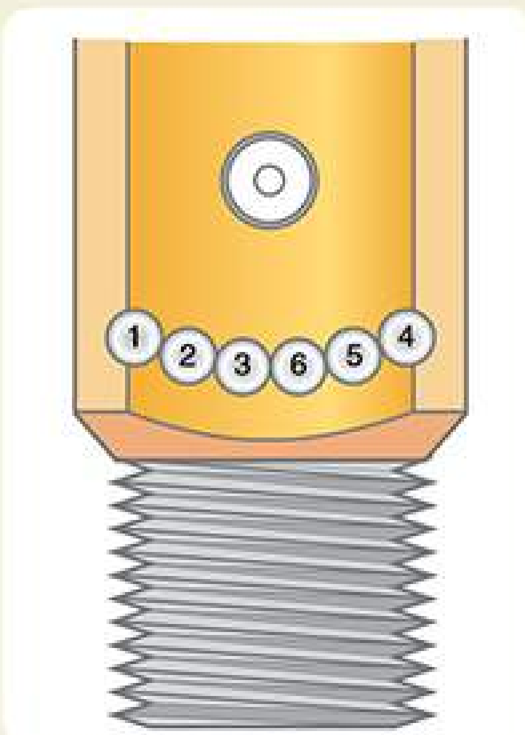


Figure 10-30 The locations of the pin-indexing safety system holes in a cylinder valve face. Each cylinder of a specific gas has a given pattern and a given number of pins.

Figure 10-31 A yoke-type pressure-reducing gauge is used with a portable oxygen cylinder.

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Pressure Regulators

The pressure of the gas in a full oxygen cylinder is approximately 2,000 psi. This is far too much pressure to be safe or useful for your purposes. Pressure regulators reduce the pressure to a more useful range, usually 40 to 70 psi. Most pressure regulators in use today reduce the pressure in a single stage, although multi-stage regulators exist. A two-stage regulator will reduce the pressure first to 700 psi and then to 40 to 70 psi.

After the pressure is reduced to a workable level, the final attachment for delivering the gas to the patient is usually one of the following:

- A quick-connect female fitting that will accept a quick-connect male plug from a pressure hose or ventilator/resuscitator
- A flowmeter that will permit the regulated release of gas measured in liters per minute

Flowmeters

Flowmeters are usually permanently attached to pressure regulators on emergency medical equipment. The two types of flowmeters that are commonly used are pressure-compensated flowmeters and Bourdon-gauge flowmeters.

A pressure-compensated flowmeter incorporates a float ball within the tapered calibrated tube. The flow of gas is controlled by a needle valve located downstream from the float ball. This type of flowmeter is affected by gravity and must always be maintained in an upright position for an accurate flow reading **Figure 10-32**.

The Bourdon-gauge flowmeter is not affected by gravity and can be used in any position **Figure 10-33**. It is a pressure gauge that is calibrated to record flow rate. This type of flowmeter, however, is generally now considered outdated. New flowmeters incorporate a fixable setting with either a dial or a knob that sets the flow. In these regulators, a Bourdon-gauge is not necessary.

Procedures for Operating and Administering Oxygen

To place an oxygen cylinder into service and administer medical oxygen to a patient, follow the steps in **Skill Drill 10-7**:

1. Inspect the cylinder and its markings. If the cylinder was commercially filled, it will have a plastic seal around the valve stem covering the opening in the stem. Remove the seal, and inspect the opening to make sure that it is free of dirt and other debris. The valve stem should not be sealed or covered with adhesive tape or any petroleum-based substances. These can contaminate the oxygen and can contribute to combustion when mixed with pressurized oxygen.

Figure 10-32 A pressure-compensated flowmeter contains a float ball that rises or falls according to the gas flow within the tube. It must be maintained in an upright position for an accurate reading.

"Crack" the cylinder by slowly opening and then reclosing the valve to help make sure that the dirt particles and other possible contaminants do not enter the oxygen flow. Never face the tank toward yourself or others when cracking the cylinder. Open the tank by attaching a tank key (wrench) to the valve and rotating the valve counterclockwise. You should be able to hear clearly the rush of oxygen coming from the tank. Close the tank by rotating the valve clockwise **Step 1**.

2. Attach the regulator/flowmeter to the valve stem after clearing the opening. On one side of the valve stem, you will find three holes. The larger one, on top, is a true opening through which the oxygen flows. The two smaller holes below it do not extend to the inside of the tank. They provide stability to the regulator. Following the design of the pin-indexing system, these two holes are very precisely located in positions that are unique to the oxygen cylinders.

Figure 10-33 The Bourdon-gauge flowmeter is not affected by gravity and can be used in any position.

Above the pins on the inside of the collar is the actual port through which oxygen flows from the cylinder to the regulator. A metal-bound elastomeric sealing washer (also called a gasket) is placed around the oxygen port to optimize the airtight seal between the collar of the regulator and the valve stem **Step 2**. In the past, crush gaskets made of plastic and nylon were used, but are no longer recommended. If used, crush gaskets can be used only once and then they must be replaced.

3. Place the regulator collar over the cylinder valve, with the oxygen port and pin-indexing pins on the side of the valve stem that has the three holes. Open the screw bolt just enough to allow the collar to fit freely over the valve stem. Move the regulator so that the oxygen port and the pins fit into the correct holes on the valve stem. The screw bolt on the opposite side should be aligned with the dimple depression. As you hold the regulator securely against the valve stem, hand tighten the screw bolt until the regulator is firmly attached to the cylinder. At this point, you should not see any open spaces between the sides of the valve stem and the interior walls of the collar **Step 3**.

Skill Drill 10-7 Placing an Oxygen Cylinder Into Service

Step 1

Using an oxygen wrench, turn the valve counterclockwise to slowly "crack" the cylinder.

Step 2

Attach the regulator/flowmeter to the valve stem using the two pin-indexing holes and make sure that the washer is in place over the larger hole.

Step 3

Align the regulator so that the pins fit snugly into the correct holes on the valve stem, and hand tighten the regulator.

Step 4

Attach the oxygen connective tubing to the flowmeter.

4. With the regulator firmly attached, open the cylinder completely, check for air leaking from the regulator–oxygen cylinder connection, and read the pressure level on the regulator gauge. Most portable cylinders have a maximum pressure of approximately 2,000 psi. Most EMS systems consider a cylinder with less than 500 to 1,000 psi to be too low to keep in service. Learn your department's policies in this regard and follow them.

   The flowmeter will have a second gauge or a selector dial that indicates the oxygen flow rate. Several popular types of devices are widely used. Attach the selected oxygen device to the flowmeter by connecting the universal oxygen connecting tubing to the "Christmas tree" nipple on the flowmeter. Most oxygen-delivery devices come with this tubing permanently attached; however, some oxygen masks do not. You must attach this tubing to the oxygen-delivery device if it is not already attached **Step 4**.

Safety Tips

Slowly open the oxygen tank after attaching the regulator and check for leaks. Remember that although oxygen itself is not combustible, it supports combustion, and any ignition source may cause fire or an explosion in an oxygen-rich environment—especially if oxygen is being released too quickly from the cylinder at the time or if the seal between the regulator and oxygen cylinder is not secure.

Open the flowmeter to the desired flow rate. Flow rates will vary based on the oxygen-delivery device being used. Remember that you must be completely familiar with the equipment before attempting to use it on a patient. Once the oxygen is flowing at the desired rate, apply the oxygen device to the patient and make any necessary adjustments. Monitor the patient's response to the oxygen and to the oxygen device, and periodically recheck the regulator gauge to make sure there is sufficient oxygen in the cylinder. Disconnect the tubing from the flowmeter nipple and turn off the cylinder valve when oxygen therapy is complete or when the patient has been transferred to the hospital and is using the hospital's oxygen system. In a few seconds, the sound of oxygen flowing from the nipple will cease. This indicates that all the pressurized oxygen has been removed from the flowmeter. Turn off the flowmeter. The gauge on the regulator should read zero with the tank valve closed. This reading confirms that there is no pressure left above the valve stem. As long as there is a pressure reading on the regulator gauge, it is not safe to remove the regulator from the valve stem.

Hazards of Supplemental Oxygen

Combustion

Oxygen does not burn or explode. However, it does support combustion. The more oxygen is around, the faster the combustion process. A small spark, even a glowing cigarette, can become a flame in an oxygen-rich atmosphere. Therefore, you must keep any possible source of fire away from the area while oxygen is in use. Make sure the area is adequately ventilated, especially in industrial settings where hazardous materials may be present and where sparks are easily generated. Be extremely cautious in any enclosed environment in which oxygen is being administered, as an oxygen-rich environment increases the chance of fire if a spark or flame is introduced. A bystander who is smoking or sparks generated during vehicle extrication are possible sources of ignition. Never leave an oxygen cylinder standing unattended. The cylinder can be knocked over, injuring the patient or damaging the equipment.

Oxygen Toxicity

The administration of oxygen to patients is a common practice. While many patients in the prehospital environment require high concentrations of oxygen, not all patients do. Excessive supplemental oxygen can have a detrimental effect on patients with certain illnesses (ie, COPD, bronchopulmonary dysplasia).

Recent research has shown that while the administration of oxygen benefits many patients and is rarely problematic, high concentrations of oxygen are potentially harmful for a select population. **Oxygen toxicity** refers to damage to cellular tissue due to excessive oxygen levels in the blood. Years ago, high concentrations of oxygen were thought to benefit all patients in the prehospital environment. However, current evidence suggests that increased cellular oxygen levels contribute to the production of oxygen free radicals. These radicals may lead to tissue damage and cellular death in some patients.

The International Liaison Committee on Resuscitation guidelines published by the American Heart Association recognize there may be negative effects of oxygen toxicity and recommend that oxygen be administered to patients experiencing signs of a myocardial infarction when they have signs of heart failure, are short of breath, or have a room air oxygen saturation less than 94%. In addition, patients experiencing signs of shock should be placed on oxygen. Understand that hypoxemia is much worse than oxygen toxicity; when in doubt, or if unable to measure oxygen saturation reliably, supplemental oxygen should be administered.

Pulse oximetry is not always available to the EMT. When pulse oximetry is available, tailor oxygen therapy to the patient's needs, and administer the minimum amount of oxygen necessary to maintain oxygen saturation at or above 94%. Exceptions to these minimums include patients who have been exposed to carbon monoxide.

Oxygen-Delivery Equipment

In general, the oxygen-delivery equipment used in the field should be limited to nonrebreathing masks, BVMs, and nasal cannulas, depending on local protocol. However, you may encounter other devices during transports between medical facilities.

Nonrebreathing Masks

The nonrebreathing mask is the preferred way of giving oxygen in the prehospital setting to patients who are breathing adequately but are suspected of having or showing signs of hypoxia. With a good mask-to-face seal, it is capable of providing up to 90% inspired oxygen.

Words of Wisdom

Oxygen-Delivery Devices

Oxygen-Delivery Devices

Device	Flow Rate	Oxygen Delivered
Nasal cannula	1 to 6 L/min	24% to 44%
Nonrebreathing mask with reservoir	10 to 15 L/ min	Up to 95%
BVM with reservoir	15 L/min	Nearly 100%
Mouth-to-mask device	15 L/min	Nearly 55%

The nonrebreathing mask is a combination mask and reservoir bag system. Oxygen fills a reservoir bag that is attached to the mask by a one-way valve. The system is called a nonrebreathing mask because the exhaled gas escapes through flapper valve ports at the cheek areas of the mask Figure 10-34. These valves prevent the patient from rebreathing exhaled gases.

In this system, you must be sure that the reservoir bag is full before the mask is placed on the patient. Adjust the flow rate so that the bag does not fully collapse when the patient inhales, to about two-thirds of the bag volume, or 10 to 15 L/min. Make sure the bag stays inflated. Should the bag collapse when the patient inhales, increase the flow rate of oxygen. In addition, if oxygen therapy is discontinued, remove the mask from the patient's face. Leaving the mask in place while oxygen is not flowing allows the patient to rebreathe exhaled carbon dioxide. Use a pediatric nonrebreathing mask, which has a smaller reservoir bag, with infants and children, as they will inhale a smaller volume.

Figure 10-34 The nonrebreathing mask contains flapper valve ports at the cheek areas of the mask to prevent the patient from rebreathing exhaled gases.

Nasal Cannulas

A **nasal cannula** delivers oxygen through two small, tubelike prongs that fit into the patient's nostrils **Figure 10-35**. This device can provide 24% to 44% inspired oxygen when the flowmeter is set at 1 to 6 L/min. For the comfort of your patient, flow rates above 6 L/min are not recommended with the nasal cannula.

The nasal cannula delivers dry oxygen directly into the nostrils, which, over prolonged periods, can cause dryness or irritate the mucous membrane lining of the nose. Therefore, when you anticipate a long transport time, consider the use of humidification.

A nasal cannula has limited use in the prehospital setting. For example, a patient who breathes through the mouth or who has a nasal obstruction will likely get little or no benefit from a nasal cannula. Always try to give high-flow oxygen through a nonrebreathing mask if you suspect that a patient may have hypoxia, coaching the patient if necessary. If the patient will not tolerate a nonrebreathing mask, you will have to use a nasal cannula, which some patients find more comfortable. As always, a good assessment of your patient will guide your decision.

Figure 10-35 The nasal cannula delivers oxygen directly through the nostrils.

▶ Partial Rebreathing Masks

The partial rebreathing mask is similar to a nonrebreathing mask except that there is no one-way valve between the mask and the reservoir. Consequently, patients rebreathe a small amount of their exhaled air. This has some benefit when you want to increase the patient's partial pressure of carbon dioxide, which makes this the ideal mask for patients who you think are suffering from hyperventilation syndrome. The oxygen enriches the air mixture and delivers a gas mix of approximately 80% to 90% oxygen. You can easily convert a nonrebreathing mask to a partial rebreathing mask by removing the one-way valve between the mask and the reservoir bag.

▶ Venturi Masks

A Venturi mask has a number of attachments that enable you to vary the percentage of oxygen delivered to the patient while a constant flow is maintained from the regulator **Figure 10-36**. This is accomplished by the Venturi principle, which causes air to be drawn into the flow of oxygen as it passes a hole in the line. The Venturi mask is a medium-flow device that delivers 24% to 40% oxygen, depending on the manufacturer.

The main advantage of the Venturi mask is the use of its fine adjustment capabilities in the long-term management of physiologically stable patients. However, in the emergency setting, such fine adjustments are not necessary. When you need to adjust the oxygen concentration in an emergency, it is typically done by adjusting the flow rate or changing the delivery device.

▶ Tracheostomy Masks

Patients with tracheostomies do not breathe through their mouth and nose. A face mask or nasal cannula therefore cannot be used to treat them. Masks designed specifically for these patients cover the tracheostomy hole and have a strap that goes around the neck. These masks are usually available in intensive care units, where many patients have tracheostomies, and may not be available in an emergency setting. If you do not have a tracheostomy mask, you can improvise by placing a face mask over the stoma. Even though the mask is shaped to fit the face, you can usually get an adequate fit over the patient's neck by adjusting the strap Figure 10-37.

YOU are the Provider — PART 4

A rescue unit arrives at the scene to assist you and your partner. As you are preparing to load the patient onto the stretcher, you note that his level of consciousness has markedly diminished and he is making a snoring sound when he breathes. You immediately reassess him.

Recording Time: 6 Minutes	
Level of consciousness	Responsive only to pain
Respirations	10 breaths/min, shallow, snoring
Pulse	130 beats/min, weak
Skin	Cool and moist; cyanotic
Blood pressure	118/54 mm Hg
Spo_2	89% (on oxygen)

9. What should be your *most* immediate action?

10. How should you adjust your treatment of the patient?

Figure 10-36 The Venturi mask.

Figure 10-37 If you do not have a tracheostomy mask, use a face mask instead.

Humidification

Some EMS systems provide humidified oxygen to patients during extended transport or for certain conditions such as croup **Figure 10-38**. However, humidified oxygen is usually indicated only for long-term oxygen therapy. Dry oxygen is not considered harmful for short-term use. An oxygen humidifier consists of a small single-patient-use bottle of water through which the oxygen leaving the cylinder becomes moisturized before it reaches the patient. Because the humidifier must be kept in an upright position, however, it is practical only for the fixed oxygen unit in the ambulance. Therefore, many EMS systems do not use humidified oxygen in the prehospital setting. Always refer to medical control or local protocols for guidance involving patient treatment issues.

Figure 10-38 Giving humidified oxygen may be preferred with long transport times. However, the use of this type of oxygen-delivery system is not universal in all EMS systems.

Assisted and Artificial Ventilation

A patient who is not breathing needs artificial ventilation and 100% supplemental oxygen. Assisted and artificial ventilation are probably the most important skills in EMS—at any level. Too often emphasis is placed on advanced airway techniques, making the basic airway maneuvers seem ineffective. This cannot be further from the truth. Basic airway and ventilation techniques are extremely effective when administered appropriately. Mastery of these techniques at the EMT level is imperative.

Patients who are breathing inadequately are typically unable to speak in complete sentences. An irregular breathing pattern will also require artificial ventilation to assist patients in maintaining adequate minute volume. Keep in mind that fast, shallow breathing can be just as dangerous as very slow breathing. Fast, shallow breathing moves air primarily in the larger airway passages (dead air space) and does not allow for adequate exchange of air and carbon dioxide in the alveoli. Patients with inadequate breathing require assisted ventilations with some form of positive-pressure ventilation. Remember to follow standard precautions as needed when managing the patient's airway.

Words of Wisdom

Methods of Ventilation (listed in order of preference)

- Mouth-to-mask with one-way valve
- Two-person BVM with reservoir and supplemental oxygen
- Manually triggered ventilation device (flow-restricted, oxygen-powered ventilation device)
- One-person BVM with oxygen reservoir and supplemental oxygen

Note: This order of preference has been stated because research has shown that personnel who infrequently ventilate patients have great difficulty maintaining an adequate seal between the mask and the patient's face.

Assisting Ventilation in Respiratory Distress/Failure

When a patient is in severe respiratory distress or respiratory failure and not breathing adequately, you must intervene quickly to prevent further deterioration of the patient. Two treatment options are available in these situations: assisted ventilation and continuous positive airway pressure (CPAP). CPAP is discussed later in this chapter; the focus of this section will be on assisted ventilation.

The purpose of assisted ventilations is to improve the overall oxygenation and ventilatory status of the patient. Patients who require assisted ventilations are no longer able to maintain adequate oxygen levels for the body and need assistance to prevent further hypoxia.

You need to be familiar with the signs and symptoms associated with inadequate ventilation. Signs of altered mental status and inadequate minute volume are indications for assisted ventilation. In addition, excessive accessory muscle use and fatigue from labored breathing are signs of potential respiratory failure. Patients exhibiting these signs need immediate treatment.

Follow these steps to assist a patient with ventilations using a BVM:

1. Explain the procedure to the patient.
2. Place the mask over the patient's nose and mouth.
3. Squeeze the bag each time the patient breathes, maintaining the same rate as the patient.
4. After the initial 5 to 10 breaths, slowly adjust the rate and deliver an appropriate tidal volume.
5. Adjust the rate and tidal volume to maintain an adequate minute volume.

Artificial Ventilation

Patients who are in respiratory arrest need immediate treatment. Without it, they will die. However, the act of breathing for a patient, or artificial ventilation, is not a skill you should take lightly. Once you determine that a patient is not breathing, begin artificial ventilation immediately. The methods that you may use to provide artificial ventilation include the mouth-to-mask technique, a one- or two-person BVM, and the manually triggered ventilation device.

Normal Ventilation Versus Positive-Pressure Ventilation

It is important to understand that while artificial ventilations are necessary to sustain life, they are not the same as normal breathing. As discussed earlier, the act of air moving in and out of the lungs is based on pressure changes within the thoracic cavity. During normal ventilation, the diaphragm contracts and negative pressure is generated in the chest cavity. This essentially sucks air into the chest from the trachea in an attempt to equalize the pressure in the chest with the atmospheric pressure. However, positive-pressure ventilation generated by a device, such as a BVM, forces air into the chest cavity from the external environment, rather than based on pressure changes. This difference between normal ventilation and positive-pressure ventilation can create some challenges Table 10-6.

The physical act of the chest wall expanding and retracting during breathing serves to aid the circulatory system in returning blood to the heart. During normal ventilation, the chest wall movement works similar to a pump. The pressure changes in the thoracic cavity help draw venous return back to the heart. However, when positive-pressure ventilation is initiated, more air is needed to achieve the same oxygenation and ventilatory effects of normal breathing. This increase in airway wall pressure causes the walls of the chest cavity to push out of their normal anatomic shape. As a result, there is an increase in the overall intrathoracic pressure within the chest cavity. This pressure increase affects the venous return of blood back to the heart. The blood flow is decreased due to the increased pressure in the chest. This causes poor venous return to the heart, and the amount of blood pumped out of the heart is reduced. Therefore, it is imperative that you regulate the rate and volume of artificial ventilations to help prevent this drop in cardiac output. Cardiac output is a function of stroke volume and heart rate, such that cardiac output = stroke volume × heart rate. Stroke volume is the amount of blood ejected by the ventricle in one cardiac cycle. The heart rate is assessed by taking the pulse for 1 minute. The cardiac output is the amount of blood ejected by the left ventricle in 1 minute.

Words of Wisdom

Ventilation Rates*	
Adult	1 breath every 5 to 6 seconds
Child	1 breath every 3 to 5 seconds
Infant	1 breath every 3 to 5 seconds
*For apneic patients with a pulse.	

Mouth-to-Mouth and Mouth-to-Mask Ventilation

As you learned in your CPR course, mouth-to-mouth ventilations are now routinely done with a barrier device, such as a mask or face shield. A **barrier device** is a protective item that features a plastic barrier placed on a patient's face with a one-way valve to prevent the backflow of secretions, vomitus, and gases. Barrier devices provide adequate protection Figure 10-39. Mouth-to-mouth ventilations without a barrier device should be provided only in extreme situations. Performing mouth-to-mask ventilations with a pocket mask containing a one-way valve is a safer method to prevent possible disease transmission.

Table 10-6 Normal Ventilation Versus Positive-Pressure Ventilation

	Normal Ventilation	Positive-Pressure Ventilation
Air movement	Air is sucked into the lungs due to the negative intrathoracic pressure created when the diaphragm contracts.	Air is forced into the lungs through a means of mechanical ventilation.
Blood movement	Normal breathing allows blood to naturally be pulled back to the heart.	Intrathoracic pressure is increased, causing compression of the vena cava and reducing blood return to the heart. This causes the amount of blood pumped by the heart to be reduced.
Airway wall pressure	Not affected during normal breathing.	More volume is required to have the same effects as normal breathing. As a result, the walls are pushed out of their normal anatomic shape.
Esophageal opening pressure	Not affected during normal breathing.	Air is forced into the stomach, causing gastric distention that could result in vomiting and aspiration.
Overventilation	Overventilation is not typical of normal breathing.	Forcing volume and rate results in increased intrathoracic pressure, gastric distention, and decrease in cardiac output (hypotension).

Figure 10-39 Barrier devices, such as a plastic shield or a pocket mask with a one-way valve, provide adequate protection.

A mask with an oxygen inlet provides oxygen during mouth-to-mask ventilation to supplement the air from your lungs. Remember that the gas you exhale contains 16% oxygen. With the mouth-to-mask system, however, the patient gets the additional benefit of significant oxygen enrichment with inspired air. This system also frees both your hands to help keep the airway open and helps you to provide a better seal between the mask and face, thus delivering adequate tidal volume.

The mask may be shaped like a triangle or a doughnut, with the apex (top) placed across the bridge of the nose. The base (bottom) of the mask is placed in the groove between the lower lip and the chin. In the center of the mask is a chimney with a 15/22-mm connector.

Follow these steps to use mouth-to-mask ventilation **Skill Drill 10-8**:

1. Kneel at the patient's head. Open the airway using the head tilt–chin lift maneuver or the jaw-thrust maneuver if trauma is suspected. Insert an oral or nasal airway, if possible, to help maintain airway patency. Connect the one-way valve to the face mask and place the mask on the patient's face. Make sure the top is over the bridge of the nose and the bottom is in the groove between the lower lip and the chin. Hold the mask in position by placing your thumbs over the top part of the mask and your index fingers over the bottom half. Grasp the lower jaw with the remaining three fingers on each hand, making an airtight seal by pulling the lower jaw into the mask. Maintain an upward and forward pull on the lower jaw with your fingers to keep the airway open. This method of securing the mask to the patient's face is known as the EC-clamp method **Step 1**.
2. Take a deep breath and exhale through the open port of the one-way valve. Breathe slowly into the patient's mask until you observe adequate chest rise **Step 2**.
3. Remove your mouth, and watch for the patient's chest to fall during passive exhalation **Step 3**.

You know that you are providing adequate ventilations if you see the patient's color improving and the chest rise adequately and if you do not meet esistance when ventilating. You should also hear and feel air escape as the patient exhales. Make sure that you are providing the correct number of breaths per minute for the patient's age.

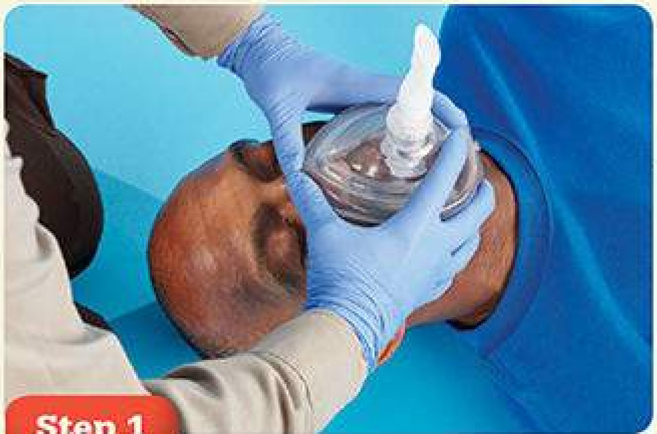
To increase the oxygen concentration, administer high-flow oxygen at 15 L/min through the oxygen inlet valve of the mask. This, when combined with your exhaled breath, will deliver approximately 55% oxygen to the patient. If supplemental oxygen is available, deliver a tidal volume of approximately 500 to 600 mL (6 to 7 mL/kg) over 1 second.

The Bag-Valve Mask

With an oxygen flow rate of 15 L/min and an adequate mask-to-face seal, a BVM with an oxygen reservoir can deliver nearly 100% oxygen **Figure 10-40**. Most BVMs on the market today include modifications or accessories (reservoirs) that permit the delivery of oxygen concentrations approaching 100%; however, the device can deliver only as much volume as you can squeeze out of the bag by hand. The BVM provides less tidal volume than mouth-to-mask ventilation; however, it delivers a much higher concentration of oxygen. The BVM is the most common method used to ventilate patients in the field. While an experienced EMT will be able to supply adequate tidal volume with a BVM, as a new EMT you should develop proficiency at ventilating airway-training manikins before using a BVM on a patient. If you have difficulty adequately ventilating a patient with a BVM, you should immediately switch to an alternative method of ventilation, such as the mouth-to-mask technique.

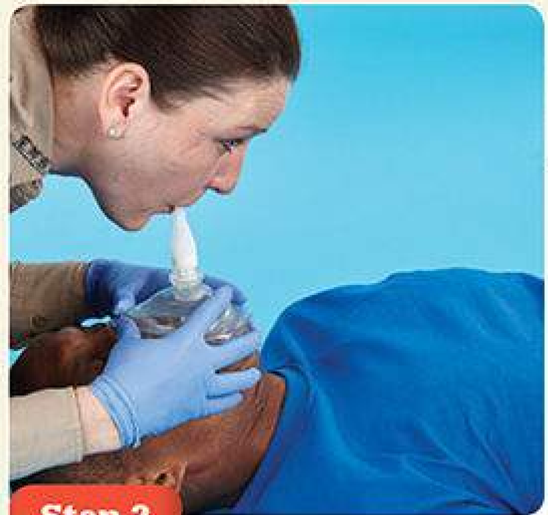
A BVM should be used when you need to deliver high concentrations of oxygen to patients who are not ventilating adequately. The device is also used for patients in respiratory arrest, cardiopulmonary arrest, and respiratory failure. The BVM may be used with or without oxygen. However, to ensure the highest concentration of delivered oxygen, you must attach supplemental oxygen and a reservoir. Use an oral or nasal airway adjunct in conjunction with the BVM.

Skill Drill 10-8 Performing Mouth-to-Mask Ventilation



Step 1

Once the patient's head is properly positioned and an airway adjunct is inserted, place the mask on the patient's face. Seal the mask to the face using both hands (EC-clamp method).



Step 2

Breathe into the one-way valve until you note visible chest rise.

Step 3

Remove your mouth and watch the patient's chest fall during exhalation.

Words of Wisdom

Volume Capabilities of the Bag-Valve Mask

Size	Amount, mL
Adult	1,200 to 1,600
Pediatric	500 to 700
Infant	150 to 240

Bag-Valve Mask Components. All adult BVMs should have the following components:

- A disposable self-refilling bag
- No pop-off valve, or if one is present, the capability of disabling the pop-off valve
- An outlet valve that is a true valve for nonrebreathing
- An oxygen reservoir that allows for delivery of high-concentration oxygen

Figure 10-40 A BVM with an oxygen reservoir can deliver nearly 100% oxygen if a good seal between the mouth and mask is achieved and if supplemental oxygen is used.

- A one-way, no-jam inlet valve system that provides an oxygen inlet flow at a maximum of 15 L/min with standard 15/22-mm fittings for face mask and endotracheal tube (or other advanced airway adjunct) connection
- A transparent face mask
- Ability to perform under extreme environmental conditions, including extreme heat or cold

The total volume in the bag of an adult BVM is usually 1,200 to 1,600 mL. The pediatric bag contains 500 to 700 mL, and the infant bag holds 150 to 240 mL.

The volume of air (oxygen) delivered to the patient is based on one key observation—chest rise and fall. This, in essence, is generally the only means of assessing tidal volume in the field. In most situations, you will be using the BVM attached to high-flow oxygen (15 L/min). When using the BVM with high-flow oxygen on an adult patient, you should squeeze the bag enough to cause a noticeable rise of the patient's chest—a volume of about 600 mL (approximately 6 to 7 mL/kg) over 1 second.

By delivering just enough tidal volume to see the chest rise, the risk of gastric distention (and associated complications of vomiting and aspiration) is reduced.

It is not practical for you to accurately measure tidal volume in milliliters per kilogram for each patient ventilated in the field. The key is to watch for good chest rise and fall—let these observations determine the appropriate amount of volume to deliver.

Bag-Valve Mask Technique. Whenever possible, you and your partner should work together to provide BVM ventilation.

One EMT can maintain a good mask seal by securing the mask to the patient's face with two hands while the other EMT squeezes the bag. Ventilation using a BVM is a challenging skill: it may be very difficult for one EMT to maintain a proper seal between the mask and the face with one hand while squeezing the bag well enough to deliver an adequate volume to the patient. This skill can be difficult to maintain if you do not have many opportunities to practice. Effective one-person BVM ventilation requires considerable experience. Also, performance of this skill depends on having enough personnel to carry out other actions that need to be done at the same time, such as chest compressions, putting the stretcher in place, or helping to lift the patient onto the stretcher.

YOU are the Provider — PART 5

You continue your treatment of the patient, load him into the ambulance, and proceed to the hospital. A member of the rescue team, who is also an EMT, accompanies you to assist with patient care. After reassessing the patient, you call in your report to the emergency department (ED).

Recording Time: 10 Minutes	
Level of consciousness	Responsive only to pain
Respirations	14 breaths/min, shallow
Pulse	100 beats/min, stronger
Skin	Warm and moist; less cyanotic
Blood pressure	124/62 mm Hg
Spo_2	92% (on oxygen)

11. Has your treatment improved the patient's condition? If so, how do you know?
12. What is the appropriate technique for ventilating an apneic adult?
13. What are the dangers of hyperventilating a patient?

Follow these steps to use the one-person BVM technique **Skill Drill 10-9**:

1. Select the proper size mask and assemble your equipment. Kneel above the patient's head. Maintain the patient's neck in an extended position unless you suspect a cervical spine injury **Step 1**. In that case, stabilize the patient's head and neck and use the jaw-thrust maneuver. Have your partner hold the head, or, if you are alone, use your knees to stabilize the head.
2. Open the patient's mouth, and suction as needed. Insert an oral or nasal airway to maintain airway patency **Step 2**.
3. Place the mask on the patient's face **Step 3**. Make sure the top is over the bridge of the nose and the bottom is in the groove between the lower lip and the chin. If the mask has a large, round cuff around the ventilation port, center the port over the patient's mouth. Inflate the collar to obtain a better fit and seal to the face if necessary.
4. Create a seal by holding your index finger over the lower part of the mask and your thumb over the upper part of the mask. Then use your remaining fingers to pull the lower jaw into the mask. This is known as the EC-clamp method and will maintain an effective face-to-mask seal.
5. Bring the lower jaw up to the mask with the last three fingers of your hand. This will help to maintain an open airway. Make sure you do not grab the fleshy part of the neck, as you may compress structures and create an airway obstruction.
6. Squeeze the bag with your other hand until you see adequate chest rise **Step 4**. Perform this in a rhythmic manner once every 5 seconds for an adult and once every 3 seconds for infants and children. In patients with ongoing CPR and an advanced airway in place, such as an endotracheal tube, a laryngeal mask airway, or a King airway, use a simplified ventilation rate of 1 breath every 6 seconds, without pausing chest compressions.

If two EMTs are available to manage the airway, have one EMT hold the mask in position by placing the thumbs over the top part of the mask and the index fingers over the bottom half. Use the last three fingers of the hands to bring the lower jaw up to the mask. This helps to seal the mask to the face and maintain an open airway. The second EMT squeezes the bag with two hands until the chest rises adequately in the same manner as the one-person technique **Figure 10-41**.

Words of Wisdom

In certain situations, you will need to perform ventilations with a BVM before supplemental oxygen is available. If you are unable initially to attach your BVM to an oxygen source, do not withhold ventilations. Provide ventilations using the standard technique and attach the BVM to an oxygen source as soon as it is available.

When using the device to assist ventilations of a patient who is breathing too slowly (hypoventilation) with reduced tidal volume, squeeze the bag as the patient tries to breathe in. Then, for the next 5 to 10 breaths, slowly adjust the rate and delivered tidal volume until an adequate minute volume is achieved.

To assist respirations of a patient who is breathing too fast (hyperventilation) with reduced tidal volume, you must first explain the procedure to the patient if the patient is coherent. Initially assist respirations at the rate at which the patient has been breathing, squeezing the bag each time the patient inhales. Then, for the next 5 to 10 breaths, slowly adjust the rate and the delivered tidal volume until an adequate minute volume is achieved.

As you are assisting ventilations with a BVM, you should evaluate the effectiveness of your delivered ventilations. You will know that artificial ventilations are not adequate if the patient's chest does not rise and fall with each ventilation, the rate at which you are ventilating is too slow or too fast, or the heart rate does not return to normal. If too much air is escaping from under the mask, reposition the mask for a better seal. If the patient's chest does not rise and fall, you may need to reposition the head or use an airway adjunct. If the patient's chest still does not rise and fall after you have made these corrections, check for an airway obstruction. If an obstruction is not present, attempt ventilations using an alternative method, such as the mouth-to-mask technique.

The BVM may also be used in conjunction with an endotracheal tube or with other advanced airway devices. Advanced airway techniques are beneficial when a good seal is difficult to maintain, the patient has a cervical spine injury, or the patient's condition warrants. These techniques are discussed later in the text.

Skill Drill 10-9 Performing One-Rescuer Bag-Valve Mask Ventilations

Step 1

Assemble your equipment and position yourself above the patient's head. Open the airway using the head tilt-chin lift or jaw-thrust maneuver.

Step 2

Open the patient's mouth and suction as necessary to clear secretions. Insert an oral or nasal airway.

Step 3

Select the appropriate mask and position it properly on the patient's face. Following the EC-clamp method, make a seal by holding your index finger over the lower part of the mask and your thumb over the upper part of the mask. Then use your remaining fingers to pull the lower jaw into the mask. Bring the lower jaw up to the mask with the last three fingers of your hand. Avoid the fleshy soft tissue of the neck.

Step 4

Squeeze the bag with your other hand until you see adequate chest rise. For adults, squeeze once every 5 seconds. For infants and children, squeeze once every 3 seconds. In patients with ongoing CPR and an advanced airway in place, use a rate of 1 breath every 6 seconds.

Figure 10-41 With two-person BVM ventilation, you hold the mask in place while your partner squeezes the bag with two hands until the patient's chest rises adequately.

Words of Wisdom

The Sellick maneuver, also known as cricoid pressure, has been used to inhibit the flow of air into the stomach (and thus reduce gastric distention) and reduce the chance of aspiration by helping block the regurgitation of gastric contents from the esophagus. In this maneuver, a rescuer applies cricoid pressure on the patient by placing the thumb and index finger on either side of the cricoid cartilage (at the inferior border of the larynx) and pressing down.

According to the International Liaison Committee on Resuscitation (ILCOR) guidelines, cricoid pressure may actually *impede* ventilation and not completely prevent aspiration. For this reason, the procedure is generally not recommended. Be sure to follow your local protocol regarding the use of the Sellick maneuver.

Gastric Distention. When using a BVM or any other ventilation device, be alert for **gastric distention**, inflation of the stomach with air. Although gastric distention most commonly affects children, it also affects adults. Gastric distention is most likely to occur when you ventilate the patient too forcefully or too rapidly with a BVM or pocket-mask. It may also occur when the airway is obstructed as a result of a foreign body or improper head position. For this reason, give slow, gentle breaths during artificial ventilation over 1 second (enough to see the chest rise) in the adult patient. As compliance decreases, you will notice it becoming increasingly difficult to squeeze the BVM to get air into the lungs. Slight gastric distention is not of concern; however, severe inflation of the stomach is dangerous because it may cause vomiting and increase the risk of aspiration during CPR. Gastric distention can also significantly reduce the lung volume by elevating the diaphragm, especially in infants and children. Gastric distention is a common complication associated with the use of manually triggered ventilation devices, a key reason why these devices are not highly recommended.

To prevent or alleviate distention, do the following: (1) ensure that the patient's airway is appropriately positioned, (2) ventilate the patient at the appropriate rate, and (3) ventilate the patient with the appropriate volume.

If the patient's stomach appears to be distending, recheck and reposition the head, and watch for rise and fall of the chest wall as you perform rescue breathing. Continue slow rescue breathing without attempting to expel the stomach contents. If gastric distention makes it impossible to ventilate the patient and an ALS provider is not available to perform orogastric tube or nasogastric tube decompression, consider applying pressure over the upper abdomen. Manual decompression should only be used as a last resort. Applying manual pressure over the patient's upper abdomen will likely result in vomiting; therefore, if vomiting occurs, turn the patient's entire body to the side, suction and/ or wipe out the mouth with your gloved hand, and return the patient back to a supine position so that you can continue rescue breathing.

Passive Ventilation

The process of expansion and contraction of the chest creates a "pump" for air movement in and out of the chest. Normally, the muscles of the chest wall are the driving force behind the expansion and contraction of the chest. However, when a patient is not breathing, the movement of the chest wall is completely dependent on the EMS providers' ability to provide artificial breathing to the patient—active ventilation.

During cardiac arrest, you are responsible for providing high-quality chest compressions to circulate blood and artificial ventilations to oxygenate the hemoglobin. Since movement of the chest wall has been shown to assist in the ventilation process, patients receiving chest compressions benefit from a process known as **passive ventilation**. This is sometimes also called passive oxygenation or apneic oxygenation. In passive ventilation, air movement in and out of the chest cavity occurs passively as a result of compressing the chest. When the chest is compressed, air is forced out of the thorax. As the chest recoils following compression, a negative pressure is created within the chest, which results in a vacuum. This leads to air being sucked into the chest cavity, similar to what occurs with muscle contraction during active inhalation.

Words of Wisdom

Indications That Artificial Ventilation Is Adequate:

- Visible and equal chest rise and fall with ventilation
- Ventilations delivered at the appropriate rate
  - 10 to 12 breaths/min for adults*
  - 12 to 20 breaths/min for infants and children*
  - In patients with ongoing CPR and an advanced airway in place, 1 breath every 6 seconds
- Heart rate returns to normal range
- Patient's color is improving (pink)

Indications That Artificial Ventilation Is Inadequate:

- Minimal or no chest rise and fall
- Ventilations are delivered too fast or too slowly for patient's age
- Heart rate does not return to normal range
- Patient's color remains cyanotic, mottled, or deteriorates

*In apneic patients with a pulse.

When you are performing chest compressions, passive ventilation can be enhanced by inserting an oropharyngeal airway and providing supplemental oxygen to the patient. You can also improve oxygenation during passive ventilation by applying supplemental oxygen with a nasal cannula or a nonrebreathing mask.

Manually Triggered Ventilation Devices

Another method of providing artificial ventilation is with a **manually triggered ventilation device** Figure 10-42. These devices, also known as flow-restricted, oxygen-powered ventilation devices, are widely available and have been used in EMS for several years. The major advantage of this device is that it allows a single rescuer to use both hands to maintain a mask-to-face seal while providing positive-pressure ventilation. It also reduces rescuer fatigue associated with using a BVM on extended transports. However, recent findings suggest that manually triggered ventilation devices are associated with difficulty in maintaining adequate ventilation without assistance and should not be used routinely because of the high incidence of gastric distention and possible damage to structures within the chest cavity. Another disadvantage is that a special unit and additional training are required when using the manually triggered ventilation device on infants and children. In addition, this device *should not* be used on patients with COPD or suspected cervical spine or chest injuries. Because the rescuer is not actively squeezing a bag, it is difficult to assess for lung compliance. As a result, the rescuer should take extra care when ventilating; the high ventilatory pressures generated by the device may damage lung tissue if not carefully monitored. Typical adult ventilation consumes 5 L/min of oxygen versus the manually triggered device at 15 to 25 L/min.

Figure 10-42 A manually triggered ventilation device can provide up to 100% oxygen.

Manually Triggered Ventilation Device Components. Manually triggered ventilation devices should have the following components:

- A peak flow rate of 100% oxygen at up to 40 L/min
- An inspiratory pressure safety release valve that opens at approximately 60 cm of water and vents any remaining volume to the atmosphere or stops the flow of oxygen
- An audible alarm that sounds whenever you exceed the relief valve pressure
- The ability to operate satisfactorily under normal and varying environmental conditions
- A trigger (or lever) positioned so that both your hands can remain on the mask to provide an airtight seal while supporting and tilting the patient's head and keeping the jaw elevated

Learning how to use these devices correctly requires proper training and considerable practice. As with BVMs, you must make sure there is an effective seal between the patient's face and mask. The amount of pressure necessary to ventilate a patient adequately will vary according to the size of the patient, the patient's lung volume, and the condition of the lungs. A patient with COPD will need greater pressure to receive adequate volume than would be necessary for a patient with normal lungs. Pressures that are too great can cause a **pneumothorax**. Always follow local medical protocols carefully when you use these devices.

Automatic Transport Ventilator/ Resuscitator

The **automatic transport ventilator (ATV)** is essentially a manually triggered ventilation device attached to a control box that allows the variables of ventilation to be set. Although the ATV lacks the sophisticated control of a hospital ventilator, it frees you to perform other tasks, such as maintaining a mask seal or ensuring continued patency of the airway. You can even perform non–airway-related tasks if the patient has an advanced airway in place and is being ventilated with the ATV. However, even though an ATV is helpful, always have a BVM and mask prepared and ready for use should a malfunction occur with the ATV.

Most models have adjustments for respiratory rate and tidal volume. In most cases, the respiratory rate is set at the midpoint or average for the patient's age. Tidal volume is usually estimated using the formula of 6 to 7 mL/kg because ATVs are oxygen-powered and provide oxygen-enriched breathing gas. The tidal volume can be adjusted based on the patient's chest rise and physiologic response. ATVs are considered volume-cycled/rate-controlled ventilators. This means that they deliver a preset volume at a preset respiratory rate, although this does not guarantee that all of the volume is being delivered to the lungs.

Like the manually triggered ventilation device, the ATV is generally oxygen-powered, although some models may require an external power source. Whereas this device does require oxygen, it generally consumes 5 L/min of oxygen, unlike a BVM that uses 15 to 25 L/min. In addition, just like the manually triggered ventilation device, the ATV has a pressure relief valve, which can lead to hypoventilation in patients with poor lung compliance, increased airway resistance, or airway obstruction. **Compliance** is the ability of the alveoli to expand when air is drawn in during inhalation. Poor lung compliance is the inability of the alveoli to fully expand during inhalation.

Whereas ATVs potentially free you to perform other tasks, constant reassessment of the patient is necessary. Barotrauma is a common complication associated with manually triggered ventilation devices and the ATV. In addition, you need to assess for full chest recoil when using an ATV. This step is not only essential with patients in respiratory arrest, but with patients in cardiac arrest receiving chest compressions as well.

Continuous Positive Airway Pressure

Continuous positive airway pressure (CPAP) is a noninvasive means of providing ventilatory support for patients experiencing respiratory distress. Many people who have been diagnosed with obstructive sleep apnea wear a CPAP unit at night to maintain their airway while they sleep **Figure 10-43**. Over the past several years, the use of CPAP in the prehospital environment has proven to be an excellent adjunct in the treatment of respiratory distress associated with obstructive pulmonary disease and acute pulmonary edema. Typically, many of the patients would be managed with advanced airway devices, such as endotracheal intubation. Research has shown that there is a significant increase in morbidity and mortality when patients with these conditions receive intubation for their condition in the field. CPAP offers an alternative means for providing ventilatory assistance to patients and helps to decrease the overall morbidity and mortality. Because of the simplicity of the device and its great benefit to the patient, CPAP is becoming widely used at the EMT level. However, not all EMTs are trained in the use of CPAP. Follow your local protocols.

Figure 10-43 Many people who have been diagnosed with obstructive sleep apnea wear a CPAP unit at night to maintain their airway while they sleep.

Mechanism

CPAP increases pressure in the lungs, opens collapsed alveoli, pushes more oxygen across the alveolar membrane, and forces interstitial fluid back into the pulmonary circulation. The therapy is typically delivered through a face mask that is held to the head with a strapping system. A good seal with minimal leakage between the face and mask is essential.

Many CPAP systems use oxygen as the driving force to deliver the positive ventilatory pressure to the patient. Frequently check the oxygen regulator when administering CPAP; depending on the flow and the patient's respiratory rate, some CPAP units can empty a D cylinder in as little as 5 to 10 minutes.

The mechanism that determines the amount of pressure delivered to the patient (such as 5 cm H_2O) varies depending on the manufacturer. In most cases, the result is similar to hanging your head out the window while driving on the highway. This results in a high inspiratory flow and the need to push a pressure valve open with exhalation. While this may appear to require a great deal of effort on the part of a patient who is already in distress, many patients make a dramatic turnaround when CPAP is applied.

Because CPAP increases pressure inside the chest, it reduces the amount of blood flow returning to the heart. As the pressure in the thorax increases, the venous flow of blood returning to the heart meets the resistance of the increased pressure in the chest. The result is a decrease in the workload of the heart and a drop in cardiac output. This is not common with lower levels of CPAP; however, caution should be used when considering CPAP in patients with low blood pressure. Continually reassess patients for sudden drops in blood pressure.

Indications

CPAP is indicated for patients experiencing respiratory distress in which their own compensatory mechanisms are not enough to keep up with their oxygen demand. Whereas most patients improve after the application of CPAP, it is important to remember that CPAP is merely treating the symptoms and not necessarily the underlying pathology.

The following are some general guidelines for CPAP candidates:

- Patient must be alert and able to follow commands
- Patient is displaying obvious signs of moderate to severe respiratory distress (eg, accessory muscle use, tripod position) from an underlying pathology, such as pulmonary edema or obstructive pulmonary disease (ie, COPD)
- Patient is breathing rapidly, such that it affects overall minute volume (greater than 26 breaths/min)
- Pulse oximetry reading is less than 90%

Whereas these guidelines should be considered when assessing the need for CPAP, it is important that you follow your local guidelines and protocols.

Contraindications

CPAP has proven to be immensely beneficial to patients experiencing respiratory distress from acute pulmonary edema or obstructive pulmonary disease; however, there are times when CPAP is not appropriate for the patient.

The following are general contraindications for CPAP use:

- A patient who is in respiratory arrest
- Signs and symptoms of a pneumothorax or chest trauma
- A patient who has a tracheostomy
- Active gastrointestinal bleeding or vomiting
- Patient is unable to follow verbal commands

In addition to these contraindications, always reassess the patient for signs of deterioration and/ or respiratory failure. CPAP is an excellent tool to improve ventilation; however, not all patients will improve with this device. Once signs of respiratory failure become apparent or the patient is no longer able to follow commands, remove CPAP from the patient, and initiate positive-pressure ventilation with a BVM attached to high-flow oxygen.

Application

Several varieties of CPAP units are available to EMS providers; however, most follow the same general guidelines for use and set up. CPAP units are generally composed of a generator, a mask, a circuit that contains corrugated tubing, a bacteria filter, and a one-way valve. The CPAP generator creates resistance throughout the respiratory cycle. This resistance creates a back pressure into the airways that pushes open the smaller airway structures, such as bronchioles and alveoli, as the patient exhales. The amount of pressure can be determined by adjusting a valve within the system or with a separate valve that can be attached to the CPAP system. A pressure of 7.0 to 10.0 cm H_2O is generally an acceptable therapeutic range for a patient on CPAP. Always consult the operations manual of a particular CPAP device for proper assembly instructions.

Since most CPAP units are powered by oxygen, it is important to have a full cylinder of oxygen when using CPAP. Some CPAP units use a continuous flow of oxygen, while others use oxygen on more of a demand basis. In either situation, continuously monitor the amount of available oxygen in your cylinder. A typical CPAP unit will deplete a full D cylinder of oxygen in 15 to 30 minutes, depending on the fraction of inspired oxygen (FIO_2) setting. Therefore, proper planning for oxygen consumption is necessary when considering applying CPAP. In addition, some of the newer CPAP devices allow the provider to adjust the FIO_2. Some CPAP devices are set to deliver a fixed FIO_2 of 30% to 35%; however, some can deliver as high as 95%.

Over the past several years, new disposable CPAP devices have become available to the EMS provider. These devices typically have a mask that is secured to the face, similar to standard CPAP devices. However, these devices run entirely off the oxygen system and do not require the adjustment of a valve. Depending on the manufacturer, a valve in either the tubing or the mask creates the pressure needed for the system. Pressure is controlled by changing the oxygen flow. The higher the oxygen flow rate, the higher the pressure. These devices are gaining in popularity as they are lightweight and relatively easy to operate.

Follow the steps in **Skill Drill 10-10** to use CPAP:

1. Take standard precautions. Confirm blood pressure. Check your equipment, then connect the circuit to the CPAP generator. Make sure your generator is connected to an oxygen source and/or a power source if required **Step 1**.
2. Connect the face mask to the circuit tubing **Step 2**. Once the system is connected, check to see if there is an on/off button. Some of the newer models have this feature. Make sure the device is set in the "on" position before you apply CPAP to the patient.
3. Connect the tubing to the oxygen tank **Step 3**.
4. Confirm the device is working, and place the mask over the patient's mouth and nose, creating as much of an airtight seal as possible. This can be a rather difficult task depending on your patient. Many patients will resist the application of a mask to their face while in severe respiratory distress. Explain the application to the patient and coach him or her through the application of the mask. Allowing the patient to hold the mask to his or her face initially may actually be beneficial in alleviating some of the stress associated with CPAP application **Step 4**.
5. Once the mask is on the face, use the strapping mechanism to secure it to the patient's head, making sure the seal between the mask and face remains. Consult the manufacturer's guidelines for specific strapping instructions **Step 5**.
6. Adjust the pressure valve and the FIO_2 accordingly to maintain adequate oxygenation and ventilation. With CPAP in place, the patient's oxygenation should improve and the work of breathing should decrease. Constant reassessment of patients for signs of deterioration is essential **Step 6**.

Complications

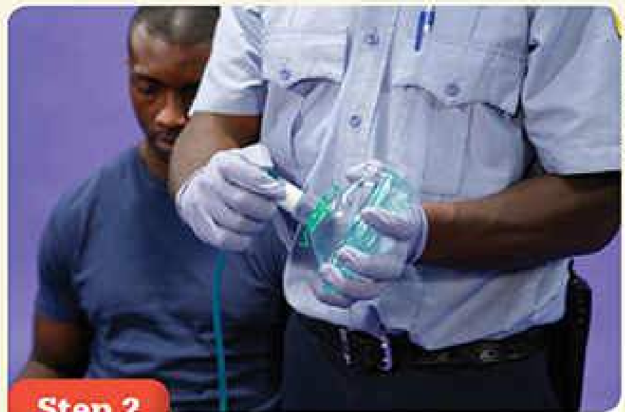
The application and administration of CPAP is a relatively easy process. However, some patients may find CPAP claustrophobic and will resist the application. As patients become more hypoxic, the application of a mask to their face is sometimes perceived as suffocation, rather than helping them breathe. In any event, it is important to explain the application to patients and coach them through the process. Do not force the mask on patients. This will create a higher level of anxiety and increase their oxygen demand. Coach patients through the application of CPAP, allowing them to adjust to the situation. Coaching patients is not always an easy task; it takes practice and a willingness to work closely with your patient during a difficult time.

Due to the high volume of pressure generated by CPAP, there is the possibility of causing a pneumothorax. Whereas some literature suggests this is not likely, you should be aware of this risk and continually assess your patients for signs and symptoms of a pneumothorax.

Skill Drill 10-10 Using CPAP

Step 1

Take standard precautions. Confirm blood pressure. Check your equipment, then connect the circuit to the CPAP generator.



Step 2

Connect the face mask to the circuit tubing.

Step 3

Connect the tubing to the oxygen tank.

Step 4

Confirm that the device is on before you apply it to the patient's face. Place the mask over the patient's mouth or nose or allow the patient to hold it to his or her mouth and nose.

Step 5

Use the strapping mechanism to secure the CPAP to the patient's head. Make sure there is a tight seal.

Step 6

Adjust the pressure valve and the FIO_2, according to the manufacturer's recommendations to maintain adequate oxygenation and ventilation. Reassess the patient.

In addition to a pneumothorax, high pressure in the chest can lower a patient's blood pressure. As the intrathoracic pressure increases, venous blood returning to the heart meets resistance from the increased pressure in the chest. This can result in a sudden drop in blood pressure. While this is not common with lower levels of CPAP, continuous monitoring of blood pressure is necessary.

CPAP has shown positive results consistently with patients experiencing moderate and severe respiratory distress; however, there are still cases in which patients deteriorate. It is important that you reassess the patient for signs of deterioration. If the patient is no longer able to follow verbal commands and/or goes into respiratory failure/arrest, you must act quickly to remove CPAP and begin positive-pressure ventilation using a BVM attached to high-flow oxygen.

Special Considerations

Stomas and Tracheostomy Tubes

BVM ventilation may also need to be used for patients who have had a laryngectomy (surgical removal of the larynx). These patients have a permanent tracheal stoma (an opening in the neck that connects the trachea directly to the skin) **Figure 10-44**. This type of stoma, known as the **tracheostomy**, is an opening at the center front and base of the neck. Many patients who have had a laryngectomy will have other openings in the neck, according to the type of operation performed. You should ignore any opening other than the midline tracheal stoma. The midline opening is the only one that can be used to put air into the patient's lungs.

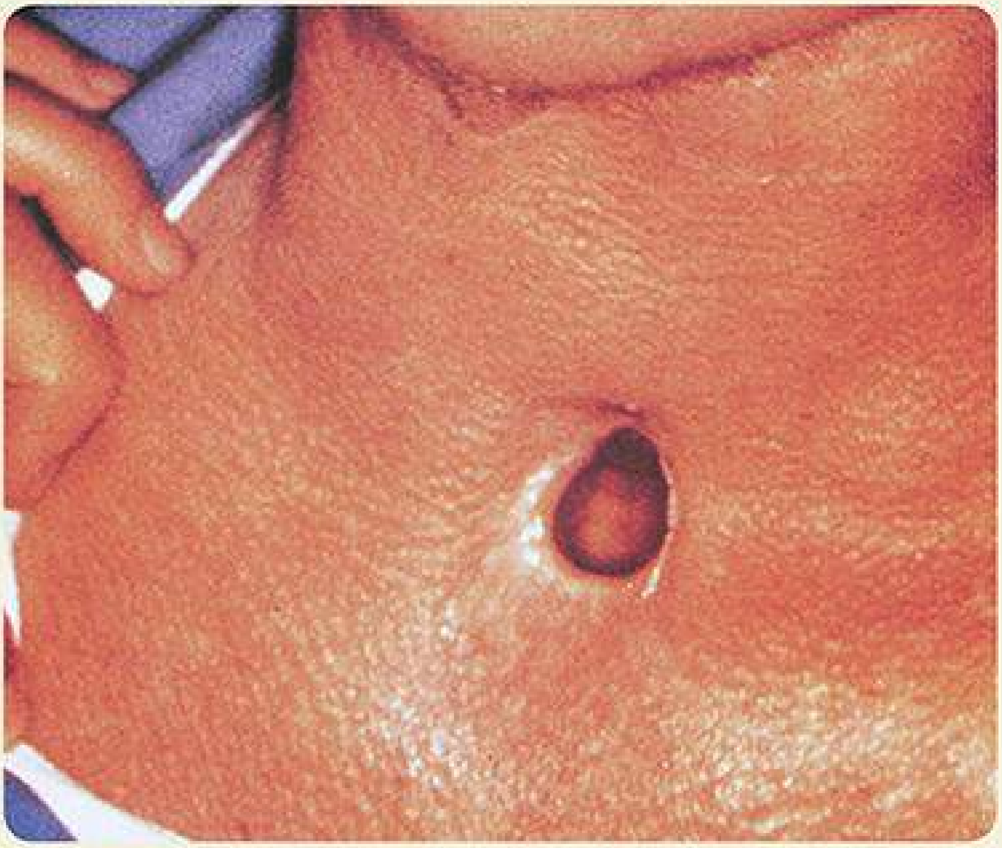


Figure 10-44 A tracheal stoma typically lies in the midline of the neck. The midline opening is the only one that can be used to deliver oxygen to the patient's lungs.

YOU are the Provider PART 6

On arrival at the ED, your reassessment reveals that the patient's condition has improved significantly. His eyes are open, he responds to verbal stimuli, and his breathing, although still somewhat labored, has improved.

Recording Time: 17 Minutes	
Level of consciousness	Eyes open; responsive to verbal stimuli
Respirations	16 breaths/min, slightly labored, adequate depth
Pulse	88 beats/min, strong and regular
Skin	Pink, warm, and moist
Blood pressure	132/72 mm Hg
Spo_2	97% (on oxygen)

You transfer care of the patient to the ED physician, who tells you that he believes the patient is experiencing acute exacerbation of his congestive heart failure. After further treatment in the ED, the patient is admitted to the intensive care unit.

14. How does respiratory failure differ from respiratory arrest?
15. Was your patient experiencing respiratory failure or respiratory arrest?

Neither the head tilt–chin lift nor the jaw-thrust maneuver is required for ventilating a patient with a stoma. If the patient has a tracheostomy tube, ventilate through the tube with a BVM (the standard 15/22-mm adapter on the BVM will fit onto the tube in the tracheal stoma) and 100% oxygen attached directly to the BVM. If the patient has a stoma and no tube is in place, use an infant or child mask with your BVM to make a seal over the stoma. Seal the patient's mouth and nose with one hand to prevent a leak of air through the upper airway when you ventilate through a stoma. Release the seal of the patient's mouth and nose for exhalation. This allows the air to exhale through the upper airway.

If you are unable to ventilate a patient who has a stoma, try suctioning the stoma and the mouth with a French or soft-tip catheter before giving the patient artificial ventilation through the mouth and nose. If you seal the stoma during mouth-to-mouth ventilation, the ability to ventilate the patient may be improved, or it may help to clear any obstructions.

Foreign Body Airway Obstruction

A foreign body that *completely* blocks the airway in a patient is a true emergency that will result in death if not treated immediately. In an adult, sudden foreign body airway obstruction usually occurs during a meal. In a child, it occurs while eating, playing with small toys, or crawling around the house. An otherwise healthy child who has sudden difficulty breathing has probably aspirated a foreign object.

By far, the most common airway obstruction in an unconscious patient is the tongue, which relaxes and falls back into the throat. There are other causes of airway obstruction that do not involve foreign bodies in the airway. These include swelling (from infection or acute allergic reaction) and trauma (tissue damage from injury). With airway obstruction from medical conditions such as infection and acute allergic reactions, repeated attempts to clear the airway as if there were a foreign body will be unsuccessful and potentially dangerous. These patients require specific emergency medical care for their condition; therefore, rapid transport to the hospital is critical.

Recognition

Early recognition of airway obstruction is crucial for you to be able to provide emergency medical care effectively. Obstruction from a foreign body can result in a **mild airway obstruction** or a **severe airway obstruction**.

Patients with a mild airway obstruction are still able to exchange air but will have varying degrees of respiratory distress. Great care must be taken to prevent a mild airway obstruction from becoming a severe airway obstruction. The patient will usually have noisy breathing and may be coughing. Assess the patient and determine whether the patient has **good air exchange** or **poor air exchange**.

With good air exchange, the patient can cough forcefully, although you may hear **wheezing** (the production of whistling sounds during respiration) between coughs. Wheezing is usually indicative of a mild lower airway obstruction. As long as the patient can breathe, cough forcefully, or talk, you should not interfere with the patient's efforts to expel the foreign object on his or her own. Continue to monitor the patient closely and encourage the patient to continue coughing. Abdominal thrusts are usually not effective for dislodging a partial obstruction. Attempts to remove the object manually could force the object farther down into the airway and cause a severe airway obstruction. Continually reassess the patient's condition and be prepared to provide treatment if the air exchange becomes poor or a mild obstruction becomes a severe obstruction.

With poor air exchange, the patient has a weak, ineffective (not forceful) cough and may have increased difficulty breathing, **stridor** (a high-pitched noise heard primarily on inspiration), and cyanosis. Stridor is an indication of a mild upper airway obstruction. You must quickly recognize this situation and provide immediate care.

For patients with mild airway obstruction with poor air exchange, treat immediately as if there is a severe airway obstruction.

Patients with a severe airway obstruction cannot breathe, talk, or cough. One sure sign of a severe obstruction is the sudden inability to speak or cough during or immediately after eating. The person may clutch or grasp his or her throat (universal distress signal), begin to turn cyanotic, and have extreme difficulty breathing **Figure 10-45**. There is little or no air movement. Ask the conscious patient, "Are you choking?" If the patient nods "yes," provide immediate treatment. If the obstruction is not cleared quickly, the amount of oxygen in the patient's blood will decrease dramatically. If not treated, the patient will become unconscious and die.

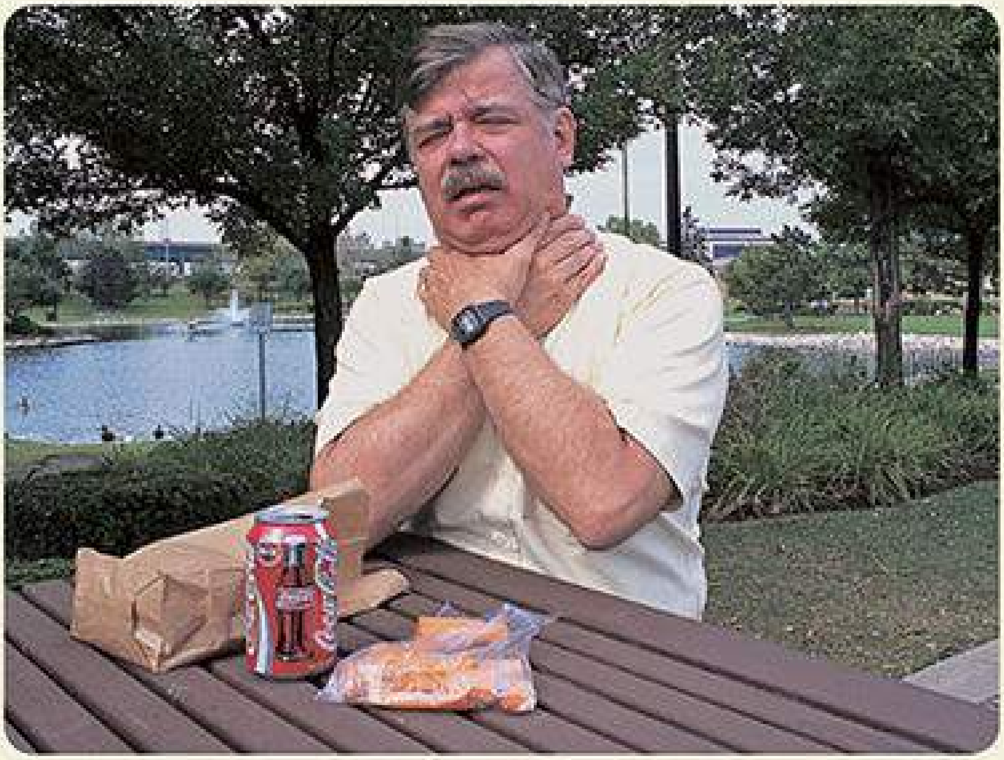


Figure 10-45 The universal sign of choking is a person who grasps his or her throat and has difficulty breathing.

Figure 10-46 When you open the airway and attempt ventilations, it will be obvious to you if the airway is still blocked.

Some patients with a severe airway obstruction will be unconscious as you form your general impression. You may not know that an airway obstruction is the cause of their condition. There are many other causes of unconsciousness and respiratory failure, including stroke, heart attack, trauma, seizures, and drug overdoses. A complete and thorough patient assessment by you, therefore, is essential to providing appropriate emergency medical care.

If the patient is found unresponsive, does not appear to be breathing, and does not have a pulse, begin CPR with high-quality chest compressions. When you open the airway and attempt two ventilations following chest compressions, it will be obvious to you if the airway is blocked **Figure 10-46**. The compressions may have been enough to clear the airway; however, if you are unable to ventilate the patient after several attempts (no chest rise and fall) or you feel resistance while ventilating, consider the possibility of an airway obstruction. Resistance to ventilation can also be due to poor lung compliance. As discussed, compliance is the ability of the alveoli to expand when air is drawn in during inhalation; poor lung compliance is the inability of the alveoli to fully expand during inhalation.

Emergency Medical Care for Foreign Body Airway Obstruction

Perform the head tilt–chin lift maneuver to clear an obstruction that has been caused by the tongue and throat muscles relaxing back into the airway in any person who is found unconscious. This should be performed on unresponsive patients with adequate or inadequate breathing who are not suspected of having spinal trauma. If spinal trauma is suspected, open the airway with a jaw-thrust maneuver. Large pieces of vomited food, mucus, loose dentures, or blood clots in the mouth should be swept forward and out of the mouth with your gloved index finger. When available, use suction to maintain a clear airway.

Abdominal thrusts are the most effective method of dislodging and forcing an object out of the airway of a conscious adult or child. Residual air, which is always present in the lungs, is compressed upward and used to expel the object. Use abdominal thrusts until the object dislodges or the patient becomes unconscious.

For the unresponsive patient with a severe foreign body airway obstruction, reassess to confirm apnea and inability to ventilate. Begin chest compression just as you would for CPR, following the 30 compressions to 2 breaths ratio. At the completion of the 30 compressions, perform a tongue-jaw lift by grasping the jaw with your thumb and index finger. Place your thumb onto the tip of the patient's lower teeth and tongue while placing your index finger under the bony portion of the chin. Be careful not to compress the soft tissues under the chin. Pull the jaw/mouth open and look at the back of the oropharynx for any foreign objects. If an object is observed, remove it with a gloved index finger or suction. Only attempt to remove an object if it is visible during examination of the open mouth; blind sweeps of the back of the oropharynx may push an object farther down in the airway, making the obstruction worse. Once the object(s) is removed or if no object was seen during the tongue-jaw lift, attempt to ventilate. If you are still unable to ventilate, repeat the process.

If you are unable to clear a severe airway obstruction with your initial attempts, begin rapid transport and continue your efforts to relieve the obstruction with abdominal thrusts (chest compressions in the unresponsive patient) on the way to the hospital.

Remember to treat patients with a mild airway obstruction with poor air exchange as if they have a severe airway obstruction.

Patients with a mild airway obstruction and good air exchange should be monitored closely for deterioration of their condition. If the patient is unable to clear the obstruction and remains conscious, support (or let the patient control) the airway position that is most efficient and comfortable. Provide supplemental oxygen, and transport to the hospital.

Words of Wisdom

If spinal trauma is suspected, open the airway using the jaw-thrust maneuver.

Dental Appliances

Many dental appliances can cause an airway obstruction. If a dental appliance, such as a crown or bridge, dentures, or even a piece or sections of braces, has become loose, manually remove it before providing ventilations. Simple manual removal may relieve the obstruction and allow the patient to breathe on his or her own.

Providing BVM or mouth-to-mask ventilation is usually much easier when dentures can be left in place. Leaving the dentures in place provides more structure to the face and will generally assist you in being able to provide a good face-to-mask seal, thus delivering adequate tidal volume. However, loose dentures make it difficult to perform artificial ventilation by any method and can easily obstruct the airway. Therefore, dentures and dental appliances that do not stay in place should be removed. Dentures and appliances may become loose or be completely out of place following an accident or as you are providing care. Periodically reassess the patient's airway to make sure these devices are firmly in place. If dentures become dislodged, if possible, place them in a container and transport with the patient.

Facial Bleeding

Airway problems can be especially challenging in patients with serious facial injuries **Figure 10-47**. Because the blood supply to the face is so rich, injuries to the face can result in severe tissue swelling and bleeding into the airway. Control bleeding with direct pressure and suction as necessary.

Figure 10-47 Airway problems can be especially challenging in patients with serious facial injuries.

Courtesy of Dr. Ken Harrison, Careflight/NSW Institute of Trauma & Injury Management.

YOU are the Provider — SUMMARY

1. What is the function of the respiratory system?

The function (physiology) of the respiratory system, as critical as it is, is quite simple: to bring oxygen into the lungs and remove carbon dioxide from the lungs. Failure of the respiratory system will compromise oxygenation—the loading of oxygen onto the hemoglobin molecule—and cause carbon dioxide to accumulate in the blood. This results in the buildup of dangerous acids in the bloodstream.

2. What is the difference between ventilation and respiration?

Ventilation is the movement of air into and out of the lungs. Normal, unassisted breathing occurs through a process called negative-pressure ventilation. When the diaphragm and intercostal muscles contract, the thorax enlarges and pressure within it falls; this creates a slight vacuum, which pulls air into the lungs. By contrast, positive-pressure ventilation occurs when air is pushed into the lungs, such as when performing artificial ventilation with a BVM or pocket face mask.

Respiration is the process of exchanging oxygen and carbon dioxide. Pulmonary (external) respiration is the exchange of oxygen and carbon dioxide between the blood and alveoli in the lungs. Cellular (internal) respiration is the exchange of oxygen and carbon dioxide between the blood and the body's cells. Adequate cellular respiration relies on adequate ventilation, oxygenation, and pulmonary respiration.

3. How often should you assess a patient's airway and breathing status?

Assessment of a patient's airway and breathing status should be an ongoing process, from the time you initially encounter the patient until he or she is delivered to the ED. A patient's airway may be patent and his or her breathing may be adequate initially; however, this can change quickly. Frequent assessments allow you to detect airway or breathing problems and correct them immediately.

4. Is this patient's airway patent?

A patent airway is one that is open and free of secretions or foreign bodies. At the present time, the patient's airway is patent. However, a patent airway does not mean that the patient is breathing adequately. Carefully assess your patient!

5. Is he breathing adequately? Why or why not?

A patient who is breathing adequately is able to move enough air into and out of the lungs to adequately oxygenate the blood. Adequate breathing in the adult is characterized by a respiratory rate of between 12 and 20 breaths/min; adequate depth (tidal volume); the ability to speak in complete sentences; a regular pattern of inhalation and exhalation; skin that is pink, warm, and dry; pink mucous membranes; and a normal mental status.

The patient in this scenario is not breathing adequately. His respirations are severely labored, he can only speak in two-word sentences, and his mental status is decreased (ie, he is "sleepy"). An altered mental status in a patient with respiratory distress indicates that the brain is hypoxic—that is, it is not receiving enough oxygen.

6. How should you manage his present airway and breathing status?

If a patient is unable to draw enough air into the lungs on his own through the process of negative-pressure ventilation, you must provide some form of positive-pressure ventilation. In a conscious or semiconscious patient, this involves applying a BVM to the patient's face and advising him or her that each time he or she takes a breath, you will squeeze the bag.

Continuous positive airway pressure (CPAP) may also be beneficial to this patient. CPAP delivers positive pressure to the spontaneously breathing patient during the respiratory cycle. It is especially useful in treating patients with breathing difficulty secondary to congestive heart failure and pulmonary edema. With CPAP, the patient breathes against positive pressure that is delivered through a tight-fitting mask. This helps prevent atelectasis (alveolar collapse), forces fluid from the alveoli, and improves gas exchange in the lungs.

Left untreated, inadequate breathing will cause the patient to continue to deteriorate—potentially to the point where he stops breathing completely. If the patient's level of consciousness decreases further, manually keep his airway open and consider inserting an airway adjunct (eg, oral or nasal airway).

7. What is cyanosis? What does it indicate?

Cyanosis is a dark blue or purple color of the skin; it indicates hypoxemia—a deficiency of oxygen in the blood. Highly oxygenated blood is bright red, which gives the patient's skin a pink appearance. If the blood is poorly oxygenated, as with inadequate breathing, it assumes a dark red or purple color. Cyanosis is commonly seen on the face, nail beds, and mucous membranes. It is important to note that cyanosis is a later sign of hypoxemia, so its absence does not rule out an airway or breathing problem.

8. What does the patient's oxygen saturation indicate?

Oxygen saturation (Spo_2) refers to the percentage of hemoglobin (the iron-containing portion of the red blood cell to which oxygen attaches) that is bound to oxygen. Oxygen saturation is measured with a pulse oximeter—a device that sends a beam of light through the capillary bed and measures the density of the blood. Pulse oximetry values normally range between 95% and 100%. An Spo_2 of between 90% and 94% indicates mild to moderate hypoxemia, while an Spo_2 of less than 90% indicates significant hypoxemia. Your patient's Spo_2 of 85% indicates that a significant portion of his blood is not being oxygenated. You must correct this immediately by ensuring that he receives high-flow oxygen. Pulse oximetry is a useful tool for assessing oxygenation provided you remember that it is only a tool, not a substitute for a good assessment.

9. What should be your *most* immediate action?

Snoring respirations indicate that the patient's tongue has fallen back into his throat and is partially blocking his airway. In fact, the tongue is the most common cause of upper airway obstruction in semiconscious and unconscious patients. Your patient's airway is no longer patent, and you must take immediate corrective action. Opening the patient's airway with the head tilt–chin lift maneuver is the quickest, most effective way of accomplishing this. Since his level of consciousness has decreased, an airway adjunct should also be inserted to help maintain his airway. In this case, a nasopharyngeal airway would be the best choice. Although his level of consciousness has significantly decreased, he is not completely unconscious and likely has a gag reflex. Inserting an oropharyngeal airway may result in vomiting and aspiration.

10. How should you adjust your treatment of the patient?

If you weren't already assisting the patient's ventilations, you certainly need to now! Ventilate the patient with 100% oxygen, ensure a good mask-to-face seal, and observe for visible chest rise during each ventilation. His decreased level of consciousness; slow, shallow breathing; and profoundly low oxygen saturation make it clear that he is rapidly progressing toward respiratory arrest. This is likely because he is fatigued from laboring to breathe for a prolonged period. If a patient cannot bring enough oxygen into the lungs, hypoxia will develop. Hypoxia—a dangerous condition in which the tissues and cells of the body are deprived of oxygen—can rapidly cause death unless promptly treated.

11. Has your treatment improved the patient's condition? If so, how do you know?

Compared with earlier assessments, the patient's condition has improved. His skin color and condition are improving, his oxygen saturation is increasing, his heart rate and quality are improving, and his respiratory rate (unassisted), although still shallow, has increased. He still requires assisted ventilation; however, if you continue to ventilate him adequately with high-flow oxygen, you can keep him stable until his underlying problem can be evaluated and definitively treated by a physician. Do not let your guard down, however, because his condition could just as easily deteriorate again.

12. What is the appropriate technique for ventilating an apneic adult?

When ventilating an apneic adult, you should deliver each breath over a period of 1 second—just enough to produce visible chest rise—at a rate of 10 to 12 breaths/min (one breath every 5 to 6 seconds).

13. What are the dangers of hyperventilating a patient?

Hyperventilation (ventilating too fast or with too much force) can have several negative effects on the patient and should be avoided. Hyperventilation increases the incidence of gastric distention, thus increasing the threat of aspiration if regurgitation occurs. Hyperventilation also hyperinflates the lungs; this effect may reduce the amount of blood that returns to the heart and cause cardiac output to fall. Proper ventilation involves delivering each breath over a period of 1 second—just enough to cause visible chest rise—at the appropriate rate (10 to 12 breaths/min for adults; 12 to 20 breaths/min for infants and children).

14. How does respiratory failure differ from respiratory arrest?

Respiratory failure is just that—failure of the respiratory system to bring oxygen into the lungs and remove carbon dioxide. The patient is breathing; however, it is inadequate and requires ventilation assistance. If not promptly treated, respiratory failure can rapidly deteriorate to respiratory arrest. In respiratory arrest, the patient is no longer breathing; he or she is apneic (cessation of breathing). Patients with respiratory arrest need immediate artificial ventilation; otherwise, cellular death will occur and cause cardiopulmonary arrest.

15. Was your patient experiencing respiratory failure or respiratory arrest?

Initially, the patient was experiencing respiratory distress; however, his condition deteriorated to respiratory failure. This was evidenced by a decrease in his level of consciousness, slowing of his respirations, and falling oxygen saturation. Because he was treated promptly and appropriately, he never experienced respiratory arrest (he never stopped spontaneously breathing).

EMS Patient Care Report (PCR)

Date: 3-4-16	**Incident No.:** 090109	**Nature of Call:** Respiratory		**Location:** 145 Landa St.	
Dispatched: 1510	**En Route:** 1510	**At Scene:** 1515	**Transport:** 1525	**At Hospital:** 1532	**In Service:** 1541

Patient Information

Age: 55 **Sex:** M **Weight (in kg [lb]):** 75 kg (165 lb)	**Allergies:** None **Medications:** Digoxin, Vasotec, Lasix **Past Medical History:** Congestive heart failure, HTN **Chief Complaint:** Respiratory distress

Vital Signs

Time: 1517	**BP:** 126/60	**Pulse:** 120	**Respirations:** 30	**Spo_2:** 88%
Time: 1523	**BP:** 118/54	**Pulse:** 130	**Respirations:** 10	**Spo_2:** 89%
Time: 1527	**BP:** 124/62	**Pulse:** 100	**Respirations:** 14	**Spo_2:** 92%
Time:1534	**BP:** 132/72	**Pulse:** 88	**Respirations:** 16	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

9-1-1 dispatch for a male patient with "breathing problems." Arrived on scene to find the patient, a 55-year-old man, in obvious respiratory distress. He was conscious, but appeared sleepy. Skin was cool, pale, and moist. Began assisting patient's breathing with a BVM and high-flow oxygen secondary to poor respiratory effort and signs of hypoxemia. Vital signs obtained and noted above. According to the patient's wife, he began reporting shortness of breath the day before, but it worsened today. His past medical history is significant for CHF and HTN. As preparations were being made to transport, reassessment revealed that patient's LOC had markedly decreased (responsive only to pain), his respiratory rate (unassisted) had decreased, his oxygen saturation decreased, and cyanosis to his facial area developed. Manually opened airway, inserted nasal airway device, and continued to assist breathing. Began transport to emergency department and continued treatment en route. Assessment of assisted ventilation revealed that breath sounds were audible bilaterally with a stethoscope and chest rise was visible with each ventilation. On arrival at the emergency department, the patient's LOC had improved; he was conscious and responded to verbal stimuli, and his oxygen saturation and skin condition had markedly improved. Patient was resistant to assisted ventilation; therefore, high-flow oxygen was continued via nonrebreathing mask. Delivered patient to hospital staff and gave verbal report to attending physician.**End of report**

Prep Kit

Ready for Review

- The upper airway includes the nose, mouth, jaw, oral cavity, pharynx, and larynx. Its function is to warm, filter, and humidify air as it enters the nose and mouth.
- The lower airway includes the trachea and lungs and its function is to exchange oxygen and carbon dioxide.
- Adequate breathing for an adult features a normal rate of 12 to 20 breaths/min, a regular pattern of inhalation and exhalation, adequate depth, bilaterally clear and equal lung sounds, and regular and equal chest rise and fall.
- Inadequate breathing for an adult features a respiratory rate of fewer than 12 breaths/min or more than 20 breaths/min, shallow depth (reduced tidal volume), an irregular pattern of inhalation and exhalation, and breath sounds that are diminished, absent, or noisy.
- Patients who are breathing inadequately show signs of hypoxia, a dangerous condition in which the body's tissues and cells do not have enough oxygen.
- Patients with inadequate breathing need to be treated immediately. Emergency medical care includes airway management, supplemental oxygen, and ventilatory support.
- Basic techniques for opening the airway include the head tilt–chin lift maneuver or, if trauma is suspected, the jaw-thrust maneuver.
- One basic airway adjunct is the oropharyngeal or oral airway, which keeps the tongue from blocking the airway in unconscious patients with no gag reflex. If the oral airway is not the proper size or is inserted incorrectly, it can actually cause an obstruction.
- Another basic airway adjunct is the nasopharyngeal or nasal airway, which is usually used with patients who have a gag reflex and is better tolerated than the oral airway.
- Suctioning is the next priority after opening the airway. Rigid tonsil-tip catheters are the best catheters to use when suctioning the pharynx; soft plastic catheters are used to suction the nose and liquid secretions in the back of the mouth.
- The recovery position is used to help maintain the airway in patients without traumatic injuries who are unconscious and breathing adequately.
- You must provide immediate artificial ventilations with supplemental oxygen to patients who are not breathing on their own. Patients with inadequate breathing may also require artificial ventilations to maintain effective tidal volume.
- Excessive supplemental oxygen can have a detrimental effect on patients with certain illnesses. Patients who require oxygen include: (1) patients with signs of dyspnea, (2) patients with signs of shock, and (3) patients experiencing signs of a myocardial infarction with an oxygen saturation level equal to or lower than 94%. Use pulse oximetry, when available, to tailor oxygen administration to the patient's needs.
- Handle compressed gas cylinders carefully; their contents are under pressure. Always make sure the correct pressure regulator is firmly attached before transporting a cylinder. The pin-indexing safety system features a series of pins on a yoke that must be matched with the holes on the valve stem of the gas cylinder. Pressure regulators reduce the pressure of gas in an oxygen cylinder to between 40 and 70 psi. Pressure-compensated flowmeters and Bourdon-gauge flowmeters permit the regulated release of gas measured in liters per minute.
- When oxygen therapy is complete, disconnect the tubing from the flowmeter nipple and turn off the cylinder valve, then turn off the flowmeter. As long as there is a pressure reading on the regulator gauge, it is not safe to remove the regulator from the valve stem. Keep any possible source of fire away from the area while oxygen is in use.
- Nasal cannulas and nonrebreathing masks are used most often to deliver oxygen in the field. The nonrebreathing mask is the delivery device of choice for providing supplemental oxygen to patients who are breathing adequately but are suspected of having or are showing signs of hypoxia. With a flow rate set at 15 L/min and the reservoir bag preinflated, the nonrebreathing mask can provide more than 90% inspired oxygen. If the patient will not tolerate a nonrebreathing mask, apply a nasal cannula.
- The methods of providing artificial ventilation include mouth-to-mask ventilation, two-person BVM ventilation, a manually triggered ventilation device, and one-person BVM ventilation. The manually triggered ventilation device is not a recommended ventilation device by most standards. Combined with your own exhaled breath, mouth-to-mask ventilation will give your patient up to 55% oxygen; a BVM with an oxygen reservoir and supplemental oxygen can deliver nearly 100% oxygen.
- CPAP is a noninvasive method of providing ventilatory support for patients in respiratory distress or suffering from sleep apnea.
- When you are providing artificial ventilation, remember that ventilating too forcefully can cause gastric distention. Slow, gentle breaths during artificial ventilation can help to prevent gastric distention. Patients who have a tracheal stoma or a tracheostomy tube need to be ventilated through the tube or the stoma.
- Foreign body airway obstruction usually occurs during a meal in an adult or while a child is eating, playing with small objects, or crawling about the house. The earlier you recognize an airway obstruction, the better. You must learn to

recognize the difference between airway obstruction caused by a foreign object and that caused by a medical condition.

- Foreign body airway obstructions are classified as being mild or severe. Patients with a mild airway obstruction are able to move adequate amounts of air and should be left alone. Patients with a severe airway obstruction cannot move any air at all and require immediate treatment. Perform abdominal thrusts on conscious adults and children with a severe airway obstruction. If the patient becomes unconscious, open the airway and look in the mouth (do not perform blind finger sweeps), attempt to ventilate the patient, and perform chest compressions if ventilations are unsuccessful.
- Check for loose dental appliances in a patient before assisting ventilations. Loose appliances should be removed to prevent them from obstructing the airway. Tight-fitting appliances should be left in place.

Vital Vocabulary

aerobic metabolism Metabolism that can proceed only in the presence of oxygen.

agonal gasps Occasional, gasping breaths that occur after the heart has stopped.

airway The upper airway tract or the passage above the larynx, which includes the nose, mouth, and throat.

alveolar minute volume The volume of air moved through the lungs in 1 minute minus the dead space; calculated by multiplying tidal volume (minus dead space) and respiratory rate.

alveolar ventilation The volume of air that reaches the alveoli. It is determined by subtracting the amount of dead space air from the tidal volume.

American Standard Safety System A safety system for large oxygen cylinders, designed to prevent the accidental attachment of a regulator to a cylinder containing the wrong type of gas.

anaerobic metabolism The metabolism that takes place in the absence of oxygen; the principal product is lactic acid.

apnea Absence of spontaneous breathing.

aspiration In the context of airway, the introduction of vomitus or other foreign material into the lungs.

ataxic respirations Irregular, ineffective respirations that may or may not have an identifiable pattern.

automatic transport ventilator (ATV) A ventilation device attached to a control box that allows the variables of ventilation to be set. It frees the EMT to perform other tasks while the patient is being ventilated.

bag-valve mask (BVM) A device with a one-way valve and a face mask attached to a ventilation bag; when attached to a reservoir and connected to oxygen, it delivers more than 90% supplemental oxygen.

barrier device A protective item, such as a pocket mask with a valve, that limits exposure to a patient's body fluids.

bilateral A body part or condition that appears on both sides of the midline.

bronchioles Subdivision of the smaller bronchi in the lungs; made of smooth muscle and dilate or constrict in response to various stimuli.

capnography A noninvasive method to quickly and efficiently provide information on a patient's ventilatory status, circulation, and metabolism. Effectively measures the concentration of carbon dioxide in expired air over time.

capnometry The use of a capnometer, a device that measures the amount of expired carbon dioxide.

carina Point at which the trachea bifurcates (divides) into the left and right mainstem bronchi.

chemoreceptors Monitor the levels of O_2, CO_2, and the pH of the cerebrospinal fluid and then provide feedback to the respiratory centers to modify the rate and depth of breathing based on the body's needs at any given time.

compliance The ability of the alveoli to expand when air is drawn in during inhalation.

continuous positive airway pressure (CPAP) A method of ventilation used primarily in the treatment of critically ill patients with respiratory distress; can prevent the need for endotracheal intubation.

dead space The portion of the tidal volume that does not reach the alveoli and thus does not participate in gas exchange.

diffusion A process in which molecules move from an area of higher concentration to an area of lower concentration.

dyspnea Shortness of breath.

end-tidal CO_2 The amount of carbon dioxide present at the end of an exhaled breath.

exhalation The passive part of the breathing process in which the diaphragm and the intercostal muscles relax, forcing air out of the lungs.

external respiration The exchange of gases between the lungs and the blood cells in the pulmonary capillaries; also called pulmonary respiration.

gag reflex A normal reflex mechanism that causes retching; activated by touching the soft palate or the back of the throat.

gastric distention A condition in which air fills the stomach, often as a result of high volume and pressure during artificial ventilation.

glottis The space in between the vocal cords that is the narrowest portion of the adult's airway; also called the glottic opening.

good air exchange A term used to distinguish the degree of distress in a patient with a mild airway obstruction. With good air exchange, the patient is still conscious and able to cough forcefully, although wheezing may be heard.

head tilt–chin lift maneuver A combination of two movements to open the airway by tilting the forehead back and lifting the chin; not used for trauma patients.

hypercarbia Increased carbon dioxide level in the bloodstream.

hypoxia A dangerous condition in which the body tissues and cells do not have enough oxygen.

hypoxic drive A condition in which chronically low levels of oxygen in the blood stimulate the respiratory drive; seen in patients with chronic lung diseases.

inhalation The active, muscular part of breathing that draws air into the airway and lungs.

internal respiration The exchange of gases between the blood cells and the tissues.

intrapulmonary shunting Bypassing of oxygen-poor blood past nonfunctional alveoli to the left side of the heart.

jaw-thrust maneuver Technique to open the airway by placing the fingers behind the angle of the jaw and bringing the jaw forward; used for patients who may have a cervical spine injury.

labored breathing Breathing that requires greater than normal effort; may be slower or faster than normal and usually requires the use of accessory muscles.

larynx A complex structure formed by many independent cartilaginous structures that all work together; where the upper airway ends and the lower airway begins; also called the voice box.

manually triggered ventilation device A fixed flow rate ventilation device that delivers a breath every time its button is pushed; also referred to as a flow-restricted, oxygen-powered ventilation device.

mediastinum Space within the chest that contains the heart, major blood vessels, vagus nerve, trachea, major bronchi, and esophagus; located between the two lungs.

metabolism (cellular respiration) The biochemical processes that result in production of energy from nutrients within the cells.

mild airway obstruction Occurs when a foreign body partially obstructs the patient's airway. The patient is able to move adequate amounts of air, but also experiences some degree of respiratory distress.

minute volume The volume of air moved through the lungs in 1 minute; calculated by multiplying tidal volume and respiratory rate; also referred to as minute ventilation.

nasal cannula An oxygen-delivery device in which oxygen flows through two small, tubelike prongs that fit into the patient's nostrils; delivers 24% to 44% supplemental oxygen, depending on the flow rate.

nasopharyngeal (nasal) airway Airway adjunct inserted into the nostril of an unresponsive patient or a patient with an altered level of consciousness who is unable to maintain airway patency independently.

nasopharynx The nasal cavity; formed by the union of facial bones and protects the respiratory tract from contaminants.

nonrebreathing mask A combination mask and reservoir bag system that is the preferred way to give oxygen in the prehospital setting; delivers up to 90% inspired oxygen and prevents inhaling the exhaled gases (carbon dioxide).

oropharyngeal (oral) airway Airway adjunct inserted into the mouth of an unresponsive patient to keep the tongue from blocking the upper airway and to facilitate suctioning the airway, if necessary.

oropharynx Forms the posterior portion of the oral cavity, which is bordered superiorly by the hard and soft palates, laterally by the cheeks, and inferiorly by the tongue.

oxygenation The process of delivering oxygen to the blood by diffusion from the alveoli following inhalation into the lungs.

oxygen toxicity A condition of excessive oxygen consumption resulting in cellular and tissue damage.

parietal pleura Thin membrane that lines the chest cavity.

partial pressure The term used to describe the amount of gas in air or dissolved in fluid, such as blood.

passive ventilation The act of air moving in and out of the lungs during chest compressions.

patent Open, clear of obstruction.

phrenic nerve Nerve that innervates the diaphragm; necessary for adequate breathing to occur.

pin-indexing system A system established for portable cylinders to ensure that a regulator is not connected to a cylinder containing the wrong type of gas.

pneumothorax A partial or complete accumulation of air in the pleural space.

poor air exchange A term used to describe the degree of distress in a patient with a mild airway obstruction. With poor air exchange, the patient often has a weak, ineffective cough, increased difficulty breathing, or possible cyanosis and may produce a high-pitched noise during inhalation (stridor).

pulse oximetry An assessment tool that measures oxygen saturation of hemoglobin in the capillary beds.

recovery position A side-lying position used to maintain a clear airway in unconscious patients without injuries who are breathing adequately.

residual volume The air that remains in the lungs after maximal expiration.

respiration The process of exchanging oxygen and carbon dioxide.

retractions Movements in which the skin pulls in around the ribs during inspiration.

severe airway obstruction Occurs when a foreign body completely obstructs the patient's airway. The patient cannot breathe, talk, or cough.

stoma An opening through the skin and into an organ or other structure; a stoma in the neck connects the trachea directly to the skin.

stridor A high-pitched noise heard primarily on inspiration.

suction catheter A hollow, cylindrical device used to remove fluid from the patient's airway.

surfactant A liquid protein substance that coats the alveoli in the lungs, decreases alveolar surface tension, and keeps the alveoli expanded; a low level in a premature infant contributes to respiratory distress syndrome.

tension pneumothorax A life-threatening collection of air within the pleural space; the volume and pressure have both collapsed the involved lung and caused a shift of the mediastinal structures to the opposite side.

tidal volume The amount of air (in mL) that is moved in or out of the lungs during one breath.

tonsil tips Large, semirigid suction tips recommended for suctioning the pharynx; also called Yankauer tips.

tracheostomy Surgical opening into the trachea.

ventilation Exchange of air between the lungs and the environment, spontaneously by the patient or with assistance from another person, such as an EMT.

visceral pleura Thin membrane that covers the lungs.

vital capacity The amount of air that can be forcibly expelled from the lungs after breathing in as deeply as possible.

vocal cords Thin white bands of tough muscular tissue that are lateral borders of the glottis and serve as the primary center for speech production.

wheezing The production of whistling sounds during expiration such as occurs in asthma and bronchiolitis.

Assessment *in Action*

You and your partner arrive at a local restaurant where you find an unresponsive 62-year-old man lying on the floor. Witnesses report the patient collapsed to the ground without any warning. You perform a primary assessment and note the patient has a carotid pulse, but is unresponsive and not breathing. He appears cyanotic and there are no signs of traumatic injury.

1. What is the first intervention that should take place?

   A. Apply oxygen with a nonrebreathing mask and assess vital signs.
   B. Prepare for immediate transport to a hospital.
   C. Insert an oral airway and begin ventilations with a BVM.
   D. Check the patient for any medical alert tags.

2. You attempt to ventilate the patient with a BVM and notice resistance. The chest does not rise during your ventilation. What should you do?

   A. Reposition the airway by hyperextending the head to allow for better anatomic position, then attempt to ventilate.
   B. Assume there is a foreign body airway obstruction and immediately begin chest compressions.
   C. Assume there is a foreign body airway obstruction and provide forceful ventilations.
   D. Reposition the airway by bringing the head back to a neutral position, then reopen the airway and attempt to ventilate.

3. Which of the following indicates that your artificial ventilations are inadequate?

   A. Minimal or no chest rise and fall
   B. Increased levels on pulse oximetry

C. Heart rate returning to normal range
D. Warm, pink skin

4. How can gastric distention be prevented when performing artificial ventilations?

   A. Provide rapid, forceful breaths during artificial ventilation over 1 second.
   B. Provide slow, gentle breaths during artificial ventilation over 1 second.
   C. Provide rapid, forceful breaths during artificial ventilation over 3 seconds.
   D. Provide slow, gentle breaths during artificial ventilation over 3 seconds.

5. Which of the following is contraindicated in a patient who has sustained a head injury?

   A. Insertion of an oral airway
   B. Jaw-thrust maneuver
   C. Mouth-to-mask ventilation
   D. Insertion of a nasal airway

6. While you are performing artificial ventilations on this patient, he vomits. What should you do?

   A. Roll the patient onto his side to allow for drainage of emesis.
   B. Continue ventilations with increased force to prevent aspiration.
   C. Immediately stop ventilations and begin chest compressions.
   D. Stop ventilations and wait for advanced life support to arrive.

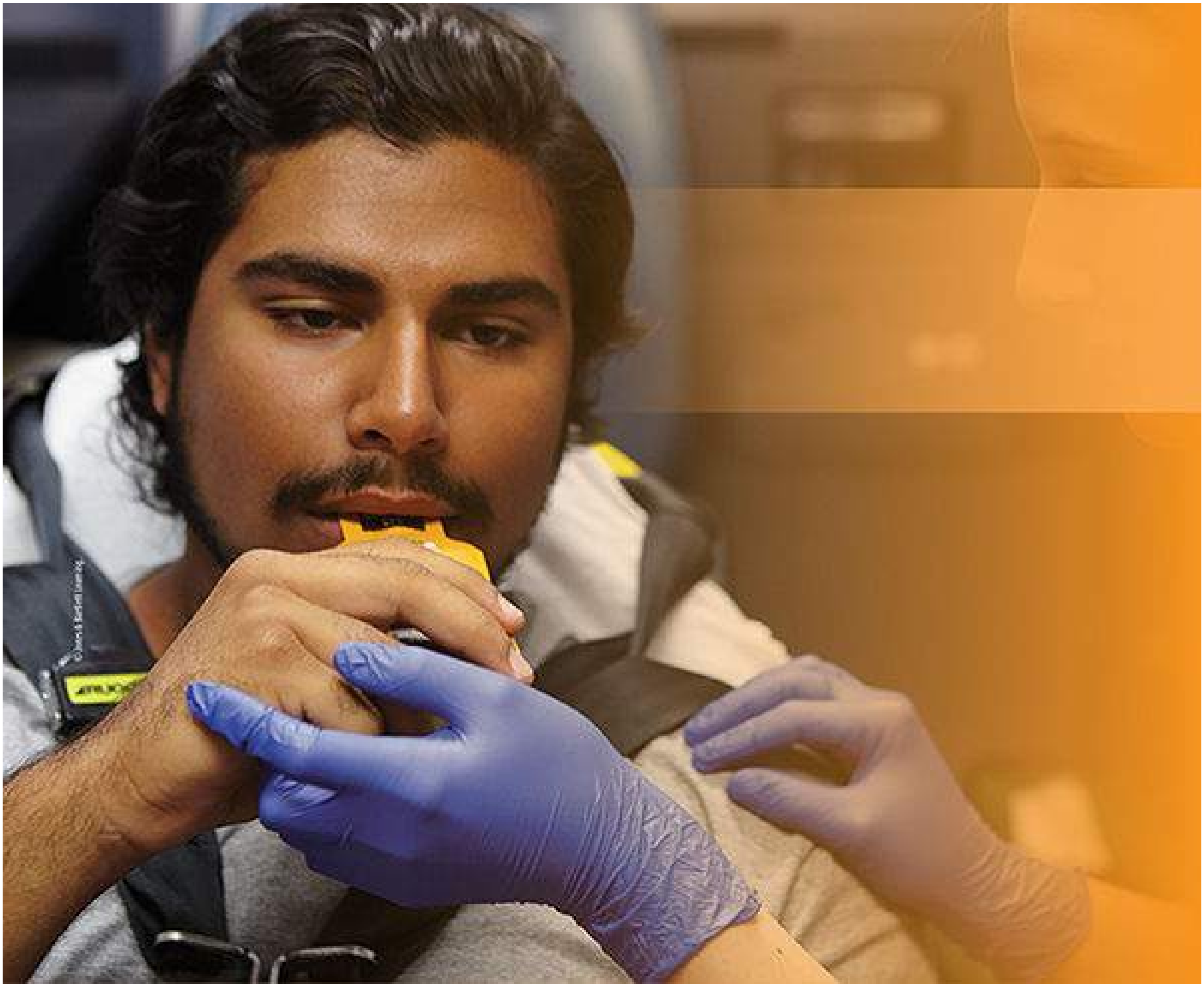
7. Your partner applies a pulse oximeter to the patient. While ventilating, you note adequate chest rise and fall and improved skin color; however, the oxygen saturation reads 88%. Which of the following is a potential cause of an inaccurate pulse oximetry reading?

   A. Hypertension
   B. Peripheral vasoconstriction
   C. Jaundice
   D. Diabetes

8. Explain the effects of hypoxia on cellular metabolism.

9. You are providing artificial ventilations to your patient with a BVM attached to oxygen. What is the difference between ventilation and oxygenation?

10. While en route to the hospital, the patient begins shallow breathing at a rate of 6 breaths/min. He remains unresponsive. What should you do?



SECTION

4

Pharmacology

11 Principles of Pharmacology

CHAPTER 11

Principles of Pharmacology

National EMS Education Standard Competencies

Pharmacology

Applies fundamental knowledge of the medications that the EMT may assist/administer to a patient during an emergency.

Principles of Pharmacology

› Medication safety (pp 461–463)
› Kinds of medications used during an emergency (pp 464–475)

Medication Administration

› Self-administer medication (pp 463–464)
› Peer-administer medication (pp 463–464)
› Assist/administer medications to a patient (pp 463–464)

Emergency Medications

› Names (p 456)
› Effects (pp 455–456)
› Actions (p 455)
› Indications (p 456)
› Contraindications (p 456)
› Complications (p 456)
› Routes of administration (pp 456–458)
› Side effects (p 456)
› Interactions (pp 465–466, 475–476)
› Dosages for the medications administered (pp 455, 462, 465–466)

Knowledge Objectives

1. Define the terms pharmacodynamics, therapeutic effects, indications, side effects, unintended effects, and untoward effects. (pp 455–456)
2. Explain medication contraindications; include an example. (p 456)
3. Explain the differences between a generic medication name and a trade medication name; provide an example of each. (p 456)
4. Differentiate enteral and parenteral routes of medication administration. (p 456)
5. Describe rectal, oral, intravenous, intraosseous, subcutaneous, intramuscular, inhalation, sublingual, and transcutaneous routes of medication administration; include the rates of absorption. (pp 457–458)
6. Explain the solid, liquid, and gas forms of medication and the routes of administration; provide examples of each. (pp 459–461)
7. List the "six rights" of medication administration; include how each one relates to EMS. (pp 461–463)
8. Explain the difference between direct orders (online) and standing orders (off-line) and the role of medical control. (p 463)
9. Discuss the medication administration circumstances involving peer-assisted medication, patient-assisted medication, and EMT-administered medication. (pp 463–464)
10. Know the generic and trade names, actions, indications, contraindications, routes of administration, side effects, interactions, and doses of 10 medications that may be administered by an EMT in an emergency as dictated by state protocols and local medical direction. (pp 463–475)
11. Describe the medication administration considerations related to special populations, including pediatric, geriatric, and pregnant patients. (pp 464, 472–473)
12. State the steps to follow when dispensing medications to a patient using an auto-injector. (p 471)
13. Explain why determining what prescription and over-the-counter medications a patient is taking is a critical aspect of patient assessment during an emergency. (pp 475–476)
14. State the steps to take if a medication error occurs. (p 477)

Skills Objectives

1. Apply the six rights of medication administration. (pp 461–463)
2. Demonstrate how to administer oral medication to a patient. (pp 464, 467–468)
3. Demonstrate how to administer aspirin to a patient with chest pain. (p 468)
4. Demonstrate how to administer oral glucose to a patient with hypoglycemia. (p 468)
5. Demonstrate how to assist a patient with the sublingual administration of a medication. (p 468)
6. Demonstrate how to administer a medication by auto-injector. (p 471)
7. Demonstrate how to administer an intranasal medication. (pp 471–472)

Introduction

Medications are an important intervention available to you as an EMT. You must understand the medications within your scope of practice, just as paramedics and nurses must understand the medications they administer. Used appropriately, a medication may alleviate pain and improve a patient's condition. Failure to administer medications safely and competently can lead to serious consequences for the patient, including death. Therefore, it is essential that you have the knowledge and skills to administer or assist in administration of these medications.

This chapter describes the various forms of medications, the different ways in which they can be administered, and how they work. It then takes a close look at each of the seven forms of medications you may be asked to administer or help patients to self-administer. It will also explain when it is dangerous to administer these medications.

How Medications Work

Pharmacology is the science of drugs, including their ingredients, preparation, uses, and actions on the body. Although the terms *drugs* and *medications* are often used interchangeably, the term drugs may make some people think of narcotics or illegal substances. For this reason, you should use the word *medications*, especially when interviewing patients and families. In general terms, a **medication** is a substance that is used to treat or prevent disease or relieve pain.

Pharmacodynamics is the process by which a medication works on the body. Different types of receptors are located throughout the body. Receptors are sites on cells where medications or chemicals produced in the body can bind and produce an effect. When medications are given, they bind to these sites and either stimulate the receptors to produce an effect or block the receptors to prevent other chemicals or medications from binding. Thus, a medication can either increase or decrease a normal function of the body. Medications that cause stimulation of receptors are called **agonists**. Medications that bind to a receptor and block other medications or chemicals from attaching are called **antagonists**, or blockers.

Words of Wisdom

It is important for you to become familiar with the "street" names of commonly used and abused drugs. Most users will not tell you they took methylenedioxy-methamphetamine; most likely you will hear terms like ecstasy, XTC, Molly, rolling, or popping. Research these street names using a reliable source, such as the National Institutes of Health (NIH) or the Centers for Disease Control and Prevention (CDC).

The **dose** is the amount of the medication that is given. The dose often depends on the patient's weight or age. The dose also depends on the desired action of the medication. The **action** is the intended **therapeutic effect** that a medication is expected to have on the body. The therapeutic effect is also referred to as the desired or intended effect. These factors, among others, can help to explain why one dose of medication works quickly and efficiently on one patient and the same dose has little effect on another patient. Doses of medications may need to be decreased for infants because they have small bodies. Doses may also need to be decreased for older adults because they cannot process medications as efficiently as younger people.

YOU are the Provider — PART 1

You and your partner are dispatched to a residence at 4864 Project Avenue for an older woman with "diabetic problems." The time is 0600 hours, the weather is clear, the traffic is light, and your response time to the scene is approximately 5 minutes.

1. What is pharmacology?
2. Why is knowledge of pharmacology important to patient care?

Indications are the reasons or conditions for which a particular medication is given. For example, nitroglycerin relaxes the walls of all blood vessels, both veins and arteries. This increases the blood flow and the supply of oxygen to the heart muscle. In this way, nitroglycerin may relieve the discomfort that can occur with the cardiac condition called angina. Therefore, nitroglycerin is indicated for chest pain associated with angina.

There are times when you should not give a medication, even if it usually is indicated for that person's condition. Such situations are called **contraindications**. A medication is contraindicated when it would harm the patient or have no positive effect on the patient's condition. For example, the administration of activated charcoal may be indicated when a patient has swallowed a poison. Generally, activated charcoal, premixed with water, is used to prevent the body from absorbing a poison. However, activated charcoal would be contraindicated if the patient were unconscious and could not swallow. Some contraindications are "absolute," meaning the medication should never be given if the contraindication is present. For example, severe hypotension is an absolute contraindication for nitroglycerin. Some contraindications are "relative," meaning the benefits of administering the drug may outweigh the risks. For example, glaucoma (a condition of increased pressure within the eye) is a relative contraindication for many drugs. Consider a patient with anaphylaxis and a history of glaucoma. It would likely be more dangerous to withhold epinephrine from this patient than to administer it.

Side effects are any actions of a medication other than the desired ones. There are two types of side effects: unintended effects and untoward effects. **Unintended effects** are the effects that are undesirable but pose little risk to the patient, such as a slight headache after taking nitroglycerin. **Untoward effects** are the effects that can be harmful to the patient, such as hypotension after taking nitroglycerin.

Consider diphenhydramine (Benadryl). People take this medication for allergic reactions (indication). The medication is supposed to block the effects of histamine (intended effect). Its side effects include dry mouth and drowsiness (unintended effect) and it can increase the pressure of the fluid within the eye (untoward effect). Asthma is a relative contraindication for diphenhydramine because it can worsen lower airway constriction.

Medication Names

Medications usually have two names. The **generic name** (such as ibuprofen) is a simple, clear, nonproprietary name. The generic name is not capitalized. Sometimes a medication is called by its generic name more often than by any of its trade names. For example, you may hear "nitroglycerin" used more often than the trade names Nitromist and Nitrostat. All medications that are licensed for use in the United States are listed by their generic names in the *United States Pharmacopoeia and the National Formulary (USP-NF)*.

A **trade name** is the brand name that a manufacturer gives to a medication, such as Tylenol (acetaminophen). As a proper noun, a trade name begins with a capital letter. Trade names are used in every aspect of our daily lives, not just in medications. Well-known examples include Jell-O, Band-Aid, Kleenex, and Coke. A medication may have many different trade names, depending on how many companies manufacture it. Advil, Nuprin, and Motrin all are trade names for the generic medication ibuprofen. A trade name sometimes is also designated by a raised registered symbol; that is, Advil®.

Medications may be **prescription medications** or **over-the-counter (OTC) medications**. Prescription medications are distributed to patients only by pharmacists according to a physician's order. OTC medications may be purchased directly, without a prescription. In recent years, many medications previously available only by prescription have become available in OTC form, such as Nasacort, Nexium, and Flonase.

You may come into contact with patients who have taken recreational drugs such as heroin or cocaine. Other patients may take herbal remedies, enhancement drugs, vitamin supplements, or alternative medicines. As we have discussed, the body's cells are configured to operate using chemical reactions; they cannot discern between safe and unsafe pharmacologic agents. Any medication that a patient takes can be pharmacologically active and can cause an effect. As an EMT, you need to ask patients about any and all medications they take.

Routes of Administration

Medications can enter the body through a variety of routes. To simplify this topic, the routes of medication administration are divided into two categories: enteral and parenteral. **Enteral medications** enter the body through the digestive system. Typically, the form of the medication will be a pill or a liquid such as cough medicine. Medications administered via this route tend to absorb slowly and are therefore not commonly used in an emergency setting. **Parenteral medications** enter the body by a route other than the digestive tract, the skin, or the mucous membranes. Parenteral medications are often in a liquid form and are generally administered using syringes and needles. These medications are absorbed much more quickly and offer a more predictable and measurable response.

Regardless of the route of administration of a medication, the end goal is to get that medication into the bloodstream. **Absorption** is the process by which medications travel through body tissues until they reach the bloodstream. Often the rate at which a medication is absorbed into the bloodstream depends on its route of administration. **Table 11-1** lists common routes of medication administration and rates of absorption.

- **Per rectum (PR)**. Per rectum means by rectum. This route of delivery is most commonly used with children because of easier administration and more reliable absorption. (Children often regurgitate some or all of a medication.) For similar reasons, many medications that are used for nausea and vomiting come in a rectal suppository form. Some medications to control seizures are administered PR when it is impossible to administer them intravenously. The PR route also is used to give some medications when the patient cannot swallow or is unconscious.
- **Oral**. Many medications are taken by mouth, or **per os (PO)**, and enter the bloodstream through the digestive system. This process often takes as long as 1 hour. One of the advantages of using this route is that it is noninvasive. Patients are often much happier to take a pill than to have a needle stuck in them. It is also less expensive to use enteral medications than to use parenteral. The main disadvantage of this administration route is the unpredictability of medication absorption. If the patient has vomiting or diarrhea, the amount of medication that is absorbed will be altered. Some medications, referred to as orally disintegrating tablets (ODTs), are put directly onto the tongue, where they dissolve. This is an alternative administration form for patients who may have difficulty swallowing. Some forms of medications are adversely affected by stomach acids, so dissolving them directly on the tongue avoids breakdown by gastric acids. An example of this type of medication is ondansetron (Zofran), which is used to treat nausea and vomiting.

Table 11-1 Routes of Administration and Rates of Absorption

Route	Rate
Enteral	
Sublingual (SL)	Rapid
Per rectum (PR)	Rapid
By mouth (PO)	Slow
Parenteral	
Intravenous (IV)	Immediate
Intraosseous (IO)	Immediate
Inhalation	Rapid
Intranasal (IN)	Rapid
Intramuscular (IM)	Moderate
Subcutaneous (SC)	Slow
Transcutaneous	Slow

- **Intravenous (IV) injection**. Intravenous means into the vein. Medications that need to enter the bloodstream immediately may be injected directly into a vein. This is the fastest way to deliver a chemical substance, but the IV route cannot be used for all chemicals. For example, aspirin, oxygen, and charcoal cannot be given by the IV route.
- **Intraosseous (IO) injection**. Intraosseous means into the bone. Medications that are given by this route reach the bloodstream through the bone marrow. Giving a medication by the IO route, into the marrow, requires drilling a needle into the outer layer of the bone. Because this is painful, the IO route is used most often in patients who are unconscious as a result of cardiac arrest or extreme shock. Often, the IO route is used for children who have fewer available (or difficult to access) IV sites.
- **Subcutaneous (SC) injection**. Subcutaneous means under the skin. A SC injection is given into the fatty tissue between the skin and the muscle. Because there is less blood here than in the muscles, medications that are given by this route are generally absorbed more slowly, and their effects last longer. A SC injection is a useful way to give medications that cannot be taken by mouth, as long as they do not irritate or damage the tissue. Daily insulin injections for patients with

diabetes are given by the SC route. Some forms of epinephrine can be given by the SC route.

- **Intramuscular (IM) injection**. Intramuscular means into the muscle. Usually, medications that are administered by IM injection are absorbed quickly because muscles have a lot of blood vessels. However, not all medications can be administered by the IM route. Possible problems with IM injections are damage to muscle tissue and uneven, unreliable absorption, especially in people with decreased tissue perfusion or who are in shock.

  You will typically use the IM route of medication administration with an auto-injector. These devices deliver a predetermined amount of medication into the patient when pressed firmly into the thigh. Examples of this delivery method would be the EpiPen auto-injector, which is used for anaphylactic reactions (see Chapter 20, *Immunologic Emergencies*), and the DuoDote Auto-Injector or the Antidote Treatment-Nerve Agent Auto-Injector (ATNAA), which are used for nerve agent exposure (see Chapter 40, *Terrorism Response and Disaster Management*).
- **Inhalation**. Some medications are inhaled into the lungs so that they can be absorbed into the bloodstream more quickly. Others are inhaled because they work in the lungs. Generally, inhalation helps minimize the effects of the medication in other body tissues. Such medications come in the form of aerosols, fine powders, and sprays.
- **Sublingual (SL)**. Sublingual means under the tongue. Medications given by the SL route, such as nitroglycerin tablets, enter through the oral mucosa under the tongue and are absorbed into the bloodstream within minutes. This route is faster than the oral route, and it protects medications from chemicals in the digestive system, such as acids that can weaken or inactivate them.
- **Transcutaneous (transdermal)**. Transcutaneous means through the skin. Some medications can be absorbed transcutaneously, such as the nicotine in patches used by people who are trying to quit smoking. On occasion, a medication that also comes in another form is administered transcutaneously to achieve a longer-lasting effect. An example is an adhesive patch containing nitroglycerin.
- **Intranasal (IN)**. Intranasal is a relatively new format for the delivery of some medications. In this route a liquid medication is pushed through a specialized device called a **mucosal atomizer device (MAD)**. The liquid medication is aerosolized and is administered into a nostril. The head and face are very vascular; therefore, absorption is rather quick with this route. The flu vaccine and naloxone (Narcan), a reversal agent for opioid overdose that will be discussed later in this chapter, are examples of medications that can be administered intranasally.

Table 11-2 lists the words that are used for routes of medication delivery, along with their meanings.

Table 11-2 Routes of Administration: Words and Their Meanings

This Word...	From These Latin Words...	Means
Inhalation	*inhalatio* (drawing air into the lungs)	inhaling or breathing in
Intramuscular (IM)	*intra* (into) and *muscularis* (of the muscles)	into muscle
Intraosseous (IO)	*intra* (into) and *osse* (bone)	into bone
Intravenous (IV)	*intra* (into) and *venosus* (of the veins)	into vein
Per os (PO)	*per* (by) and *os* (mouth)	by mouth
Per rectum (PR)	*per* (by) and *rectum* (rectum)	by rectum
Subcutaneous (SC)	*sub* (under) and *cutis* (skin)	under the skin
Sublingual (SL)	*sub* (under) and *lingua* (relating to the tongue)	under the tongue
Transcutaneous (transdermal)	*trans* (through) and *cutis* (skin)	through the skin
Intranasal	*intra* (into) and *nasal* (nose)	into the nose

Safety Tips

Make absolutely certain you follow standard precautions when administering any medication, particularly topical drugs. If the medication can be absorbed into the patient's skin, it can be absorbed into yours as well.

Medication Forms

The form of a medication usually dictates the route of administration. For example, a tablet or a spray cannot be given through a needle. The manufacturer chooses the form to ensure the proper route of administration, the timing of its release into the bloodstream, and its effects on the target organs or body systems. As an EMT, you should be familiar with the following seven medication forms.

Tablets and Capsules

Most medications that are given by mouth to adult patients are in tablet or capsule form. Capsules are gelatin shells filled with powdered or liquid medication. If the capsule contains liquid, the shell is sealed and usually soft. If the capsule contains powder, the shell can usually be pulled apart. In tablets, the medication is compressed under high pressure. Tablets often contain other materials that are mixed with the medication.

Some tablets are designed to dissolve very quickly in small amounts of liquid so that they can be given sublingually (under the tongue) and absorbed rapidly. An example is the sublingual nitroglycerin tablet used to treat chest pain in patients with cardiac conditions. These medications are especially useful in emergency situations, because medications that must be swallowed and then digested provide a slower route of delivery. For example, an oral pain medication is less useful than an IV pain medication when pain relief is needed immediately.

Solutions and Suspensions

A **solution** is a liquid mixture of one or more substances that cannot be separated by filtering or allowing the mixture to stand. Solutions can be given by almost any route. When given by mouth, solutions may be absorbed from the stomach fairly quickly because the medication is already dissolved. Many solutions can be given as an IV, IM, or SC injection. If a patient has an anaphylactic reaction, you may help him or her to self-administer a solution of epinephrine using an auto-injector (EpiPen).

YOU are the Provider — PART 2

You arrive at the scene and find the patient, a 68-year-old woman, sitting in a recliner in her living room. Her son, who called 9-1-1, tells you that she is not "acting right." He also tells you that she has taken her medications today, but is not sure when she last ate. You assess the patient as your partner opens the jump kit and prepares to begin treatment.

Recording Time: 0 Minutes	
Appearance	Confused; diaphoretic; pale
Level of consciousness	Conscious but confused
Airway	Open; clear of secretions or foreign bodies
Breathing	Increased rate; shallow depth
Circulation	Radial pulses, rapid and weak; skin, pale and diaphoretic

As your partner gives the patient high-flow oxygen via nonrebreathing mask, her son tells you that she has diabetes, heart disease, and depression. Her medication list includes eight different prescription medications, including glimepiride (Amaryl), nitroglycerin (Nitrostat), and sertraline (Zoloft). You assess her blood glucose level, which reads 36 mg/dL. The patient is disoriented to place and time but able to speak and follow simple commands.

3. Other than oxygen, what other medication does this patient require, and why?
4. What are the "six rights" of medication administration and why are they important?
5. Why is it significant to know the patient took her medications on an empty stomach?

Many substances do not dissolve well in liquids. Some of these can be ground into fine particles and evenly distributed throughout a liquid by shaking or stirring. This type of mixture is called a **suspension**. An example is activated charcoal, which you may give to patients who have taken overdoses of certain medications or ingested certain poisons.

Suspensions separate if they stand or are filtered. It is very important that you shake or swirl a suspension before administering it to ensure that the patient receives the right amount of medication. For example, if you are a parent, you may have had to shake a suspension of oral antibiotic before giving it to your child.

Suspensions usually are administered by mouth but sometimes are given rectally. Occasionally, suspensions are applied directly to the skin to treat skin problems. You may have used calamine lotion in this way. Injectable suspensions are given via IM or SC injection only. Certain hormone shots or vaccinations are given this way because of the suspended particles. They cannot be given by IV injection because the suspended particles do not remain dissolved.

Metered-Dose Inhalers

If liquids or solids are broken into small enough droplets or particles, they can be inhaled. A **metered-dose inhaler (MDI)** is a miniature spray canister used to direct such substances through the mouth and into the lungs **Figure 11-1** and is often used by a patient with a respiratory illness such as asthma or emphysema. An MDI delivers the same amount of medication each time it is used. Because an inhaled medication usually is suspended in a propellant, the MDI must be shaken vigorously before the medication is administered. Many patients who use MDI medications also self-administer medications with a nebulizer. Use of MDIs and nebulizers will be discussed later in this chapter.

Topical Medications

Lotions, creams, and ointments are **topical medications**; that is, they are applied to the surface of the skin and affect only that area. Lotions contain the most water, and ointments contain the least. Lotions (such as calamine lotion) are absorbed the most rapidly, and ointments (such as triple antibiotic ointment [Neosporin]) the most slowly. Hydrocortisone cream, to diminish skin itching, is an example of a medical cream that can also be given in ointment form.

Figure 11-1 Some medications are inhaled into the lungs with a metered-dose inhaler so that they can be absorbed into the bloodstream near the site of desired action more quickly.

Transcutaneous Medications

Transdermal medications are designed to be absorbed through the skin, or transcutaneously. Medications such as nitroglycerin paste usually have properties or delivery systems that help to dilate the blood vessels in the skin and, thus, speed absorption into the bloodstream. In contrast with most topical medicines, which work directly on the application site, transdermal medications are usually intended for systemic (whole-body) effects. A note of caution: If you touch such a medication with your bare skin while administering it, you will absorb it just as readily as the patient will. This can be very dangerous. For example, if you absorb nitroglycerin paste, your blood pressure may drop and cause you to faint while driving the ambulance to the hospital.

One delivery system for transcutaneous medications is the adhesive patch. Patches attach to the skin and allow even absorption of a medication for many hours **Figure 11-2**. Prescription and OTC medications come in this form. Common examples are nitroglycerin, nicotine, some pain medications, and some oral contraceptives.

Gels

A **gel** is a semiliquid substance that is administered orally in capsule form or through plastic tubes. Gels usually have the consistency of pastes or creams but are transparent (clear). "Gelatinous" means thick and sticky, like gelatin. Depending on your local medical directives, as an EMT, you may give oral glucose in gel form to a patient with diabetes **Figure 11-3**.

Figure 11-2 Some medications are transcutaneous, or administered through the skin, such as the nitroglycerin patch shown.

Figure 11-3 Oral glucose, used in diabetic emergencies, is available in gel and tablet forms.

Gases for Inhalation

Gaseous medications are neither solid nor liquid. The medication most commonly used in gas form is oxygen. You might not think of oxygen as a medication; however, in its concentrated form, it is a potent medication that has systemic effects. You will deliver this gas through a nonrebreathing mask, nasal cannula, or bag-valve mask (BVM). Current guidelines and potential risks of oxygen administration will be discussed in Chapter 10, *Airway Management*.

Words of Wisdom

When you document the use of oxygen, include the liter flow rate, the time oxygen was delivered (usually recorded in military time), and the type of device used. For example, "0915—Nonrebreathing mask at 15 L/min. Patient states shortness of breath has improved." Always remember to document the patient's response to oxygen administration.

General Steps in Administering Medication

As an EMT, you may only administer medications for which you have an order from medical control. Medical control may be provided online or offline based on local protocol. You must be familiar with the six general steps of administering any medication to a patient. These steps are the "six rights" of medication administration Table 11-3. Medication errors, which will be discussed later in this chapter, are disturbingly common and almost always result from failure to follow these six rights. After the medication has been administered, you will need to reassess the patient to see if it worked. You should look for side effects and then be prepared to document your findings and your actions.

When administering or assisting with the administration of patient medications, you must have an order from medical control to do so. If this order is given to you directly through online medical control, it is important that you repeat the order back to the physician. This is referred to as the echo technique and it is done to ensure that you heard the order correctly.

Table 11-3 The "Six Rights" of Medication Administration

Right patient
Right medication
Right dose
Right route
Right time
Right documentation

The following example illustrates the correct way to acknowledge orders for medications. EMT Johnson is talking on the radio to medical control. She has already given the physician all of the patient assessment information and vital signs. She now asks, "Do you have any orders?" Dr. Ortez says, "Yes, please assist the patient with one nitroglycerin tablet. Make sure the tablet is administered sublingually. Reassess the patient's pain and blood pressure and contact me for further orders if needed." EMT Johnson should reply, "Dr. Ortez, I copy one nitroglycerin tablet sublingual, reassess the patient's pain and blood pressure, and contact you again if needed." Dr. Ortez says, "That is correct. ABC Hospital clear."

If at any point while you are receiving an order for a medication you are confused or unclear about what to do, you should tell medical control. It is very important that you understand what the physician wants you to do. With all of the noise on a hectic scene, or in the back of an ambulance, it is important to err on the cautious side. If you are not sure what to do, say so and ask for the order to be clarified. If you believe a medication order may be harmful to the patient, it is your responsibility to address your concerns with the ordering physician.

The other way to receive orders to administer or assist with medications is through indirect or off-line medical control. Protocols are documents that contain standing orders for the administration of certain medications. For example, your system may use a protocol that describes how the medical director wants you to deal with a patient who is having respiratory difficulties. Part of this protocol may direct you to use a nonrebreathing mask to deliver oxygen at 15 L/min. You may do this without calling online medical control if the patient meets the criteria of the protocol.

The "six rights" of medication administration are as follows:

1. **Right patient.** For EMS, this safety check may seem unneeded if there is only one patient; however, there will be times when you will be working with more than one patient. Consider the following scenario. You respond to a patient with chest pain and discover that the patient is preparing to self-administer one nitroglycerin tablet sublingually. You check the bottle prior to administration and discover that the medication was actually prescribed for his wife. Depending on local protocols, administering a medication that was prescribed for a different patient may represent a violation.

2. **Right medication.** Verify the proper medication and prescription, if applicable. Once received, confirm the medication order and determine that the patient is still a candidate for the medication. Make sure the patient does not have any contraindications for the medication. It is always a good idea to have your partner confirm the medication before you administer it. Carefully read the label. If it is the patient's own prescription, the bottle may show the trade name or the generic name. If you have any questions, contact online medical control. Make sure that the medication is the patient's own and does not belong to a friend or relative. You should never give a medication to a patient who has been prescribed for someone else.
3. **Right dose.** Verify the form and dose of the medication. Once you have confirmed the order and verified that the medication is the correct one to give, you must make sure that the form of the medication and the dose are correct. This is where it is important to pay very close attention to detail. If you are ordered to give 324 mg of aspirin, you will need to read the bottle to determine how many milligrams are in each tablet. If aspirin is available in 81-mg tablets, how many will you need to give the patient? Again, it is always a good idea to have your partner confirm the dosage before administering it.
4. **Right route.** Verify the route of the medication. Now you must make sure the route matches the order you received. For example, suppose you are told to give the patient a sublingual nitroglycerin tablet. The patient's nitroglycerin tablet bottle is empty, but he has another bottle of nitroglycerin capsules. These are to be swallowed four times a day. The medication is the same, even the dose may be the same, but the route of delivery is different from the order given. You may not substitute the capsules for the tablets without specific orders from medical control.
5. **Right time.** Check the expiration date and condition of the medication. The last step before administering a medication is to make sure the expiration date has not passed. Prescription and OTC medications have an expiration date. Check the label. If no date can be found, you should examine the medication with suspicion. If you find discoloration, cloudiness, or particles in a liquid medication, you should not use it. If a patient with asthma gives you an MDI and the expiration date on it is smudged, you should not use it. After the medication is administered, you will need to reassess the patient to see if it has worked. Does the patient still have the same complaint as before you administered the medication? Has it changed? Is the patient experiencing any side effects? You should reassess the vital signs, especially heart rate and blood pressure, at least every 5 minutes if the patient's condition changes. If the medication is being administered to help reduce pain (such as oxygen), you should ask the patient to rate his or her pain both before and after medication administration. A 0 to 10 scale, or the Wong-Baker pain scale, is often used to help patients quantify their pain level. In addition, if the physician orders you to repeat the medication, it is important to do so at the right time. For example, if you are advised to repeat administration of nitroglycerin in 10 minutes if the patient's pain is unresolved, you should not wait 15 minutes.
6. **Right documentation.** Remember the EMS rule: The work is not done until the paperwork is done. Once the medication has been given, you must document your actions and the patient's response. This includes the time you gave the medication and the name, dose, and route of administration. Did the patient's condition improve, worsen, or not change? Were there any side effects? A second EMS rule says, "If you did not write it down, it did not happen." Should your performance ever be questioned, accurate documentation is your best defense.

Medication Administration and the EMT

There are several medications that may be carried on the EMS unit, including oxygen, oral glucose, activated charcoal, aspirin, and epinephrine. When used wisely, each can be a powerful tool. Keep in mind, however, that you may give these medications only according to standing orders in a protocol (off-line medical control) or a direct order (online medical control). Along with the several different medications that can be given by EMTs, there are several different routes of administration that will be used to deliver these medications to the patient.

Before specific medications are discussed, the circumstances surrounding the administration of the medications need to be discussed. Over the years, EMTs have been allowed increasing responsibility to work with medications, but this growth has come with some degree of confusion and worry. Many departments throughout the United States have strict controls on when an EMT is allowed to administer a medication. The circumstances are:

- **Peer-assisted medication**
- **Patient-assisted medication**
- **EMT-administered medication**

In peer-assisted medication administration, you are administering medication to yourself or your partner. At times it may be necessary for an EMS crew to receive medications because they were exposed to a toxic nerve agent, such as during a terrorism incident. In this case, you would first treat yourself and then your partner. Typically, nerve agent antidotes are administered via an auto-injector (see Chapter 40, *Terrorism Response and Disaster Management*, for more information).

In patient-assisted medication administration, you are assisting the patient with the administration of his or her own medication, such as an EpiPen, an MDI bronchodilator, or nitroglycerin. Perhaps the patient cannot find his or her medication. Maybe the patient is so upset that he or she cannot open the pill bottle or hold the MDI steady. In this circumstance, the patient is trying to administer the medication, but you need to offer some help so the task can be completed.

The last circumstance is EMT-administered medications. Here you are directly administering the medication to the patient. It can certainly be difficult to find the exact point where "assisting" a patient ends and actually administering a medication begins. The patient may be severely confused or unable to understand the need for the medication. Common medications that you will administer in this circumstance are oxygen, oral glucose, activated charcoal, nitroglycerin, and aspirin.

It is important for you to understand that the medication itself does not necessarily dictate whether or not you will be assisting or directly administering. Medical control, state guidelines, and local protocols will be the determining factors that define the role of the EMT. The EpiPen has often been an example of a medication that is both patient-assisted and EMT-administered. Refer to your local standards to obtain a listing of how and when EMTs can administer medications.

Words of Wisdom

The following is a list of medications that, depending on local protocol, may be administered by EMTs. Keep in mind that this list is ultimately set by the state in which you will be delivering patient care and the medical director of your agency.

- Oxygen
- Activated charcoal
- Oral glucose
- Aspirin
- Epinephrine
- Metered-dose inhaler (MDI) medications
- Nitroglycerin
- Naloxone

You may administer or help to administer medications only under the following conditions:

- Medical control gives you a direct order to administer a medication and/or the local medical protocols under which you are working permit you to administer that medication.
- The local medical protocols, developed by a medical physician under whom you are working, include standing orders for the use of a medication in defined situations.

It is imperative that you do not give or help patients take any other medications under any other circumstances.

Special Populations

Pediatric and geriatric patients often have slower absorption and elimination times, necessitating modification of the doses administered. Pregnant patients are limited in the medications they can take because of the risk to the fetus.

Medications Used by EMTs

The following is a discussion of medications that may be administered by EMTs. Again, your state, department, and medical director will ultimately define what medications are carried on your ambulance. Table 11-4 provides an excellent overview of these medications and their actions, indications, contraindications, routes of administration, side effects, interactions, and doses.

The 2009 National EMS Education Standards recognize that some regions of the country may need their EMTs involved in the administration of additional medications aside from oxygen, oral glucose, activated charcoal, aspirin, and epinephrine. The exact list of medications that you will be allowed to manage is ultimately controlled by the state and medical director of your agency.

Oral Medications

There are several medications you may be asked to administer or to assist with administration. Activated charcoal, oral glucose, aspirin, and several OTC medications can be administered by this route. As discussed, the advantages of this route are its ease of access and comfort level for the patient. One of the disadvantages of administering medications orally is that the digestive tract can be easily affected by foods, stress, and illness. The speed of movement of food through the tract dramatically changes the speed of absorption. As with all medications, you need to start with the six rights. Follow these steps to perform oral medication administration:

1. Take standard precautions.
2. Confirm the medication is not expired.
3. Obtain medical direction per local protocol.
4. Confirm that the patient has a patent airway and is able to swallow, then instruct the patient to swallow or chew the medication **Figure 11-4**.
5. Monitor the patient's condition and document.

Activated Charcoal

Many poisoning emergencies involve overdoses of medications taken by mouth. Many medications bind with activated charcoal, reducing the amount of medication that can be absorbed by the body. **Adsorption** means to bind to or stick to a surface, while absorption is the process by which medications travel through body tissues until they reach the bloodstream. **Activated charcoal** is ground into a very fine powder to provide the greatest possible surface area for binding. You will probably carry a container with a premixed suspension of activated charcoal powder and water in the EMS unit, if allowed by local protocol **Figure 11-5**. The usual dose is 1 to 2 g/kg of body weight. To convert pounds to kilograms, remember that 1 kg is equal to 2.2 lb. One method is to divide the patient's weight (in lb) by 2.2 to calculate his or her approximate weight in kg. For example, a 200 lb man weighs approximately 90.9 kg. You should use a method of calculating a patient's weight consistent with and accepted by local protocol.

Table 11-4 EMT Medication Overview

Medications EMTs Administer or May Assist in Administering								
Generic/Trade	Action	Indications	Contraindications	Routes	Side Effects	Interactions	Adult Dose	Administration Concerns
Activated charcoal (Actidose with Sorbitol)	Adsorbs toxic substances in the digestive tract	Most oral poisonings; overdose	Decreased level of consciousness; overdose of corrosives, caustics, or petroleum substances	PO	Nausea, vomiting, constipation, black stools	Bonds with and inactivates most medications/substances in the digestive tract	1 to 2 g/kg	Stains (protect patient and provider clothing); do not give when giving other PO medications
Aspirin (Bayer)	Anti- inflammatory agent and anti-fever agent; prevents platelets from clumping, thereby decreasing formation of new clots	Relief of mild pain, headache, muscle aches; chest pain of cardiac origin	Hypersensitivity; recent bleeding	PO	Nausea, vomiting, stomach pain, bleeding, allergic reactions	Caution should be used in patient who are taking anticoagulants	160 to 325 mg; 160- to 325-mg chewable tablets for chest pain	Do not administer for pain caused by trauma or for fevers in children; patients with chest pain must be able to chew tablets
Common fast-acting MDI medications (albuterol [Proventil, Ventolin])	Stimulates nervous system, causing bronchodilation	Asthma/difficulty breathing with wheezing	Hypersensitivity; tachycardia (relative); chest pain of cardiac origin	Inhalation	Hypertension, tachycardia, anxiety, restlessness	Increases effects of other nervous system stimulants	1 to 2 inhalations; wait 5 minutes before repeating dose	Patient must inhale all medication in one breath; coach patient to hold breath for 5 seconds after inhalation
Epinephrine (EpiPen)	Stimulates nervous system, causing bronchodilation	Anaphylactic reaction	Chest pain of cardiac origin; hypothermia; hypertension	IM	Hypertension, tachycardia, anxiety, restlessness	Increases effects of other nervous system stimulants	0.3 mg for adult; 0.15 mg for children	Medication will last approximately 5 minutes; do not repeat dose; ensure ALS is en route for continuing treatment
Naloxone (Narcan, EVZIO auto-injector)	Reverses respiratory depression secondary to opioid overdose	Opioid poisoning	Hypersensitivity	IM, IN	Nausea, vomiting	Additional doses may be required for severe opioid overdoses	0.4 mg auto-injector; 2 mg IN	Patients may wake up combative

Medications EMTs Administer or May Assist in Administering								
Generic/ Trade	**Action**	**Indications**	**Contraindications**	**Routes**	**Side Effects**	**Interactions**	**Adult Dose**	**Administration Concerns**
Nitroglycerin (Nitrostat, Nitromist)	Dilates blood vessels	Chest pain of cardiac origin	Hypotension; use of sildenafil (Viagra) or another treatment for erectile dysfunction within the previous 24 hours; head injury	SL tablet or spray	Headache, burning under tongue, hypotension, nausea	Increases dilating effects of other blood vessel–dilating medications	0.3 to 0.4 mg SL; 0.4 mg spray	Ensure ALS is en route
Oral glucose (Glutose)	When absorbed, provides glucose for cell use	Low blood glucose (hypoglycemia)	Decreased level of consciousness; nausea; vomiting	PO	Nausea, vomiting	None	1/2 to 1 tube	Patient must be awake, have control of airway, and be able to follow commands
Oxygen (no trade name)	Reverses hypoxia; provides oxygen to be absorbed by lungs	Hypoxia or suspected hypoxia	Very rarely used in patients with COPD; do not use near open flames, as oxygen will support combustion	Inhalation	Decreased respiratory effort in rare cases in patients with COPD	Can support combustion	Use oxygen delivery devices to administer 28% to 100% oxygen.	No open flames nearby; do not withhold oxygen from patients in respiratory distress
Common Over-the-Counter (OTC) Medications								
Acetaminophen (Tylenol)	Analgesic and fever reducer	Relief of mild pain or fever, headache, muscle aches	Hypersensitivity	PO	Allergic reaction	Take caution to avoid potential overdosing. Many OTC medications contain acetaminophen	500 to 1,000 mg every 4 hours as needed; dose is weight-based for children	Weight of child is more important than age
Diphenhydramine (Benadryl)	Antihistamine (blocks histamine)	Mild allergic reactions	Asthma; glaucoma; pregnancy; hypertension; infants	PO	Sleepiness (although can stimulate children), dry mouth and throat	Do not take with alcohol or MAO inhibitors (a type of psychiatric medication)	25 to 50 mg	Can use in severe allergic reaction; however, epinephrine is administered first
Ibuprofen (Advil, Motrin, Nuprin)	Nonsteroidal anti-inflammatory drug that reduces inflammation and fever; analgesic	Mild pain or fever, headache, muscle aches	Hypersensitivity	PO	Nausea, vomiting, stomach pain, bleeding, allergic reactions	Do not take with aspirin	200 to 400 mg every 4 to 6 hours; dose is weight-based in children	Do not take for pain caused by trauma; weight of child is more important than age

Figure 11-4 Instruct the patient to chew (eg, baby aspirin) or swallow (eg, activated charcoal) the medication.

The bond between medication and charcoal is not permanent. The medication may break free and be absorbed into the bloodstream if activated charcoal remains in the digestive system throughout a normal day. As a result, charcoal is frequently suspended with another medication called sorbitol (a complex sugar). This suspension has a laxative effect that causes the entire mixture, including the medication, to move quickly through the digestive system. The sorbitol additive increases the risk of dehydration due to diarrhea. This can be especially dangerous with pediatric patients. Consult local protocol regarding which form of activated charcoal you can administer.

Activated charcoal is given by mouth. Although sorbitol sweetens the suspension, the black charcoal makes it look unappealing. For this reason, you should use a covered container and ask the patient to drink the fluid through a straw. Also, it is important to have a layer of protective clothing, such as a gown, over your uniform. Activated charcoal stains clothing, so protect yourself and the patient's clothes when administering it. This medication should not be given to anyone with an altered level of consciousness because of the risk of aspiration. Activated charcoal is not indicated for patients who have ingested an acid, an alkali, or a petroleum product.

Figure 11-5

Activated charcoal is a suspension that is sometimes used for patients who have taken a medication overdose or swallowed a poison.

YOU are the Provider PART 3

After administering 15 g of oral glucose to the patient, you reassess her and note that her condition has improved. She is conscious and alert and asks you what happened. As you explain what happened to her, your partner takes her vital signs.

Recording Time: 5 Minutes	
Respirations	22 breaths/min; regular and adequate
Pulse	112 beats/min; strong and regular
Skin	Pink; slightly moist
Blood pressure	122/72 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)
Blood glucose	70 mg/dL

6. What medications are typically carried on an EMT ambulance?
7. As an EMT, what medications can you assist the patient to self-administer?

Oral Glucose

Glucose is a sugar that our cells use as fuel. Although some cells can use other sugars, brain cells must have glucose. If the level of glucose in the blood gets too low, a person can suffer a loss of consciousness, have seizures, and ultimately die.

The medical term for an extremely low blood glucose level is **hypoglycemia**. Hypoglycemia can be caused by an excess of insulin, which is taken to control blood glucose levels. Patients with diabetes who use insulin regularly usually understand the effects of this medication on the body. The **oral glucose** that is carried in the EMS unit, as well as glucose tablets, can counteract the effects of hypoglycemia in the same way as a caloric beverage such as juice or a non-diet soda, but faster. This is because common table sugar (sucrose) and fruit sugars (fructose) are complex sugars and must be broken down before they can be absorbed. Glucose is a simple sugar that is readily absorbed by the bloodstream.

As an EMT, you can give glucose only by mouth. Hospital personnel and advanced providers (AEMTs and paramedics) can also give a form of glucose (dextrose) intravenously. Glucose is available as a gel designed to be spread on the mucous membranes between the cheek and gum; however, absorption through this route is not as quick as with injection. Because the patient may be conscious one moment and unconscious the next, you must be very careful when administering oral glucose. Never administer oral medications to an unconscious patient or to one who is unable to swallow or protect the airway. See Chapter 19, *Endocrine and Hematologic Emergencies*, for more information on the administration of oral glucose.

Safety Tips

Never attempt to give anything by mouth to a patient with a decreased level of consciousness. Remember, an altered LOC may be an indication for a medication such as oral glucose; however, a decreased LOC can be a contraindication for oral medications, due to the potential for airway compromise.

Aspirin

Aspirin (acetylsalicylic acid or ASA) is an antipyretic (reduces fever), analgesic (reduces pain), and anti-inflammatory (reduces inflammation) medication that inhibits platelet aggregation (clumping). This last property makes it one of the most used medications today. Research has shown that the aggregation of platelets in the coronary arteries under certain conditions is one of the direct causes of heart attack. Patients at risk for coronary artery disease are often prescribed one or two "baby" (or children's) aspirins a day. During a potential heart attack, aspirin may be lifesaving.

Contraindications for aspirin include documented hypersensitivity to aspirin (absolute), preexisting liver damage (absolute), bleeding disorders (relative), and asthma (relative). Because of the association of aspirin with Reye syndrome (a rare but serious condition that causes swelling in the brain and liver), it should not be given to children.

Sublingual Medications

The sublingual route of administration has many advantages. Assuming the patient is awake, alert, and able to follow commands, it is easy to talk with the patient and advise him or her to place a pill under his or her tongue. The head and face receive large amounts of blood flow, so absorption rates are relatively quick. Be aware, however, that any medication placed in the mouth requires constant evaluation of the airway. You must also be alert to any signs of choking on the pill. If the patient is uncooperative or unconscious, this route of medication administration should not be used.

Nitroglycerin

Many patients with cardiac conditions carry some form of fast-acting nitroglycerin to relieve the pain of angina. **Nitroglycerin** has been used medically since the 1800s. Nitroglycerin is typically the only medication that you will help to administer sublingually **Figure 11-6**.

If you have ever run for a prolonged period, you probably remember your muscles developed a painful, heavy, burning sensation. This is because the demand for oxygen by the muscles exceeded the supply. When a similar pain develops in heart muscle, it is called angina pectoris. The cause is the same—not enough oxygen. In this case the pain is due to a blockage or narrowing in the blood vessels that supply the heart. Occasionally, the cause is a spasm in these blood vessels. Unlike a runner with sore legs, the heart muscle cannot stop and rest until the pain goes away.

The purpose of nitroglycerin is to increase blood flow by relieving the spasms or causing the arteries to dilate. It does this by relaxing the muscular walls of the coronary arteries and veins. Nitroglycerin also relaxes veins throughout the body, so less blood is returned to the heart and the heart does not have to work as hard each time it contracts. In short, blood pressure is decreased. Because of this, it is important that you always take the patient's blood pressure before administering nitroglycerin. If the systolic blood pressure is less than 100 mm Hg, the nitroglycerin may have the harmful effect of lowering the blood flow to the heart's own blood vessels. Even a patient who has adequate blood pressure should sit or lie down with the head elevated before taking this medication. If the patient is standing, he or she may faint when blood flow to the brain is reduced as the nitroglycerin starts to work. If a significant drop in the patient's blood pressure (15 to 20 mm Hg) occurs and the patient suddenly feels dizzy or sick, have the patient lay down.

Figure 11-6 Nitroglycerin, which is prescribed for chest pain, can be given sublingually as a spray **(A)** or tablet **(B)**.

A: Courtesy of Shionogi Pharma, Inc.; B: © Jones & Bartlett Learning.

During a heart attack (myocardial infarction, or MI), a narrowing or blockage in a coronary artery blocks the blood flow to a section of the heart muscle (myocardium). If the blockage is not cleared in time, that section of the heart muscle beyond the clot will die. If nitroglycerin no longer brings relief to a person in whom it has previously worked, the person may be experiencing an MI instead of an angina attack. Therefore, it is important to know how much nitroglycerin a patient has needed in the past to relieve chest pain and how much has been taken during the current emergency, including the use of nitroglycerin patches. Always report this information to medical control. Remember, you cannot administer this medication without clearance from medical control or standing orders.

There are important interactions to consider when administering nitroglycerin. Erectile dysfunction medications, such as sildenafil (Viagra), tadalafil (Cialis), and vardenafil (Levitra), can have potentially fatal interactions with nitroglycerin. When taken together, nitroglycerin and sildenafil can cause a dramatic drop in blood pressure. Always ask a patient who has been prescribed nitroglycerin if he or she has used any medication for the treatment of erectile dysfunction within the previous 24 hours. If he or she has, do not administer the nitroglycerin and report this to medical control. Keep in mind that drugs for erectile dysfunction may be used by both men and women; do not assume women have not taken erectile dysfunction drugs.

Nitroglycerin has the following effects:

- Relaxes the muscular walls of coronary arteries and veins
- Results in less blood returning to the heart
- Decreases blood pressure
- Relaxes arteries throughout the body
- Often causes a mild headache and/or burning under the tongue after administration

Administering Nitroglycerin by Tablet. Nitroglycerin is usually taken sublingually. The patient places a tiny tablet under the tongue, where it dissolves. The tablet should create a slight tingling or burning sensation under the tongue. Exposure to light, heat, or air may degrade the strength of the medication. If the nitroglycerin does not produce the typical burning sensation, it may have lost potency because of aging or improper storage. If you notice any signs of improper storage, be sure to include that information in the patient's medical history. In addition, be sure to check the expiration date on the bottle.

Sublingual nitroglycerin tablets should be stored in their original glass container with the cap screwed on tightly. Note that what looks like cotton in the container is actually rayon. If real cotton is placed in the container, it can absorb nitroglycerin, thus reducing the potency of the tablets. Other medications placed in the container can likewise rob nitroglycerin of its power.

Administering Nitroglycerin by Metered-Dose Spray. Some patients who take nitroglycerin use a metered-dose spray, which deposits medication on or under the tongue. Each spray is equivalent to one tablet. To ensure direct, proper dosing on the bottom of the tongue, do not use a spacer with the metered-dose canister when giving nitroglycerin by this method.

Whether using the tablets or the metered-dose spray, you should wait 5 minutes for a response before repeating the dose. Closely monitor the patient's vital signs, particularly the blood pressure. Give repeated doses per medical control and/or local protocol. Remember, always wear gloves when handling nitroglycerin tablets or spray since this medication can be absorbed by your skin.

Next, you must reconfirm that the medication is still indicated for the patient. For example, suppose you have received and verified the order to give one sublingual nitroglycerin tablet to a patient with a cardiac condition. While you were getting the order, however, the patient begins to sweat more and becomes less responsive. Reassessment of the blood pressure reveals a pressure of 80/60 mm Hg. Using your knowledge of nitroglycerin, you recognize the contraindication and decide not to give the medication. Instead, you notify medical control of the changes in the patient's condition and seek new orders.

Knowing and understanding the local protocols under which you will be working are absolutely essential, as is a thorough knowledge of the medications within your scope of practice. Refer back to Table 11-4 for a review of all of the medications and the important information needed for their administration. See Chapter 16, *Cardiovascular Emergencies*, for more information on how to administer nitroglycerin.

Words of Wisdom

General Steps in Administering Medication

1. Obtain an order from medical control.
2. Verify the proper medication and prescription.
3. Verify the form, dose, and route of the medication.
4. Check the expiration date and condition of the medication.
5. Reassess the vital signs, especially heart rate and blood pressure, at least every 5 minutes or as the patient's condition changes.
6. Document your actions and the patient's response.

Intramuscular Medications

The intramuscular (IM) route of administration provides quick and easy access to the circulatory system without the need for placing a needle within a vein. Blood flow to the muscles is relatively stable, even during circumstances of severe illness or injury. This advantage makes the IM route an efficient means to deliver some medications. A disadvantage for this route is the use of a needle and the subsequent pain it can cause. Patients may be reluctant for you to use the needle for fear of pain or injury. With proper technique, you can administer medications via the IM route and limit the amount of pain delivered to the patient.

Epinephrine

Epinephrine is the main hormone that controls the body's fight-or-flight response and is the primary medication that you will be administering IM. Epinephrine is a sympathomimetic. A sympathomimetic mimics the effect of the sympathetic nervous system. The body releases epinephrine when there is sudden stress, such as during exercise or when the patient is suddenly scared. Because epinephrine is secreted by the adrenal glands, it is also known as adrenaline. Epinephrine has different effects on different body tissues and is used as a medication in several forms. Generally, epinephrine will increase the heart rate and blood pressure and dilate passages in the lungs. It can ease breathing problems caused by the bronchial spasms common in asthma and allergic reactions. In a person who is close to anaphylactic shock as a result of an allergic reaction, epinephrine may also help to maintain the patient's blood pressure. However, epinephrine is not indicated for patients who do not show signs of airway obstruction or wheezing due to an allergic reaction. This medication should also not be given to patients with hypertension, hypothermia, or if you believe the patient may be having a myocardial infarction.

Epinephrine has the following characteristics:

- Secreted naturally by the adrenal glands
- Dilates passages in the lungs
- Constricts blood vessels, causing increased blood pressure
- Increases heart rate and blood pressure

Refer back to Chapter 6, *The Human Body,* for more information on epinephrine.

Administering Epinephrine by Injection. Some states and EMS agencies now authorize the use of epinephrine by EMTs for the treatment of life-threatening anaphylaxis. In certain patients, insect venom or other allergens cause the body to over-release histamine, which lowers blood pressure by relaxing the small blood vessels and allowing them to leak. The over-release of histamine may also cause wheezing from bronchial spasms and swelling of the airway tissues (edema), which make it difficult for the patient to breathe. Epinephrine acts as a specific antidote to reverse the effects of histamines, countering both of these harmful effects. It constricts the blood vessels, allowing blood pressure to rise and reducing the swelling. In the lungs, it has the opposite effect; it dilates the air passages, so the flow of air is less restricted.

Epinephrine may be dispensed from an auto-injector, which automatically delivers a preset amount of the medication **Figure 11-7**. This is usually 0.3 mg of epinephrine. This is the method that you will most likely use.

Some areas may allow epinephrine to be administered by intramuscular injection using a vial of 1:1,000 concentration with a needle and syringe, as discussed in Chapter 20, *Immunologic Emergencies.*

Be sure to familiarize yourself with the procedures for using the auto-injector on your unit. Some manufacturers of auto-injectors include verbal instructions for administration. The general procedure is as follows:

1. Grasp unit with the tip pointing downward.
2. Form a fist around the unit. Do *not* place your thumb over either end of the unit.
3. With the other hand, pull off the activation cap.
4. Hold the tip near the outer part of the patient's thigh.
5. Insert firmly into the outer thigh so that the unit is perpendicular (at a 90-degree angle) to the thigh. Do not allow the unit to bounce.

Figure 11-7 An EpiPen auto-injector may be used to administer a preset dose of epinephrine.

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6. Hold firmly in the thigh for several seconds.
7. Immediately place the unit in an appropriate sharps container after administration.

Epinephrine causes a burning sensation where it is injected, and the patient's heart rate will increase after the injection, so be prepared for these side effects. Some services do not permit EMTs to carry epinephrine but do allow them to assist patients in administering their own epinephrine in life-threatening anaphylactic reactions.

Administering Naloxone by Injection. The US Food and Drug Administration (FDA) has approved an auto-injector device that delivers an IM or subcutaneous injection of naloxone (Narcan) to reverse the effects of an opioid overdose. This medication can be administered by family members or caregivers to help reverse dangerous side effects of opioid overdose, such as life-threatening respiratory depression. One version of auto-injectable naloxone, called EVZIO, provides verbal instructions for administration similar to those provided by AEDs. There are several important considerations for EMTs related to auto-injectable naloxone:

- Consult medical direction to determine if EMTs are allowed to administer naloxone in your region. As always, follow local protocol. Consider requesting assistance from ALS personnel if available for any suspected opioid overdose.
- Find out if naloxone has been administered by a bystander prior to your arrival.
- Be aware that the effects of naloxone may not last as long as opioids. Repeat doses of naloxone may be needed.
- Administration of naloxone to opioid-dependent patients can cause severe withdrawal symptoms, including seizures and cardiac arrest.
- You must consider your safety, as patients may become violent following naloxone administration.

Begin by administering naloxone in increments of 0.4 mg, then gradually increase based on the patient response, or lack thereof, to achieve the desired effect of restoring respirations while avoiding withdrawal symptoms and associated complications.

Intranasal Medications

Naloxone

Not all EMS departments will use naloxone auto-injectors, due to their expense. The most common technique for naloxone administration is via the intranasal route. Other common routes of administration include intravenous and intramuscular. All of the same considerations described for administering injectable naloxone apply when administering naloxone in any another form.

Follow these steps to administer a medication intranasally:

1. Obtain medical direction per local protocol.
2. Confirm correct medication and expiration date.
3. Attempt to determine if the patient is allergic to any medications.
4. Prepare the medication and attach the atomizer. *Never* use a needle.
5. Place the atomizer in one nostril, pointing up and slightly outward **Figure 11-8**.
6. Administer a half dose (1 mL maximum) into each nostril.
7. Reassess the patient and document appropriately.

If you do not have naloxone available, note that BVM ventilations provide necessary treatment to opioid overdose patients until definitive treatment can be reached.

Figure 11-8 Some EMTs may administer naloxone intranasally to treat an opioid overdose.

Words of Wisdom

When documenting a medication, include the name of the medication, dose and route, and vital signs before and after administration. For example: 1030 hours—vital signs: pulse, 88 beats/min; respirations, 18 breaths/min; blood pressure, 128/68 mm Hg; nitroglycerin, 0.4 mg SL. 1035 hours —vital signs: pulse, 80 beats/min; respirations, 18 breaths/min; blood pressure, 124/60 mm Hg.

Special Populations

Geriatric patients often take many medications. They might also save medications left over from previous medical conditions. Make every effort to identify which medications are current and the conditions they are being used to treat. Ask family members to help distinguish current from outdated medications, or look at the expiration dates on the medication labels. If possible, bring the medications with you to the emergency department.

Geriatric patients can become confused about their medication regimen. Uncertainty about whether they missed a dose may cause a patient to repeat the medication, possibly leading to an overdose. If you think an overdose has occurred, contact medical control.

Remember, medications can interact with each other, creating potentially harmful conditions. Even though a medication may be indicated for a special condition, it might be contraindicated in the presence of another medication. For example, if the patient is taking the heart medication propranolol (Inderal) and has an acute episode of shortness of breath, some asthma treatments might be made less effective by the heart medication.

Although medications help people to recover from acute conditions and adjust to chronic diseases, they can pose serious problems for geriatric patients. You should distinguish current from previous medications, suspect accidental or intentional overdoses, and be prepared for potentially lethal medication interactions. Document all findings, and inform medical control.

Inhalation Medications

Oxygen

Oxygen is, by far, the most commonly administered medication in the prehospital setting. All cells need **oxygen** to function properly. The heart and brain, especially, cannot function for long if oxygen levels decrease, which is why oxygen is an onboard medication for EMS units. If a patient is not breathing or is having trouble getting air into the lungs, you should administer supplemental oxygen. In general, you will be giving oxygen via a nonrebreathing mask at 10 to 15 L/min (or via nasal cannula at 2 to 6 L/min if the patient cannot tolerate a nonrebreathing mask). However, if the patient is not breathing adequately, you must also provide artificial ventilations, so you will need to use a BVM. Oxygen is usually delivered at 15 L/min with this technique.

Outside a hospital, the nonrebreathing mask is the preferred method of giving oxygen to patients who are experiencing significant respiratory difficulties or shock. With a good mask-to-face seal, this mask can provide up to 90% inspired oxygen. With a nasal cannula, oxygen flows through two small, tube-like prongs that fit into the patient's nostrils. This device can provide up to 44% inspired oxygen if the flowmeter is set at 6 L/min.

Remember that, although oxygen itself does not burn, it is a catalyst for combustion. If there is extra oxygen in the air, objects will burn more easily. So make sure there are no open flames, lit cigarettes, or sparks in the area in which you are administering oxygen.

Words of Wisdom

Oxygen is not helpful, and may be harmful, in patients who are having a heart attack or stroke when breathing is normal and the oxygen saturation is 94% or greater.

Special Populations

Children are not small adults, especially when it comes to the administration of medications. The approach to children differs from that for adults. First, doses of medications are different. Most of the assisted medications will be smaller doses. Children may not have the coordination needed to use an MDI. It will be easier if a spacer device is added to the inhaler to ensure the child receives the full benefit of the medicine. The second and most important issue in medication administration in children is affective. Children are not cognitively or emotionally the same as adults. Therefore, a little more time and effort may be required to explain each procedure. It is also in your best interest to tell the child the truth. It is very important to gain the trust of the child in the short time you have to bond with him or her.

YOU are the Provider — PART 4

The patient is placed onto the stretcher and loaded into the ambulance. She remains conscious and alert. Her son tells you that he has to retrieve some items from her house and will follow the ambulance in his car. Shortly before departing the scene, you reassess the patient's vital signs.

Recording Time: 13 Minutes	
Level of consciousness	Conscious and alert
Respirations	18 breaths/min; regular and adequate
Pulse	84 beats/min; strong and regular

Skin	Pink, warm, and slightly moist
Blood pressure	128/74 mm Hg
Spo_2	99% (on oxygen)
Blood glucose	94 mg/dL

The patient tells you that she thinks she may have accidentally taken too much of her Amaryl. You reassess her blood glucose level and note that it is 94 mg/dL.

8. You are unfamiliar with the medication Amaryl. What should you do?

9. If you were unable to obtain a blood glucose reading on this patient, would you still administer oral glucose? Why or why not?

Metered-Dose Inhalers and Nebulizers

MDIs and small volume nebulizers (SVNs) are used to administer liquid medications that have been turned into a fine mist by a flow of air or oxygen **Figure 11-9**. With the medication atomized, it is breathed into the lungs and delivered to the alveoli. Blood flow to the alveoli is very high and absorption rates are very close to those found with IV medications. This route is fast and relatively easy to access. MDIs are commonly used because of their convenience and portability. The major disadvantage of an MDI is that the patient needs to be cooperative and control his or her breathing. If the patient is unconscious, an MDI cannot be used, although you could use a nebulizer. Nebulizers are often used for more severe problems.

Medications Administered Using a Metered-Dose Inhaler or Small Volume Nebulizer

Sometimes, a respiratory condition such as asthma is not severe enough to require the use of epinephrine. In such cases, patients may use one of the chemical "cousins" of epinephrine that are more narrowly focused on the lungs. These medications are delivered with an MDI or SVN. Proper use of an MDI requires a great deal of coordination, something that may be difficult to achieve when a person is having trouble breathing. Patients must aim properly and spray just as they start to inhale. If administered improperly, most of the medication ends up on the roof of the patient's mouth. An adapter, called a "spacer," fits over the inhaler like a sleeve and can be used to avoid misdirecting the spray **Figure 11-10**. The patient sprays the prescribed dose into the chamber and then breathes in and out of the mouthpiece until the mist is completely inhaled. Spacer devices are especially useful with young children who have difficulty using an MDI.

Figure 11-9 Metered-dose inhalers and small volume nebulizers (shown here) convert liquid medications into a fine mist.

SVNs are much easier to use than MDIs; however, they take longer to deliver the medication and require an external air or oxygen source. An SVN can be more effective than an MDI in moderate to severe respiratory distress. An SVN can also be used while a patient is on CPAP and during BVM ventilation. An SVN can easily be adapted to a nonrebreathing mask for patients unable to hold an SVN. This can be especially helpful with children.

Assisting a patient with an SVN involves placing the medication into the nebulizer and then running a flow of oxygen through the device, which will atomize the liquid and allow the patient to breathe in the medication **Figure 11-11**. You will typically use an oxygen tank to deliver an SVN treatment; however, many respiratory patients have a portable SVN machine at home that can also be used. Consult local protocol to determine if use of an SVN is within the EMT scope of practice for your agency.

Follow the below steps to administer a medication via SVN. See Chapter 15, *Respiratory Emergencies*, for more information on steps for using MDIs and SVNs.

1. Obtain medical direction per local protocol.
2. Confirm correct medication and expiration date.

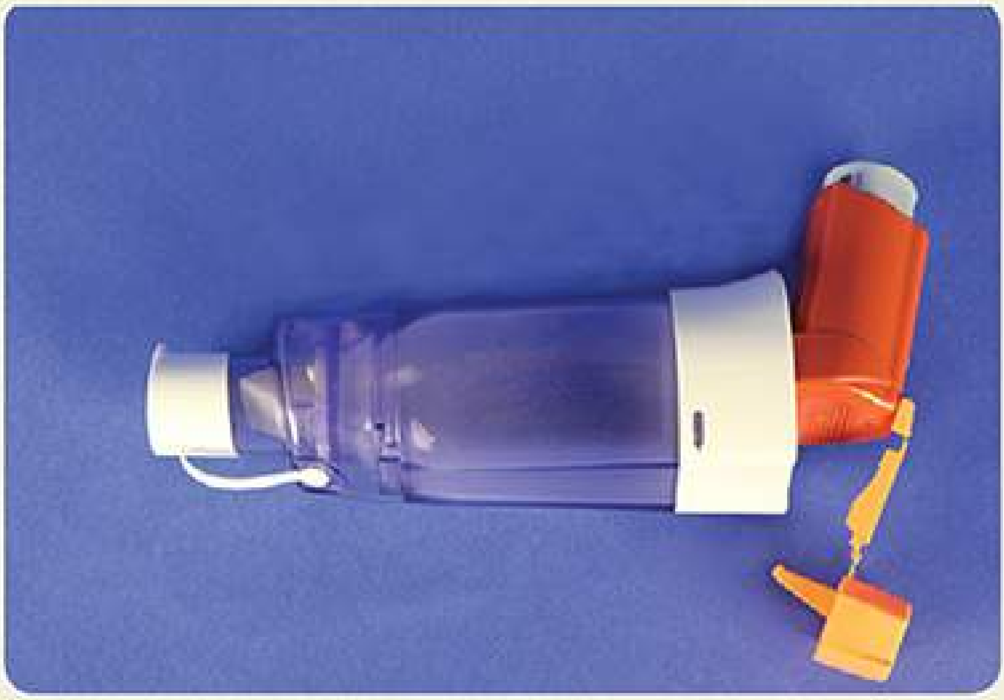

Figure 11-10 Some inhalers have spacer devices to better direct the medication spray.

Figure 11-11 With a small volume nebulizer, liquid medication is atomized by the flow of oxygen. The patient then breathes in the medication.

3. Confirm that the patient is *not* allergic to the medication.
4. Add the appropriate medication and dose to the nebulizer reservoir and assemble according to the manufacturer's instructions.
5. Connect to the nebulizer machine (often in the patient's home) or oxygen tank at 6 to 8 L/min.
6. Place the nebulizer in the patient's mouth and instruct the patient to breathe until the medication is gone (usually about 5 minutes).
7. Reassess the patient and document appropriately.

Note: some nebulizers come preconnected to an oxygen mask for easier administration for patients who are unable to hold the nebulizer.

You can activate the spray by pressing the canister into the adapter just as the patient starts to inhale. If relief is not achieved, wait 3 to 5 minutes and repeat this sequence according to the patient's prescription. Above all, it is important to ensure that the patient inhales all the medication in a single-sprayed dose.

Asthma, also known as "reactive airway disease," can be a life-threatening condition. Therefore, some patients use "rescue inhaler" MDIs to relieve bronchial spasms quickly. Just a few of the more common over-the-counter MDIs include Primatene Mist, Bronitin Mist, and Bronkaid Mist. Each of these MDIs contains epinephrine and can cause significant side effects, such as tachycardia, hypertension, and restlessness. Therefore, as mentioned earlier, most patients with asthma use certain chemical "cousins" of epinephrine that produce fewer side effects and act more specifically on the bronchi of the lungs. Common prescription MDIs include Metaproterenol (Alupent, Metaprel) and albuterol (Proventil, Ventolin). Another type of MDI used by respiratory patients is the maintenance or controller inhaler. These MDIs are slow acting and are meant to be taken regularly in order to be effective. Maintenance inhalers are *not* useful for a patient suffering acute respiratory distress and in need of immediate relief. Common maintenance inhalers include fluticasone propionate (Flovent Diskus), budesonide (Pulmicort), mometasone furoate (Asmanex Twisthaler), beclomethasone dipropionate (Qvar), and ciclesonide (Alvesco).

There are dozens of different MDIs on the market, and often patients may be prescribed several of them at once. The only medication that will be effective during an acute attack of shortness of breath will be the fast-acting rescue inhalers, such as albuterol (Proventil, Ventolin). Whether you are assisting the patient with an MDI or an SVN medication, be sure you have the right medication for a patient with acute respiratory distress.

Patient Medications

Part of your patient assessment includes finding out what medications your patient is currently taking. This information may provide vital clues to your patient's condition that may help guide your treatment or be extremely useful to the emergency department (ED) physician. Often, knowing what medications a patient takes may be the only way you can determine what chronic or underlying conditions your patient may have, such as when a patient is unable to relate his medical history to you. The patient may be unresponsive, confused, not knowledgeable about his or her medical history, uncooperative, or unable to communicate. Discovering what the patient takes and transporting the medications or a list of medications with you to the ED can be crucial in assessing your patient's needs.

In addition to prescription medications, patients often take nonprescription OTC medications, herbal medications, or other supplements. Many times, they do not consider these substances "medications" and will not report them to you unless you ask about them specifically. Yet, they may be as potent as prescription medications and can have interactions and effects on a patient's health and condition that are just as important. Be sure to ask specifically about these also. Several of the most commonly prescribed drugs for adults in the United States are used to treat cardiovascular disease and high cholesterol. **Table 11-5** lists 20 of the most prescribed medications and their uses. There are also excellent mobile apps that can help you quickly look up unfamiliar medications.

Patients are naturally reluctant to tell you about any illegal drugs or medications they may have taken. It is important to ask, and you can assure them that your only interest in asking is to be able to treat them appropriately.

Special Populations

Polypharmacy is a term referring to the use of multiple medications by one person. It is not uncommon today to find patients, especially older patients, taking many medications on a regular basis. Often, the prescription regimens can be complex and confusing. The medications may be prescribed by multiple physicians. The person may also be taking nonprescription and herbal medicines. Add to this the possibility of failing memory and confusion, and the potential for overdosing, underdosing, and harmful interactions increases exponentially.

Table 11-5 Commonly Prescribed Medications in the United States

Generic Name (Trade Name)	Use
adalimumab (Humira)	Treats arthritis
alprazolam (Xanax)	Treats anxiety disorders
amlodipine (Norvasc)	Treats high blood pressure or cardiac conditions
amoxicillin (Moxatag)	Treats infection caused by bacteria
aripiprazole (Abilify)	Treats depression
atorvastatin (Lipitor)	Treats high cholesterol
azithromycin (Zithromax)	Treats infection caused by bacteria
duloxetine (Cymbalta)	Treats depression and anxiety disorders
esomeprazole (Nexium)	Treats gastric reflux, heartburn
furosemide (Lasix)	Diuretic; treats hypertension, heart failure
metformin (Glucophage)	Treats diabetes
hydrochlorothiazide (Microzide)	Diuretic; treats hypertension, heart failure
hydrocodone (Vicodin)	Narcotic analgesic; pain reliever
levothyroxine (Synthroid)	Treats hypothyroidism
lisinopril (Zestril)	Angiotensin-converting enzyme (ACE) inhibitor; treats hypertension
metoprolol (Lopressor)	Diuretic; treats hypertension, heart failure
omeprazole (Prilosec)	Treats gastric reflux, heartburn
rosuvastatin (Crestor)	Treats high cholesterol
salmeterol (Advair)	Steroid maintenance inhaler; prevents asthma attacks, COPD
simvastatin (Zocor)	Treats high cholesterol

Medication Errors

As discussed earlier, **medication errors** are common. A medication error is inappropriate use of a medication that could lead to patient harm. For example, this could include incorrect communication of a dose or administration of an incorrect dose. According to The National Academies, over 4,100 people in the United States are harmed every day due to medication errors in hospitals, extended care facilities, and outpatient clinics. There are about 200 deaths daily just in US hospitals due to medication errors. EMS professionals are not immune to committing medication errors. Medication errors are preventable, so you must be extremely vigilant any time medications are administered to a patient.

As discussed in Chapter 1, *EMS Systems*, errors can stem from different causes. Administration of a medication that is outside one's scope of practice is a rules-based error. Choosing the wrong medication to administer is a knowledge-based error. Using incorrect equipment or an incorrect procedure for administering a medication is an example of a skills-based error.

If the circumstances of the errors are understood, it may be possible to minimize them. Ensure that the environment does not contribute to errors—ensure that lighting is sufficient, that equipment is organized, and that distractions are limited as much as possible. Consider using a “cheat sheet” to help yourself remember all crucial steps to medication administration. Finally, before administering a medication, stop to ask yourself “Why am I doing this?” Pausing for a moment allows you to sharpen your focus and ensure that you are doing what is correct.

If a medication error does take place, take the following steps. First, rapidly provide any appropriate patient care that is required. Second, notify medical control as quickly as possible. Third, follow your local protocols and document the incident thoroughly, accurately, and honestly. Additionally, talk with your partner, supervisor, or medical director. This is an opportunity for you to learn how to prevent such errors in the future. These discussions can also help identify areas for your agency to target during quality improvement.

YOU are the Provider — PART 5

The patient’s condition remains stable during transport. You transport in non-emergency mode, reassess her vital signs, and then call in your radio report to the hospital, which you will arrive at in approximately 8 minutes.

Recording Time: 19 Minutes	
Level of consciousness	Conscious and alert
Respirations	18 breaths/min; regular and adequate
Pulse	74 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	126/72 mm Hg
Spo_2	98% (on oxygen)
Blood glucose	94 mg/dL

You arrive at the hospital and give your verbal report to the charge nurse. The patient’s son arrives shortly thereafter and presents the nurse with a plastic bag containing seven medications, including those that you have already noted. After further assessment, treatment, and observation in the emergency department, the patient is discharged home with modification of her medication regimen and instructions to follow-up closely with her primary care provider.

10. What does the term “polypharmacy” mean and why is it important?

YOU are the Provider — SUMMARY

1. What is pharmacology?

Pharmacology is the study of medications, including their therapeutic uses and actions on the body. Several terms are used when discussing pharmacology. The *dose* is the amount of medication that is given to the patient. The *action* is the therapeutic effect that the medication is expected to have on the body. *Indications* are the reasons or conditions for which a particular medication is given. *Contraindications* are the reasons or conditions for which a particular medication should not be given because it may cause further harm. *Side effects* are any actions of a medication other than the desired effects.

2. Why is knowledge of pharmacology important to patient care?

Giving a medication to a patient without understanding how it will affect him or her is dangerous. Prior to administering *any* medication—including oxygen—you must understand what effect(s) it will have on the patient. In addition, you must perform a careful and accurate assessment to determine if medication therapy is even indicated.

The patient may have a condition for which a particular drug is indicated; however, various factors that are unique to the patient (eg, known allergy to the drug, unstable vital signs) may otherwise make it contraindicated. The only way you will be able to determine this is through a careful assessment.

It is easy enough to memorize the indications, contra-indications, doses, and side effects of the drugs that you may administer as an EMT, but if you do not know how the drug will affect the patient’s body, you should not be giving it.

Once you give it, you cannot take it back!

3. Other than oxygen, what other medication does this patient require, and why?

This patient is a candidate for oral glucose. A normal blood glucose level is 80 to 120 mg/dL. This patient's glucose level is 36 mg/dL, which is critically low (hypoglycemia) and would explain the patient's present mental status.

Oral glucose is available as a gel or as tablets. If authorized by medical control, you should administer oral glucose to any patient with a decreased level of consciousness, an ability to protect his or her own airway, and a history of diabetes. The only contraindications to oral glucose are an inability to swallow and unconsciousness, because of the risk of aspiration.

4. What are the "six rights" of medication administration and why are they important?

Prior to assisting a patient with his or her prescribed medication, as well as administering a drug from your ambulance, you should review the six rights of medication administration, a tool used to promote safe and accurate medication administration. Most medication errors are almost always result from failure to follow these six rights.

- **Right patient:** Look at the medication label to ensure that it reads the same name as your patient.
- **Right drug:** Check the medication label to make sure it is the right medication for the patient's condition.
- **Right dose:** Check the medication label and take note of the dose. The dosing information should be on the medication container. If it is not, contact medical control.
- **Right route:** A medication given by the wrong route, even if it is the correct medication, may be ineffective or may even cause harm to the patient.
- **Right time:** Medications that can be repeated must be given at the correct time intervals. After administering the medication, document the time. After the proper time has passed, contact medical control again if the drug needs to be readministered.
- **Right documentation:** After administering any medication to any patient, you must document the drug, dose, route, time(s) of administration, and reassessment findings after the medication has been given. Proper documentation will ensure that the receiving facility is aware of the medications the patient received in the field.

5. Why is it significant to know the patient took her medication on an empty stomach?

If a patient with diabetes takes his or her medication but does not eat, there is a significant risk of symptomatic hypoglycemia developing. If the blood glucose level becomes too low, a person can suffer a loss of consciousness, experience seizures, and ultimately die.

6. What medications are typically carried on an EMT ambulance?

There are five medications typically carried on an ambulance that is staffed by EMTs: oxygen, aspirin, oral glucose, activated charcoal, and epinephrine. Depending on local protocol, other medications may be carried on the ambulance, including naloxone, nitroglycerin, and metered-dose inhaler (MDI) medications.

It is important to note that, just because these medications are carried on the ambulance, you cannot administer them at will. They may be given only on the direct order of a physician (online medical control) or according to standing orders in your local protocol (off-line medical control).

7. As an EMT, what medications can you assist the patient to self-administer?

You may be asked to help patients self-administer certain prescription medications, including epinephrine auto-injectors (EpiPens), metered-dose inhaler medications (ie, albuterol [Proventil, Ventolin], metaproterenol [Alupent]), and nitroglycerin (Nitrostat).

First, perform a careful assessment of your patient to determine if medication therapy is indicated. Just because the patient is prescribed a particular medication does not mean that it is indicated. For example, nitroglycerin—a vasodilator drug—is contraindicated if the patient's systolic blood pressure is less than 100 mm Hg. By dilating the patient's blood vessels, nitroglycerin may cause a dangerous drop in his or her blood pressure.

8. You are unfamiliar with the medication Amaryl. What should you do?

The simplest and most obvious way of determining the purpose of a medication is to ask the patient. She is conscious and will likely be able to answer your question. If the patient is unsure what it is used for, you should refer to an EMT field guide, drug reference text or mobile app, or contact medical control. In this case, Glimepiride (Amaryl) is an oral hypoglycemic; it is commonly used by patients with type 2 diabetes mellitus to help lower their blood glucose level.

As an EMT, you will often encounter patients who take numerous medications. Just because it is not one that you carry on the ambulance or are authorized to assist the patient in taking does not mean that you should not determine its use. Much information about a patient's medical history can be obtained by looking at the medications she is taking.

9. If you were unable to obtain a blood glucose reading on this patient, would you still administer oral glucose? Why or why not?

Patients with hypoglycemia can suffer a rapid loss of consciousness, experience seizures, and even die. Withholding glucose from a patient who needs it is far more dangerous than administering it to a patient who does not. Be sure to follow local protocol regarding administration of any medication.

10. What does the term "polypharmacy" mean and why is it important?

Polypharmacy refers to the use of multiple medications by the same patient. It is not uncommon to find patients, especially older patients, taking multiple prescribed medications, over the counter medications, and herbal remedies on a regular basis; this often makes a patient's medication regimen complex and confusing.

The potential for inadvertent underdosing and overdosing and harmful drug interactions increases in patients who take multiple medications. Furthermore, the patient's primary problem may be the result of one or more of the medications he or she is taking.

You should carry a field guide or similar reference that lists common prescription and nonprescription medications. In cases where the patient is unable to communicate with you and a reliable source (eg, family member, caregiver) is not available to answer your questions, the patient's medications can give you important clues as to his or her medical history.

EMS Patient Care Report (PCR)

Date: 7-5-16	**Incident No.:** 220109	**Nature of Call:** Diabetic complications		**Location:** 4864 Project Ave.	
Dispatched: 0600	**En Route:** 0601	**At Scene:** 0606	**Transport:** 0622	**At Hospital:** 0630	**In Service:** 0636

Patient Information

Age: 68 **Sex:** F **Weight (in kg [lb]):** 64 kg (140 lb)	**Allergies:** No known drug allergies **Medications:** Amaryl, Nitrostat, Zoloft **Past Medical History:** Diabetes, heart disease, depression **Chief Complaint:** Confused

Vital Signs

Time: 0612	**BP:** 122/72	**Pulse:** 112	**Respirations:** 22	**Spo_2:** 98%
Time: 0620	**BP:** 128/74	**Pulse:** 84	**Respirations:** 18	**Spo_2:** 99%
Time: 0628	**BP:** 126/72	**Pulse:** 74	**Respirations:** 18	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC** **NRM** **BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Oral glucose

Narrative

Dispatched to a residence for a 68-year-old woman with "diabetic problems." Arrived on scene to find the patient sitting in a recliner in her living room. She was conscious, but confused. Her airway was patent and her breathing, although increased in rate, was producing adequate tidal volume. The patient was disoriented to place and time but able to speak and follow simple commands. The patient's son, who called 9-1-1, advised that his mother has type 2 diabetes, and he is not sure when she last ate. Further past medical history includes heart disease and depression. Further assessment of patient revealed that her skin was cool, clammy, and pale. She was in no obvious respiratory distress and did not appear to be experiencing any pain. Applied oxygen at 15 L/min via nonrebreathing mask and obtained initial vital signs. Blood glucose level was assessed and read 36 mg/dL. After ensuring that the patient was able to swallow, administered one tube (15 g) of oral glucose. Placed patient onto stretcher, loaded her into the ambulance, and reassessed her status. Her level of consciousness had improved and her vital signs were stable. Began transport to the hospital and closely monitored the patient en route. Her airway and breathing remained adequate and her skin color and condition improved. The patient stated that she could not remember when she had eaten last. She further stated that she thinks that she may have accidentally taken too much of her Amaryl. Reassessed her blood glucose level, which read 94 mg/dL. Delivered patient to the emergency department without incident, gave verbal report to the charge nurse, and returned to service.**End of report**

Prep Kit

Ready for Review

- Pharmacology is the science of drugs, including their ingredients, preparation, uses, and actions on the body.
- Medications may be administered through the following routes: intravenous, intramuscular, or subcutaneous injection; intranasal; oral; sublingual; intraosseous; transcutaneous; by inhalation; and by rectum.
- These routes of administration often determine the speed with which the medication takes effect.
- Medications come in seven forms: tablets and capsules, solutions and suspensions, metered-dose inhalers (MDIs), topical medications, and transdermal medications, gels, and gases.
- The administration of any medication requires approval by medical control, through direct orders given online or standing orders that are part of the local protocols.
- Once an order from medical control has been obtained, follow these steps in administering medications: Verify the patient, verify the proper medication, verify the dose, verify the route, and verify the time. Once the medication has been administered, reassess vital signs and document the patient's history, assessment, treatment, and response findings.
- Five medications are typically carried on an EMT ambulance: oxygen, aspirin, oral glucose, activated charcoal, and epinephrine. Depending on local protocol, some EMS units may carry naloxone, nitroglycerin, and metered-dose inhaler (MDI) medications.
- There are three medications that you may assist the patient to patient self-administer, including epinephrine auto-injectors (EpiPens), metered-dose inhaler medications (eg, albuterol [Proventil, Ventolin], metaproterenol [Alupent]), and nitroglycerin (Nitrostat). Remember, medications may differ depending on local protocol.
- Knowing what medications a patient takes may be the only way you can determine what chronic or underlying conditions your patient may have.
- You must be extremely vigilant when administering medications. If a medication error occurs, provide any appropriate patient care required, notify medical control as soon as possible, and document the incident.

Vital Vocabulary

absorption The process by which medications travel through body tissues until they reach the bloodstream.

action The therapeutic effect of a medication on the body.

activated charcoal An oral medication that binds and adsorbs ingested toxins in the gastrointestinal tract for treatment of some poisonings and medication overdoses. Charcoal is ground into a very fine powder that provides the greatest possible surface area for binding medications that have been taken by mouth; it is carried on the EMS unit.

adsorption The process of binding or sticking to a surface.

agonist A medication that causes stimulation of receptors.

antagonist A medication that binds to a receptor and blocks other medications.

aspirin (acetylsalicylic acid or ASA) A medication that is an antipyretic (reduces fever), analgesic (reduces pain), anti-inflammatory (reduces inflammation), and a potent inhibitor of platelet aggregation (clumping).

contraindications Conditions that make a particular medication or treatment inappropriate because it would not help, or may actually harm, a patient.

dose The amount of medication given on the basis of the patient's size and age.

EMT-administered medication Administration of a medication by the EMT directly to the patient.

enteral medications Medications that enter the body through the digestive system.

epinephrine A medication that increases heart rate and blood pressure but also eases breathing problems by decreasing muscle tone of the bronchiole tree.

gel A semiliquid substance that is administered orally in capsule form or through plastic tubes.

generic name The original chemical name of a medication (in contrast with one of its proprietary or "trade" names); the name is not capitalized.

hypoglycemia An abnormally low blood glucose level.

indications The therapeutic uses for a specific medication.

inhalation Breathing into the lungs; a medication delivery route.

intramuscular (IM) injection An injection into a muscle; a medication delivery route.

intranasal (IN) A delivery route in which a medication is pushed through a specialized atomizer device called a mucosal atomizer device (MAD) into the naris.

intraosseous (IO) injection An injection into the bone; a medication delivery route.

intravenous (IV) injection An injection directly into a vein; a medication delivery route.

medication A substance that is used to treat or prevent disease or relieve pain.

medication error Inappropriate use of a medication that could lead to patient harm.

metered-dose inhaler (MDI) A miniature spray canister through which droplets or particles of medication may be inhaled.

mucosal atomizer device (MAD) A device that is used to change a liquid medication into a spray and push it into a nostril.

nitroglycerin A medication that increases cardiac perfusion by causing blood vessels to dilate; EMTs may be allowed to assist the patient to self-administer the medication.

oral By mouth; a medication delivery route.

oral glucose A simple sugar that is readily absorbed by the bloodstream; it is carried on the EMS unit.

over-the-counter (OTC) medications Medications that may be purchased directly by a patient without a prescription.

oxygen A gas that all cells need for metabolism; the heart and brain, especially, cannot function without oxygen.

parenteral medications Medications that enter the body by a route other than the digestive tract, skin, or mucous membranes.

patient-assisted medication When the EMT assists the patient with the administration of his or her own medication.

peer-assisted medication When the EMT administers medication to him or herself or to a partner.

per os (PO) Through the mouth; a medication delivery route; same as oral.

per rectum (PR) Through the rectum; a medication delivery route.

pharmacodynamics The process by which a medication works on the body.

pharmacology The study of the properties and effects of medications.

polypharmacy The use of multiple medications on a regular basis.

prescription medications Medications that are distributed to patients only by pharmacists according to a physician’s order.

side effects Any effects of a medication other than the desired ones.

solution A liquid mixture that cannot be separated by filtering or allowing the mixture to stand.

subcutaneous (SC) injection Injection into the fatty tissue between the skin and muscle; a medication delivery route.

sublingual (SL) Under the tongue; a medication delivery route.

suspension A mixture of ground particles that are distributed evenly throughout a liquid but do not dissolve.

therapeutic effect The desired or intended effect a medication is expected to have on the body.

topical medications Lotions, creams, and ointments that are applied to the surface of the skin and affect only that area; a medication delivery route.

trade name The brand name that a manufacturer gives a medication; the name is capitalized.

transcutaneous (transdermal) Through the skin; a medication delivery route.

unintended effects Actions that are undesirable but pose little risk to the patient.

untoward effects Actions that can be harmful to the patient.

Assessment

You respond to Nathan Lane for a 50-year-old man who reports feeling weak and dizzy. You are greeted at the front door by the patient's neighbor. You find the patient seated on the couch. His skin looks pale, but he does not appear to be in any distress. He tells you that he has recently switched to two new medications for anxiety and hypertension. He states he took his first dose of both medications this morning.

1. The patient tells you he takes glimepiride. This name is an example of a(n):

   A. trade name.
   B. generic name.
   C. chemical name.
   D. official name.

2. The patient was prescribed alprazolam (Xanax) for his anxiety. In this case, anxiety would be considered a(n):

   A. indication.
   B. contraindication.
   C. side effect.
   D. intended effect.

3. The unintended effects that occur after the patient takes his medications are called:

   A. indications.
   B. contraindications.
   C. side effects.
   D. therapeutic effects.

4. What information should you include on your PCR related to the patient's medications?

A. Document the medication names and dosages.
B. Document the medication names and expiration dates.
C. The trade name and the generic name of each medication.
D. Do not document the medication names; these will be determined at the hospital.

5. If your patient takes insulin for diabetes, what route of administration does he use?

A. Oral
B. Sublingual
C. Injection
D. Inhaled

6. Your patient tells you he takes eight different prescription and over-the-counter medications every day. Which of the following statements indicates why this is important information?

A. Patients who take multiple medications rarely have problems if the medications are taken as prescribed.
B. It is unlikely that the patient's chief complaint is related to the medications he takes.
C. Patients are never prescribed medications that are not compatible.
D. Drug interaction is a concern if the patient takes multiple medications.

7. If you placed this patient on supplemental oxygen, what type of medication delivery would this be?

A. Self-administered
B. EMT-administered
C. Patient-assisted
D. Medical director-assisted

8. Which of the following is an advantage of MDI drug administration over SVN drug administration?

A. The MDI route does *not* require an external oxygen source.
B. The patient does not need to be conscious for MDI drug administration.
C. MDI medications have no side effects.
D. MDI medications do not expire.

9. What route of medication administration has the fastest onset of action? Why?

10. Why is it important to ask patients if they take any over-the-counter medications, vitamins, or herbal remedies, in addition to prescription medications?

SECTION

5

Shock and Resuscitation

CHAPTER

12

Shock

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National EMS Education Standard Competencies

Shock and Resuscitation

Applies a fundamental knowledge of the causes, pathophysiology, and management of shock, respiratory failure or arrest, cardiac failure or arrest, and post resuscitation management.

Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Knowledge Objectives

1. Describe the pathophysiology of shock (hypoperfusion). (pp 487–490)
2. Identify the causes of shock. (p 490)
3. Differentiate among the various types of shock. (pp 491–496)
4. Describe the signs and symptoms of shock including compensated and decompensated. (pp 496–497)
5. Discuss key components of patient assessment for shock. (pp 497–499)
6. Describe the steps to follow in the emergency care of the patient with various types of shock. (pp 499–505)

Skills Objectives

1. Demonstrate how to control shock. (pp 499–504)
2. Demonstrate how to complete an EMS patient care report for a patient with shock. (p 508)

Introduction

Shock has a number of meanings. For example, it is often said that a person who has been frightened or received bad news is in shock. An electric current passing through the body delivers a shock. In this chapter, **shock** (hypoperfusion) describes a state of collapse and failure of the cardiovascular system. When the circulation of blood in the body becomes inadequate, the oxygen and nutrient needs of the cells cannot be met. In the early stages of shock, the body will attempt to compensate by maintaining **homeostasis** (a balance of all systems of the body); however, as shock progresses, blood circulation slows and eventually ceases. This abnormal state of inadequate oxygen and nutrient delivery to the cells of the body causes organs and then organ systems to fail. If not treated promptly, shock can be fatal.

Shock can occur because of several medical or traumatic events such as a heart attack, severe allergic reaction, a motor vehicle crash, or a gunshot wound. As an EMT, you will respond to these different types of emergencies to provide care and transportation for these patients. Therefore, you must be constantly alert to the signs and symptoms of shock.

This chapter begins with a close-up look at perfusion, the function that fails in shock. Next it looks at the physiologic causes of shock and describes each of its major forms. Finally, it discusses the emergency treatment of shock in general and of each kind of shock in particular. See Chapter 13, *BLS Resuscitation*, for resuscitation techniques.

Pathophysiology

Perfusion

Perfusion is the circulation of blood within an organ or tissue in adequate amounts to meet the cells' current needs for oxygen, nutrients, and waste removal. The body is perfused via the circulatory system. The circulatory system is a complex arrangement of connected tubes, including the arteries, arterioles, capillaries, venules, and veins. There are two circuits in the body: the systemic circulation in the body and the pulmonary circulation in the lungs. The systemic circulation carries oxygen-rich blood from the left ventricle through the body and back to the right atrium. In the systemic circulation, as blood passes through the tissues and organs, it delivers oxygen and nutrients. Adequate perfusion is also important for the removal of waste products such as carbon dioxide, which is picked up from cells as blood circulates through the organs and returns to the heart and lungs.

Organs, tissues, and cells must have adequate oxygenation or they may die. Each time you take a breath, the alveoli, which are microscopic, thin-walled air sacs, receive a supply of oxygen-rich air. Oxygen diffuses through the walls of the alveoli into the bloodstream and attaches to hemoglobin circulating on red blood cells. If this oxygenated blood is not properly circulated, cell death may occur.

Oxygen and carbon dioxide pass rapidly across the thin walls of the alveoli by the process of diffusion. Diffusion is a passive process in which molecules move from an area with a higher concentration of molecules to an area of lower concentration. There are more oxygen molecules in the alveoli than in the blood. Therefore, the oxygen molecules move from the alveoli into the blood. Because there are more carbon dioxide molecules in the blood than in the inhaled air, carbon dioxide moves out of the blood into the alveoli.

Whereas the majority of oxygen is carried to the tissues attached to hemoglobin, carbon dioxide can be transported in the blood from tissues back to the lungs in three ways: dissolved in the plasma, combined with water in the form of bicarbonate, or attached to hemoglobin. Carbon dioxide waste products released from cells can combine with water in the bloodstream to form bicarbonate. Bicarbonate concentrations become higher as more carbon dioxide is produced and blood moves back toward the lungs. Once it reaches the lungs, the bicarbonate breaks back down into carbon dioxide and water and the carbon dioxide is exhaled. In cases of poor perfusion (shock), the transportation of carbon dioxide out of the tissues will become impaired, resulting in a dangerous buildup of waste products, which may cause cellular damage.

YOU are the Provider **PART 1**

At 2022 hours, your alert tones sound, "Medic 4, respond to the Cedar Hills Urgent Care Clinic at 1111 Cedar Hills Drive for a 39-year-old woman who is going into shock." You and your partner proceed to the clinic, which is approximately 9 minutes from your station. It is cloudy outside, the temperature is 66°F (18.9°C), and the traffic is light.

1. What additional information should you attempt to gather about the patient while en route to the clinic?
2. What is shock and how does it relate to perfusion?

Shock, or hypoperfusion, refers to a state of collapse and failure of the cardiovascular system that leads to inadequate circulation. Like internal bleeding, shock is an unseen underlying life threat caused by a medical disorder or traumatic injury. To protect vital organs, the body attempts to compensate by directing blood flow from organs that are more tolerant of low flow (such as the skin and intestines) to organs that cannot tolerate low blood flow (such as the heart, brain, and lungs). If the conditions causing shock are not promptly addressed, death may soon occur. By recognizing the signs and symptoms of shock early, you can minimize organ damage and save lives. Shock is life threatening and requires immediate recognition and rapid treatment.

As described in Chapter 6, *The Human Body*, the cardiovascular system consists of three parts: a pump (the heart), a set of pipes (the blood vessels or arteries that act as the container), and the contents of the container (the blood) **Figure 12-1**. These three parts can be referred to as the “perfusion triangle” **Figure 12-2**. When a patient is in shock, one or more of the three parts is not working properly.

Blood is the vehicle for carrying oxygen and nutrients through the vessels to the capillary beds and tissue cells, where they are exchanged for waste products. For this process to happen, the vessels (container) must be intact. Blood contains red blood cells, white blood cells, platelets, and a liquid called plasma. As discussed in Chapter 6, *The Human Body*, red blood cells are responsible for transporting oxygen to the cells and carbon dioxide (a waste product of cellular metabolism) away from the cells to the lungs where it is exhaled and removed from the body. White blood cells help the body fight infection. Platelets assist in forming blood clots. In the body, a blood clot forms depending on one of the following principles: retention of blood due to blockage in blood circulation (blood stasis), changes in the vessel wall (such as a wound), and the blood’s ability to clot (as the result of a disease process or medication). When injury occurs to tissues in the body, platelets begin to collect at the site of injury; this causes the red blood cells to become sticky and clump together. As the red blood cells begin to clump, another substance in the body called fibrinogen reinforces the red blood cells. This is the final step in the formation of a blood clot.

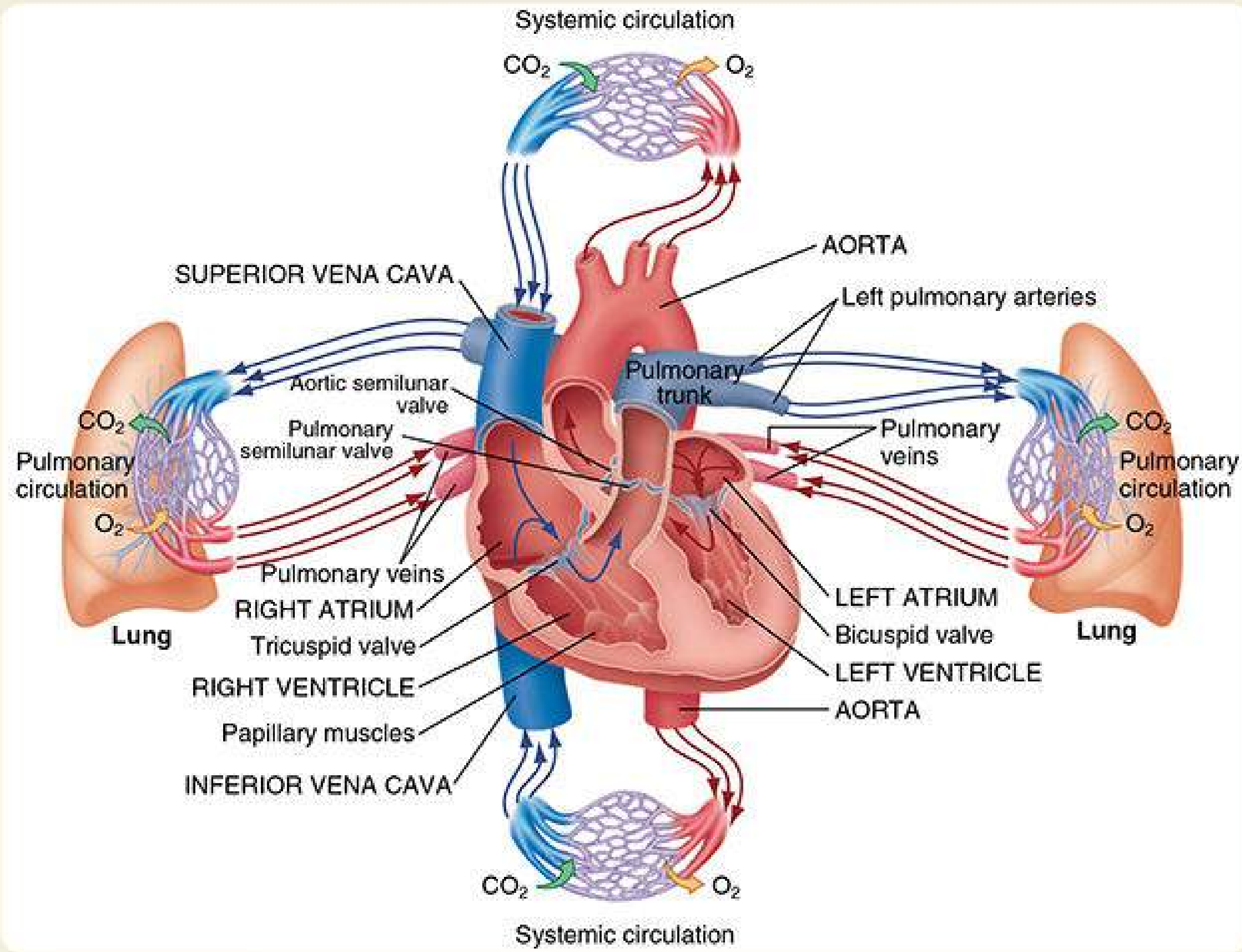


Figure 12-1 The cardiovascular system consists of three parts: the pump (heart), the container (vessels), and the contents (blood). The blood carries oxygen and nutrients through the vessels to the capillary beds, where they are exchanged for waste products.

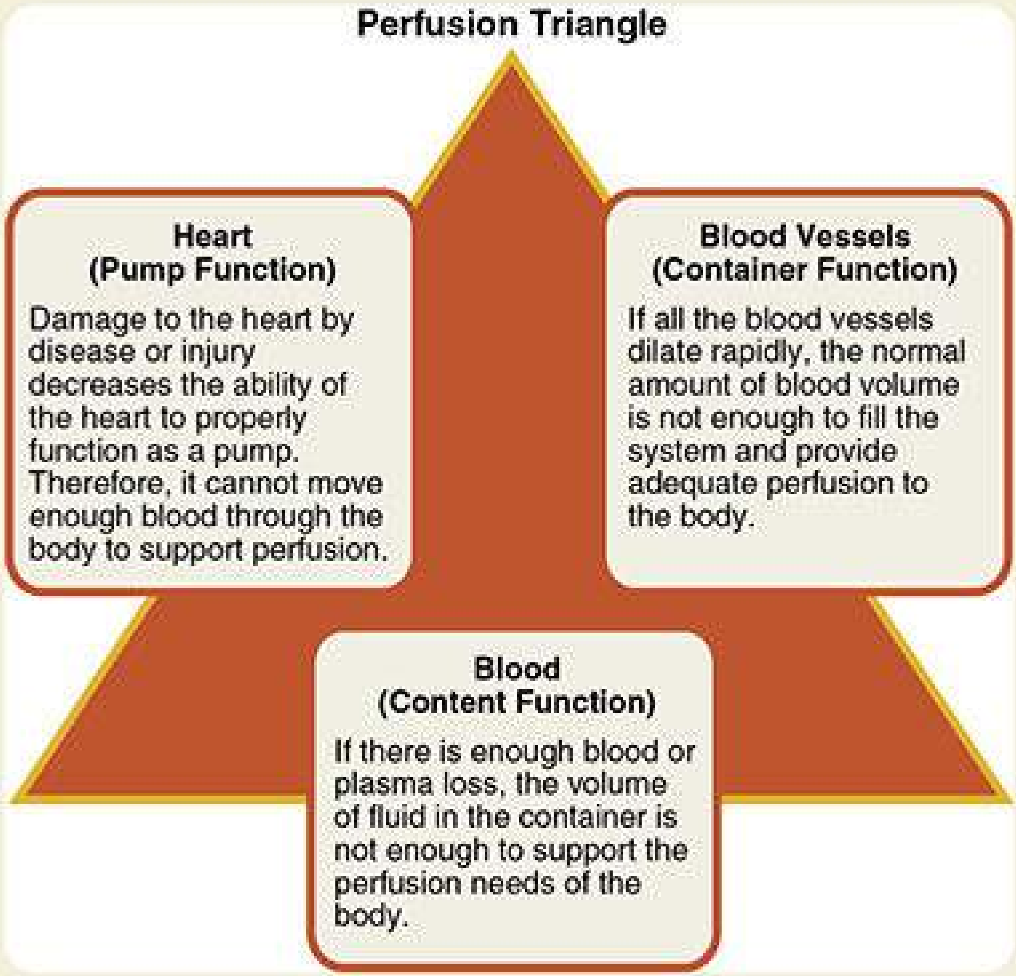


Figure 12-2 The heart, the blood vessels, and the blood represent the three parts of perfusion.

Blood clots are an important response by the body to control blood loss; however, be aware that clots are unstable and prone to rupture because blood keeps moving as a result of pressure generated by the contractions of the heart and the actions of the blood vessels as they dilate and constrict. This pressure, called blood pressure, is usually carefully controlled by the body so that there is always sufficient circulation, or perfusion, in the various tissues and organs. Blood pressure is, in fact, a rough measure of perfusion.

Words of Wisdom

Capillary hydrostatic pressure tends to force fluids through capillary walls, whereas interstitial fluid hydrostatic pressure pushes fluid back into the cells.

Remember that blood pressure is really the pressure of blood within the vessels at any one moment in time. The *systolic* pressure is the peak arterial pressure, or pressure generated every time the heart contracts; the *diastolic* pressure is the pressure maintained within the arteries while the heart rests between heartbeats. **Pulse pressure** is the difference between the systolic and diastolic pressures (systolic – diastolic = pulse pressure). It signifies the amount of force the heart generates with each contraction. A pulse pressure less than 25 mm Hg may be seen in patients with shock.

Blood flow through the capillary beds is regulated by the capillary sphincters, circular muscular walls that constrict and dilate. These **sphincters** are under the control of the **autonomic nervous system**, which regulates involuntary functions such as sweating and digestion. Capillary sphincters also respond to other stimuli such as heat, cold, the need for oxygen, and the need for waste removal. Keep in mind that, under normal circumstances, not all cells have the same needs at the same time. For example, the stomach and intestines have a high need for blood flow during and shortly after eating, when digestion is at a peak. Between meals, blood flow is lessened, and blood is diverted to other areas. The brain, by contrast, needs a constant and consistent supply of blood to function.

Thus, regulation of blood flow is determined by cellular need and is accomplished by vessel constriction or dilation, together with sphincter constriction or dilation. Maintenance of blood flow, or perfusion, is accomplished by the heart, blood vessels, and blood working together.

Perfusion requires more than just having a working cardiovascular system, however. It also requires adequate oxygen exchange in the lungs, adequate nutrients in the form of glucose in the blood, and adequate waste removal, primarily through the lungs. Carbon dioxide is one of the primary waste products of cellular work (metabolism) in the body and is removed from the body by the lungs. This is the reason adequate ventilation and oxygenation is one of your primary concerns. The body has neural and endocrine or hormonal mechanisms in place to help support the respiratory and cardiovascular systems when the need for perfusion of vital organs is increased. These mechanisms, including the autonomic nervous system and certain chemicals called hormones, are triggered when the body senses that the pressure in the system is falling. The sympathetic side of the autonomic nervous system, which is responsible for the fight-or-flight response, will assume more control of the body's functions during a state of shock. This response by the autonomic nervous system causes the release of hormones such as epinephrine and norepinephrine. These hormones cause changes in certain body functions such as an increase in the heart rate and the strength of cardiac contractions. They also cause vasoconstriction in nonessential areas, primarily in the skin and gastrointestinal tract (peripheral vasoconstriction). Together, these actions are designed to maintain pressure in the system and, as a result, sustain perfusion of all vital organs. The parasympathetic nervous system is a division of the autonomic nervous system that controls involuntary functions by sending signals to the cardiac, smooth, and glandular muscles.

Eventually, there is also a shifting of body fluids to help maintain pressure within the system. However, the response of the autonomic nervous system and hormones comes within seconds. It is this response that causes all the signs and symptoms of shock in a patient.

Causes of Shock

Shock can result from many conditions, including bleeding, respiratory failure, acute allergic reactions, and overwhelming infection. In all cases, however, the damage occurs because of insufficient perfusion of organs and tissues. As soon as perfusion stops or becomes impaired, tissues start to die, affecting all local body processes. If the conditions causing shock are not promptly stopped and reversed, death will soon follow.

Words of Wisdom

Shock is a complex physiologic process that gives subtle signs to its presence before it becomes severe. These early signs relate very closely to the events that lead to more severe shock, so it is important for you to know the underlying processes thoroughly. If you understand what causes shock, you will be able to recognize it in many patients before it gets out of control.

Understanding the basic physiologic causes of shock will better prepare you to treat it **Figure 12-3**. There are many types of shock resulting from three basic causes **Table 12-1**.

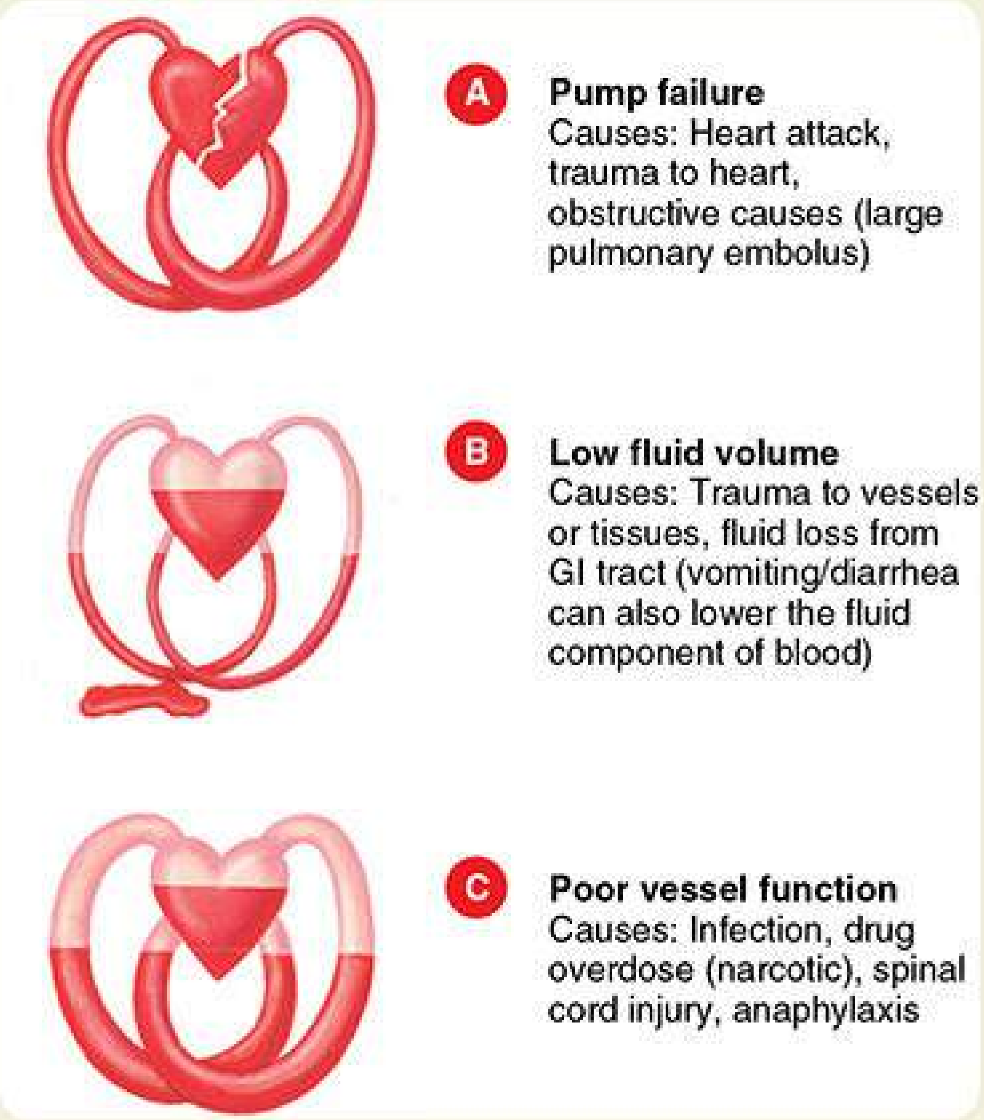


Figure 12-3 There are three basic causes of shock and impaired tissue perfusion. **A.** Pump failure occurs when the heart is damaged by disease, injury, or when an obstruction (typically in a pulmonary artery), prevents it from functioning. The heart may not generate enough energy to move the blood through the system. **B.** Low fluid volume, often a result of bleeding, leads to inadequate perfusion. **C.** The blood vessels can dilate excessively so that the blood within them, even though it is of normal volume, is inadequate to fill the system and provide efficient perfusion.

Table 12-1 Causes of Shock

Cause	Type of Shock
Pump Failure	Cardiogenic shock Obstructive shock ▪ Tension pneumothorax ▪ Cardiac tamponade ▪ Pulmonary embolism
Poor Vessel Function	Distributive shock ▪ Septic shock ▪ Neurogenic shock ▪ Anaphylactic shock ▪ Psychogenic shock
Low Fluid Volume	Hypovolemic shock ▪ Hemorrhagic shock ▪ Non–hemorrhagic shock

Types of Shock

Cardiogenic Shock

Cardiogenic shock is caused by inadequate function of the heart, or pump failure. Circulation of blood throughout the vascular system requires the constant pumping action of a normal and vigorous heart muscle. Many diseases or injuries can cause destruction or inflammation of heart muscle. Within certain limits, the heart can adapt. If too much muscular damage occurs, however, as sometimes happens after a heart attack, the heart no longer functions well. A major effect is the backup of blood into the lungs. The resulting buildup of fluid within the pulmonary tissue is called pulmonary edema. **Edema** is the presence of abnormally large amounts of fluid between cells in body tissues, causing swelling of the affected area **Figure 12-4**. Pulmonary edema leads to impaired respiration, which may be manifested by an increased respiratory rate and abnormal lung sounds.

The muscular contraction of the heart moves blood through the vessels at distinct pressures. For blood to circulate efficiently throughout the entire system, there must be the right amount of pressure and an adequate number of heartbeats. For this reason, the heart has its own electrical system that initiates and regulates its beating. Disease or injury can damage or destroy this system, causing irregular and uncoordinated beats, beats that are too slow (fewer than 60 beats/min), or beats that are too fast (more than 100 beats/min).

Cardiogenic shock develops when the heart cannot maintain sufficient output (cardiac output) to meet the demands of the body. Cardiac output is the volume of blood that the heart can pump per minute and is dependent upon several factors. First, the heart must have adequate strength, which is largely determined by the ability of the heart muscle to contract. This ability to contract is referred to as **myocardial contractility**. Second, the heart must receive adequate blood to pump. As the volume of blood coming to the heart increases, the precontraction pressure in the heart builds up. This precontraction pressure is known as **preload**. As preload increases, the volume of blood within the ventricles increases, which causes the heart muscle to stretch. When the muscle is stretched, myocardial contractility increases, leading to greater force of contraction and increased cardiac output. Lastly, the resistance to flow in the peripheral circulation must be appropriate. The force or resistance against which the heart pumps is known as **afterload**. In general, as afterload increases, cardiac output decreases. Increased afterload may also cause the heart to overwork while trying to maintain adequate cardiac output. High afterload is often the reason that heart failure develops in patients with hypertension. Cardiogenic shock may result from low cardiac output due to high afterload, low preload, poor contractility, or any combination of the three.

YOU are the Provider — PART 2

You arrive at the clinic and are escorted to the patient by a clinic technician. You find the patient lying supine on an examination table. She is conscious, but restless, and her skin is notably pale and diaphoretic. She has a blanket covering her, and she is receiving oxygen via a nasal cannula at 4 L/min. Several attempts at establishing intravenous (IV) access were unsuccessful. Your assessment of the patient reveals the following:

Recording Time: 0 Minutes	
Appearance	Restless, pale, and diaphoretic
Level of consciousness	Conscious and alert, but restless
Airway	Open; clear of secretions or foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, weak and rapid; skin is cool, pale, and diaphoretic

The clinic physician tells you that the patient presented approximately 15 minutes ago reporting abdominal pain and rectal bleeding, which apparently started about 24 hours ago. There is no history of trauma, she has a history of irritable bowel syndrome, she takes lubiprostone (Amitiza) and dicyclomine hydrochloride (Bentyl), and she is allergic to codeine.

3. Based on your assessment, what changes, if any, in the patient’s current treatment are required?

4. How do the patient’s signs and symptoms correlate with the body’s response to inadequate perfusion?

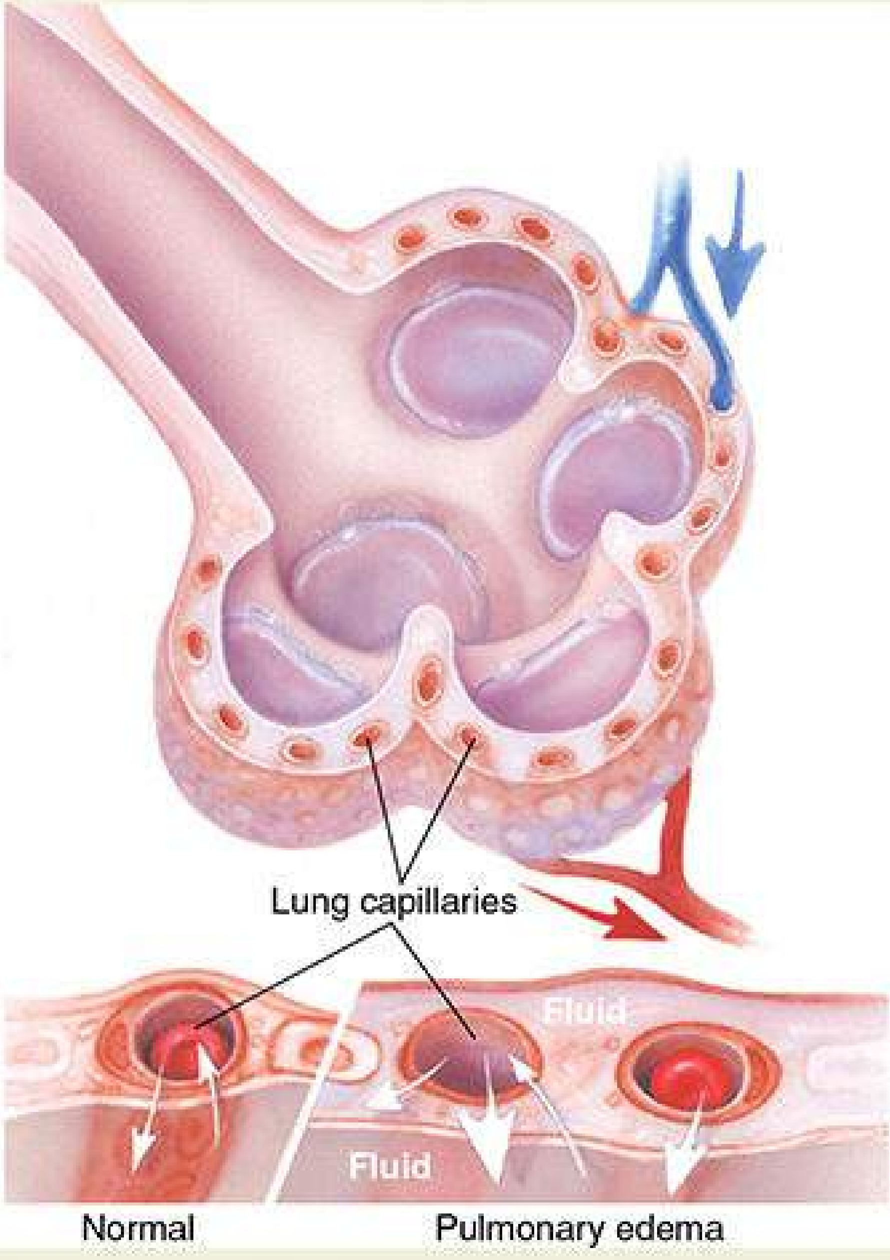


Figure 12-4 Pulmonary edema develops as a result of fluid buildup within the pulmonary tissue. The edema causes swelling and leads to impaired ventilation.

▶ Obstructive Shock

Obstructive shock is cauased by a mechanical obstruction which prevents an adequate volume of blood to fill the heart chambers. Three of the most common examples of obstructive shock are cardiac tamponade, tension pneumothorax, and pulmonary embolism.

A collection of fluid between the pericardial sac and the myocardium is called a **pericardial effusion**. If the effusion becomes large enough, it can prevent the ventricles from filling with blood—a condition called **cardiac tamponade** or pericardial tamponade. This life-threatening condition may be caused by blunt or penetrating trauma that causes hemorrhage around the heart. Large pericardial effusions leading to cardiac tamponade can also be seen in patients with cancer and autoimmune diseases. Cardiac tamponade occurs when blood leaks into the space between the tough fibrous membrane known as the pericardium and the outer walls of the heart, an area called the pericardial sac. As more blood or fluid accumulates in this confined space, the outer walls of the heart become compressed. Because the pericardium has a limited ability to stretch, the accumulated blood or fluid in the pericardial space eventually exerts back pressure on the outer walls of the heart, compressing the walls of the heart, and preventing the heart from completely refilling with blood. Continued pressure within the pericardial sac obstructs the flow of blood into the heart, resulting in decreased outflow from the heart Figure 12-5. Signs and symptoms of cardiac tamponade are referred to as Beck triad, the presence of jugular vein distention, muffled heart sounds, and a narrowing pulse pressure, where the systolic and diastolic blood pressures start to merge (systolic pressure drops and the diastolic pressure rises).

Another obstructive condition occurs with a tension pneumothorax Figure 12-6. A tension pneumothorax is caused by damage to the lung tissue. This damage allows air normally held within the lung to escape into the chest cavity. The lung collapses, and if a pneumothorax is allowed to continue untreated, a sufficient amount of air will accumulate within the chest cavity and begin applying pressure to the structures in the mediastinum. The primary organs in this area are the heart and great vessels (aorta and vena cava). When the trapped air begins to shift the chest organs toward the uninjured side, a pneumothorax becomes known as a tension pneumothorax, which is a very serious and life-threatening condition. As pressure from one side of the chest begins to push the mediastinum toward the other side, the vena cava loses its ability to stay fully expanded. This mechanical compression of the vena cava leads to reduced blood return to the right side of the heart. Blood pressure drops. The patient becomes anxious and short of breath. The heart and respiratory rates increase and become shallower. You may notice difficulty when attempting to ventilate the patient with a bag-valve mask (BVM) as well. The affected side will have decreased or absent lung sounds and the patient will become cyanotic. Tracheal deviation is a late sign of tension pneumothorax.

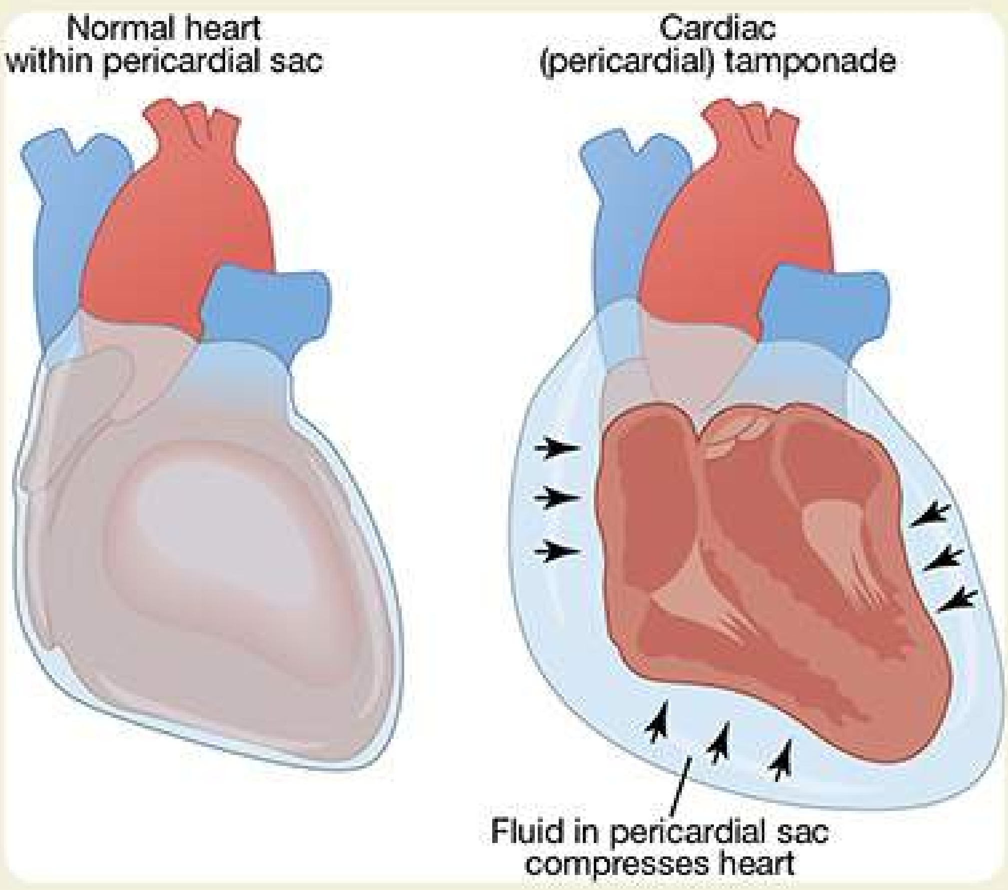


Figure 12-5 Impaired ventricular filling from a pericardial effusion causes cardiac tamponade.

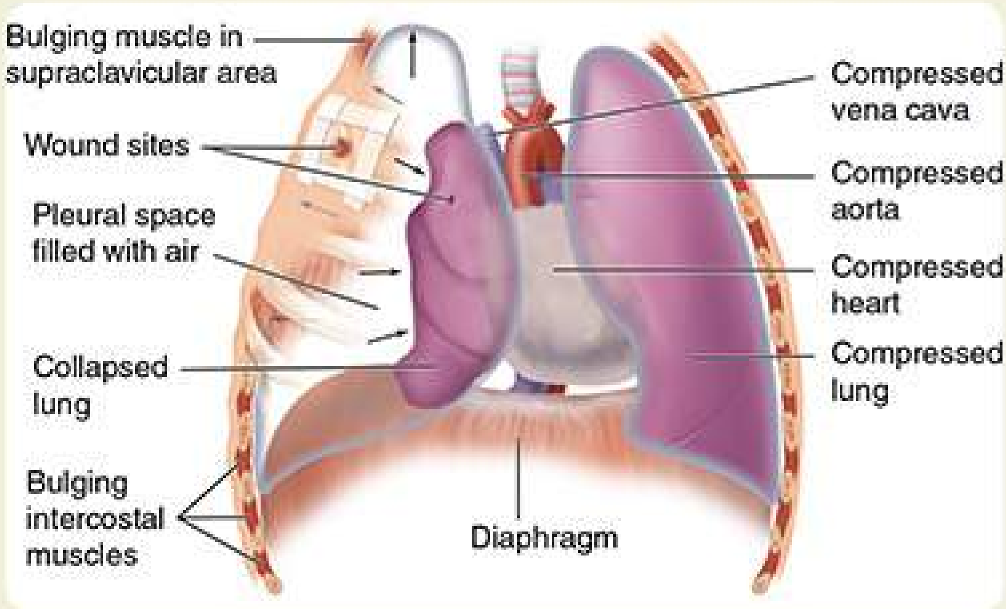


Figure 12-6 A tension pneumothorax is accumulation of air in the pleural space, which eventually compresses the heart and great vessels.

A massive and centrally located pulmonary embolism can also lead to obstructive shock. A **pulmonary embolism** is a blood clot that occurs in the pulmonary circulation and blocks the flow of blood through the pulmonary vessels. When a massive pulmonary embolism occurs, it can prevent blood from being pumped from the right side of the heart to the left, resulting in complete backup of blood in the right ventricle and leading to catastrophic obstructive shock and complete pump failure.

Distributive Shock

Distributive shock results when there is widespread dilation of the small arterioles, small venules, or both. As a result, the circulating blood volume pools in the expanded vascular beds and tissue perfusion decreases. The four most common types of distributive shock are septic shock, neurogenic shock, anaphylactic shock, and psychogenic shock.

Septic Shock

Septic shock occurs as a result of severe infections, usually bacterial, in which toxins (poisons) are generated by the bacteria or by infected body tissues. In this condition, the toxins damage the vessel walls, causing increased cellular permeability. The vessel walls leak and are unable to contract well. Widespread dilation of vessels, in combination with plasma loss through the injured vessel walls, results in shock.

Septic shock is a complex problem. First, there is an insufficient volume of fluid in the container, because much of the plasma has leaked out of the vascular system (hypovolemia). Second, the fluid that has leaked out often collects in the respiratory system, interfering with respiration. Third, the vasodilation leads to a larger-than-normal vascular bed to contain the smaller-than-normal volume of intravascular fluid.

Neurogenic Shock

Damage to the spinal cord, particularly at the upper cervical levels, may cause significant injury to the part of the nervous system that controls the size and muscular tone of the blood vessels. **Neurogenic shock** is usually the result of high spinal cord injury. Although not as common, there are medical causes as well. These include brain conditions, tumors, pressure on the spinal cord, and spina bifida. In neurogenic shock, the muscles in the walls of the blood vessels are cut off from the sympathetic nervous system and nerve impulses that cause them to contract. Therefore, all vessels below the level of the spinal injury dilate widely, increasing the size and capacity of the vascular system **Figure 12-7** and causing blood to pool.

The available 6 L of blood in the body can no longer fill the enlarged vascular system. Even if there is no blood or fluid loss, perfusion of organs and tissues becomes inadequate, and shock occurs. In this condition, a radical change in the size of the vascular system has caused shock. Characteristic signs of this type of shock are the absence of sweating below the level of injury, normal and low heart rate in the presence of hypotension, and normal warm skin.

Words of Wisdom

With neurogenic shock, many other functions that are under the control of the same part of the nervous system are also lost. The most important of them, in an acute injury setting, is the ability to control body temperature. Body temperature in a patient with neurogenic shock can rapidly fall to match that of the environment. In many situations, significant hypothermia occurs, severely complicating the situation. **Hypothermia** is a condition in which the internal body temperature falls below 95°F (35°C), usually after prolonged exposure to cool or freezing temperatures. Maintenance of body temperature is always an important element of treatment for a patient in shock.

Words of Wisdom

Microcirculation is a term used to describe the small vessels in the vasculature that are embedded within organs and responsible for the distribution of blood within tissues. True capillaries are part of microcirculation. They branch off the arterioles and allow for exchange between cells and circulation. The arteriole-venule shunts are short vessels that connect the arteriole and venule at opposite sides. The main functions of microcirculation include the regulation of blood flow and tissue perfusion, blood pressure, tissue fluid, delivery of oxygen, removal of carbon dioxide, and the regulation of body temperature and inflammation.

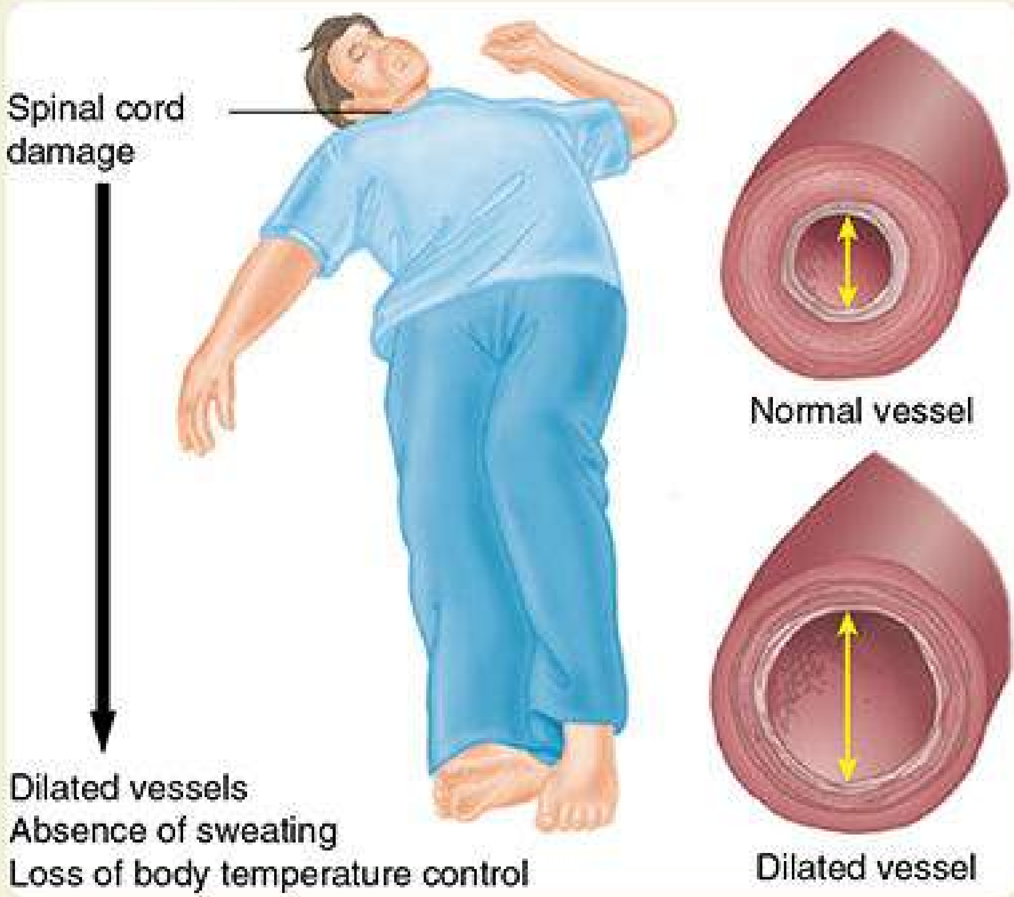


Figure 12-7 Damage to the spinal cord can cause significant injury to the part of the nervous system that controls the size and muscle tone of blood vessels. If the muscles in the blood vessels are cut off from their impulses to contract, the vessels dilate widely, increasing the size and capacity of the vascular system. The blood in the body can no longer fill the enlarged vessels; inadequate perfusion results.

Anaphylactic Shock

Anaphylaxis, or **anaphylactic shock**, occurs when a person reacts violently to a substance to which he or she has been sensitized. **Sensitization** means becoming sensitive to a substance that did not initially cause a reaction. Do not be misled by a patient who reports no history of allergic reaction to a substance on first or second exposure. Each subsequent exposure after sensitization tends to produce a more severe reaction.

Instances that cause severe allergic reactions commonly fall into the following four categories of exposure:

- Injections (tetanus antitoxin, penicillin)
- Stings (wasps, bees, hornets, ants)
- Ingestion (fish, shellfish, nuts, eggs, medication)
- Inhalation (dust, pollen, mold)

Anaphylactic reactions can develop within minutes or even seconds after contact with the substance to which the patient is allergic. There may also be a second phase reaction that occurs 1 to 8 hours after the initial reaction. The signs of such allergic reactions are very distinct and not seen with other forms of shock. Table 12-2 lists the signs of anaphylactic shock in the order in which they typically occur. Note that **cyanosis** (blue discoloration of the skin) is a late sign of anaphylactic shock.

In anaphylactic shock, there is no loss of blood, no mechanical vascular damage, and only a slight possibility of direct cardiac muscular injury. Instead, there is widespread vascular dilation, increased permeability, and bronchoconstriction. The combination of poor oxygenation and poor perfusion in anaphylactic shock may easily prove fatal.

Words of Wisdom

Skin findings such as hives without evidence of any other signs and symptoms of anaphylaxis indicate only allergy, not anaphylaxis. Monitor these patients carefully for development of other findings that suggest anaphylaxis.

Psychogenic Shock

A patient in **psychogenic shock** has had a sudden reaction of the nervous system that produces a temporary, generalized vascular dilation, resulting in fainting, or **syncope**. The fainting episode is temporary, and the patient rouses soon after. Syncope occurs when blood pools in the dilated vessels, reducing the blood supply to the brain; as a result, the brain ceases to function normally, and the patient then faints. While there are many causes of syncope, it is important to realize that some are of a serious nature but others are not. Syncope that is potentially life threatening may be caused by events such as an irregular heartbeat or a brain **aneurysm**. Other non–life-threatening events that cause syncope may be the receipt of bad news or experiencing fear or unpleasant sights (like the sight of blood).

Table 12-2 Signs and Symptoms of Anaphylactic Shock

System	Signs and Symptoms
Skin	▪ Flushed, itchy, or burning, especially over the face and upper part of the chest ▪ Urticaria (hives), which may spread over large areas of the body ▪ Edema, especially of the face, tongue, and lips ▪ Pallor ▪ Cyanosis (a bluish cast to the skin resulting from poor oxygenation of circulating blood) about the lips
Circulatory System	▪ Dilated peripheral blood vessels ▪ Increased vessel permeability ▪ Drop in blood pressure ▪ Weak, barely palpable pulse
Respiratory System	▪ Sneezing or itching in the nasal passages ▪ Stridor ▪ Upper airway obstruction ▪ Tightness in the chest, with a persistent dry cough ▪ Wheezing and dyspnea (difficulty breathing) ▪ Secretions of fluid and mucus into the bronchial passages, alveoli, and lung tissue, causing coughing ▪ Constriction of the bronchi; difficulty drawing air into the lungs ▪ Forced expiration, requiring exertion and accompanied by wheezing ▪ Cessation of breathing
Other	▪ Abdominal cramping ▪ Nausea ▪ Vomiting ▪ Altered mental status ▪ Dizziness ▪ Fainting and coma

Hypovolemic Shock

Hypovolemic shock is the result of an inadequate amount of fluid or volume in the circulatory system. There are hemorrhagic and non-hemorrhagic causes of hypovolemic shock. Injuries involving bleeding may result in hemorrhagic shock, while vomiting and diarrhea may result in non-hemorrhagic hypovolemic shock.

Hypovolemic shock also occurs with severe thermal burns. In this case, loss of intravascular plasma (the colorless part of the blood) is caused by leaking from the circulatory system into the burned tissues that lie adjacent to the injury. Likewise, crushing injuries may result in the loss of blood and plasma from damaged vessels into injured tissues.

Dehydration, the loss of water or fluid from body tissues, can cause or aggravate shock. Fluid loss may be a result of severe vomiting and/or diarrhea. Patients who are very young or old are particularly susceptible to fluid loss and therefore at risk for developing shock through dehydration. People who exercise in hot weather and are not accustomed to it may experience dehydration if they do not drink enough fluids. In these circumstances, the common factor is an insufficient volume of blood within the vascular system to provide adequate circulation to the organs of the body.

Respiratory Insufficiency

A patient with a severe chest injury, such as flail chest, or obstruction of the airway may be unable to breathe in an adequate amount of oxygen. This affects the ventilation process of respiration because not enough oxygen can be inspired to meet the metabolic demand.

An insufficient concentration of oxygen in the blood can produce a life-threatening situation as rapidly as vascular causes of shock, even if the volume of blood, the volume of the vessels, and the action of the heart are all normal. Without oxygen, the organs in the body cannot survive, and their cells promptly start to deteriorate.

Anemia is an abnormally low number of red blood cells. Red blood cells (RBCs) contain hemoglobin, an iron-containing pigment that is responsible for 96% of the transport of oxygen from the lungs to the cells of the body. Each hemoglobin molecule is able to bind to and thus carry four molecules of oxygen. Anemia may be the result of either chronic or acute bleeding, a deficiency in certain vitamins or minerals, or an underlying disease process. If anemia is present, tissues may become hypoxic because the blood is unable to deliver adequate amounts of oxygen to the tissues, even though the available hemoglobin is fully saturated with oxygen and the lungs are delivering enough oxygen to the blood. In this situation, a pulse oximeter may indicate that there is adequate saturation, even though the tissues are actually hypoxic. This type of hypoxia is known as hypoxemic hypoxia.

Certain types of poisoning may also affect the ability of cells to metabolize or carry oxygen. Carbon monoxide has a 250 times greater affinity for hemoglobin than does oxygen. If a patient is in an environment where he or she inhales carbon monoxide, it will bind to the hemoglobin, forming carboxyhemoglobin. Because the carbon monoxide is bound tightly to the hemoglobin, oxygen cannot be transported to the tissues. In another type of poisoning that results in severe functional hypoxia, cyanide impairs the ability of cells to metabolize oxygen effectively, resulting in cellular asphyxia.

The Progression of Shock

Although you cannot see shock, you can see its signs and symptoms Table 12-3. The early stage of shock, while the body can still compensate for blood loss, is called **compensated shock**. The late stage, when blood pressure is falling, is called **decompensated shock**. When shock has progressed too far, it is irreversible; however, there is no way to assess when a patient has reached that point. It is imperative to recognize and treat shock early—well before the patient transitions into the decompensated phase.

Remember that blood pressure may be the last measurable factor to change in shock. As we have seen, the body has several automatic mechanisms to compensate for initial blood loss and to help maintain blood pressure. Thus, by the time you detect a drop in blood pressure, shock is well developed. This is particularly true in infants and children, who can maintain their blood pressure until they have blood loss that is more than half their blood volume. By the time blood pressure drops in infants and children who are in shock, they are close to death.

Table 12-3 Progression of Shock

Progression	Signs and Symptoms
Compensated Shock	▪ Agitation ▪ Anxiety ▪ Restlessness ▪ Feeling of impending doom ▪ Altered mental status ▪ Weak, rapid (thready), or absent pulse ▪ Clammy (pale, cool, moist) skin ▪ Pallor, with cyanosis about the lips ▪ Shallow, rapid breathing ▪ Air hunger (shortness of breath), especially if there is a chest injury ▪ Nausea or vomiting ▪ Capillary refill of longer than 2 seconds in infants and children ▪ Marked thirst ▪ Narrowing pulse pressure
Decompensated Shock	▪ Falling blood pressure (systolic blood pressure of 90 mm Hg or lower in an adult) ▪ Labored or irregular breathing ▪ Ashen, mottled, or cyanotic skin ▪ Thready or absent peripheral pulses ▪ Dull eyes, dilated pupils ▪ Poor urinary output

You should expect shock in many emergency medical situations. For example, you would expect shock to accompany massive external or internal bleeding. You should also expect shock if a patient has any one of the following conditions:

- Multiple severe fractures
- Abdominal or chest injury
- Spinal injury
- A severe infection
- A major heart attack
- Anaphylaxis

Words of Wisdom

Frequently taking and recording vital signs—and observing perfusion indicators such as skin condition and mental status—will give you a window into the progression of shock. Monitoring vital signs every 5 minutes may reveal a pattern that will alert you to the presence of evolving shock. If suspected, expedite transport and begin treatments for shock immediately.

Patient Assessment for Shock

Scene Size-up

As you approach the scene, be alert to potential hazards to your safety. If this is a trauma scene or bleeding is suspected, put on gloves and eye protection, at a minimum. Put several pairs of gloves in your pocket for easy access in case your gloves tear or there are multiple patients with bleeding.

In incidents involving violence, such as assaults or gunshot wounds, make sure that police are on scene. At times you may need to stage several blocks away until law enforcement personnel have secured the area.

When you first see the patient, observe the scene and patient for clues to determine the nature of the illness or the mechanism of injury. This could help you anticipate the potential for development of shock.

Primary Assessment

The primary assessment for a patient with suspected shock should include a rapid exam to determine level of consciousness, identify and manage life-threatening concerns as they are found, and determine priority of the patient and transport. A patient with massive hemorrhage may require a tourniquet (or direct pressure dressings when tourniquets are not feasible or available) *before* the airway is opened. If the patient has obvious life-threatening external bleeding, it should be addressed first (even *before* airway and breathing) by controlling it quickly, then the ABCs can be assessed and treated, and treatments for shock provided.

YOU are the Provider — PART 3

You continue with the treatment initiated by the clinic; however, you remove the nasal cannula and apply high-flow oxygen via a nonrebreathing mask. Your partner takes the patient's vital signs and reports them to you and the clinic physician.

Recording Time: 4 Minutes	
Respirations	24 breaths/min; shallow
Pulse	120 beats/min; weak
Skin	Pale, cool, and diaphoretic
Blood pressure	108/58 mm Hg
Oxygen saturation (Spo_2)	94% (on oxygen)

You bring the stretcher into the room and prepare the patient for immediate transport. The patient remains conscious and alert, but is becoming increasingly restless and tells you that she is extremely thirsty.

5. Is the patient in compensated or decompensated shock? How can you tell?

Provide high-flow oxygen to assist in perfusion of damaged tissues. If the patient has signs of hypoperfusion, treat aggressively and provide rapid transport to the hospital. Request advanced life support (ALS) as necessary to assist with more aggressive shock management. Do not delay transport of the seriously injured trauma patient to complete nonlifesaving treatments in the field, such as splinting extremity fractures; instead, complete these types of treatments en route to the hospital.

When you first visualize your patient, quickly form an initial general impression. This will help you develop an early sense of urgency for care of a patient who appears "sick."

Once you are close to the patient, determine the need for manual spinal stabilization and assess the patient's level of consciousness using the AVPU scale. A patient who has an altered level of consciousness (LOC) may need emergency airway management. If the patient is awake and alert, determine a chief complaint.

Next, quickly assess the airway to ensure it is patent. Be alert to abnormal airway sounds such as gurgling (suction the airway) or stridor, indicating partial airway obstruction. Consider an adjunct such as an oropharyngeal or nasopharyngeal airway for a patient with an altered LOC.

Quickly assess breathing in the patient. Observe the patient for signs of accessory muscle use such as the muscles of the neck, intercostal retractions, or abnormal use of the abdominal muscles. An increased respiratory rate is often an early sign of impending shock. Assess for wheezes or other abnormal breath sounds. Administer high-flow oxygen, or, if needed, assist respirations with a BVM.

Assessing the patient's circulatory status can reveal important clues regarding the presence of shock. Check for the presence of a distal pulse. If you cannot obtain a distal pulse, assess for a central pulse. Make a rapid determination if the pulse is fast, slow, weak, strong, or altogether absent. A rapid pulse suggests compensated shock. In shock or compensated shock, the skin may be cool, clammy, or ashen. If the patient has no pulse and is not breathing, immediately begin cardiopulmonary resuscitation (CPR). Assess for and identify any life-threatening bleeding in trauma patients; if serious bleeding is discovered, treat it at once. You must also quickly assess skin temperature, condition, and color, and check for capillary refill time.

Words of Wisdom

In general, if an adult patient has a radial pulse, the systolic blood pressure will be at least 90 mm Hg; if the patient has a femoral pulse, the systolic pressure will be at least 80 mm Hg; and if the patient has a carotid pulse, the systolic pressure will be at least 70 mm Hg. This is why during CPR we immediately check for a carotid pulse; it is the last to go.

Once you have assessed perfusion, determine whether the patient should be treated as high priority, whether ALS is needed, and which facility to transport to.

Words of Wisdom

Trauma patients with shock, or a suspicious mechanism of injury (MOI), generally should go to a trauma center. Sometimes, local protocols dictate that a patient should be transported to the nearest hospital for stabilization prior to transfer to a definitive treatment center.

History Taking

After the life threats have been managed during the primary assessment, determine the chief complaint. Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives such as loss of sensation. Quickly obtain a SAMPLE history from the patient. Remember, if the patient has a significant change in LOC before arrival at the hospital, you should provide the hospital personnel with this important information.

Secondary Assessment

The secondary assessment is a more detailed, comprehensive examination of the patient that is used to uncover injuries that may have been missed during the primary assessment. The secondary assessment begins by repeating the primary assessment followed by a focused assessment. In some instances, such as a critically injured patient or short transport time, you may not have time to conduct a secondary assessment.

If your patient is a trauma patient with a significant mechanism of injury or multiple injuries, one who gives you a poor initial general impression, or you found problems in the primary assessment, perform a secondary assessment of the entire body. If your patient has a medical problem but is not responsive or problems were noted in the primary assessment, perform a secondary assessment of the entire body. These assessments should be performed quickly but thoroughly to ensure that you do not miss any significant or life-threatening problems or delay needed care.

If your patient has only a simple mechanism of injury, such as a twisted ankle, focus your examination on the specific area affected. Whether your examination is of the entire body or of a specific area, if a life-threatening problem is found, treat it immediately.

When time permits and the patient's condition is stable, perform a thorough examination of the patient. This includes a complete neurologic assessment.

Obtain a complete set of baseline vital signs. If the patient's condition is unstable or could become unstable, reassess vital signs every 5 minutes. If the patient is in stable condition, reassess vital signs every 10 to 15 minutes. Baseline vital signs will help you trend changes in your patient.

In addition to hands-on assessment, use monitoring devices to quantify the patient's oxygenation and circulatory status. Use a noninvasive technique to monitor blood pressure and a pulse oximeter to evaluate the effectiveness of oxygenation. It is recommended to assess the patient's blood pressure with a sphygmomanometer (blood pressure cuff) and stethoscope (manually), before using a noninvasive blood pressure monitor, to establish a baseline blood pressure and to determine the accuracy of the noninvasive blood pressure monitor.

Reassessment

Reassess the patient's vital signs, interventions, chief complaint, ABCs, and mental status. You must determine what interventions are needed for your patient based on the assessment findings. Focus on supporting the cardiovascular system. Treat for shock early and aggressively by providing oxygen and keeping the patient warm.

Emergency Medical Care for Shock

You must begin immediate treatment for shock as soon as you realize that the condition may exist. As with any type of patient care, you should begin by following standard precautions. Control all obvious external bleeding. Place dry, sterile dressings over the bleeding sites, and secure with bandages. If direct pressure is not rapidly successful in the control of bleeding from an extremity, apply a tourniquet proximal to the bleeding site according to local protocol **Figure 12-8**. The use of tourniquets is further described in Chapter 25, *Bleeding*. Make sure the patient has an open airway. Maintain manual in-line stabilization if necessary, and check breathing and pulse.

Comfort, calm, and reassure the patient, while maintaining the patient in the supine position. Never allow patients to eat or drink anything prior to being evaluated by a physician. Patients who have had a severe heart attack or who have lung disease may find it easier to breathe in a sitting or semi-sitting position.

If spinal immobilization is indicated, splint the patient on a backboard. Do not delay transport by applying individual splints in the field when shock is present. If time allows, splint individual extremity fractures during transport. This minimizes pain, bleeding, and discomfort, all of which can aggravate shock. It also prevents the broken bone ends from further damaging adjacent soft tissue.

Remember that inadequate ventilation may be a major factor in the development of shock. Always provide oxygen, assist with ventilations, and use airway control adjuncts as needed, and continue to monitor the patient's breathing. To prevent the loss of body heat, place blankets under and over the patient. Be careful not to overload the patient with covers or attempt to warm the body too much; it is best for the patient to maintain a normal body temperature. Do not use external heat sources, such as hot water bottles or heating pads. They may harm a patient in shock by causing vasodilation and decreasing blood pressure even more.

Figure 12-8 If direct pressure does not quickly control bleeding from an extremity, a tourniquet should be applied proximal to the bleeding site.

Words of Wisdom

Consider whether or not you need to treat each patient you encounter for shock. Many conditions can lead to shock, such as infections, allergic reactions, trauma, and severe dehydration. Learn to recognize shock early and expedite the care and transport for all patients with signs of shock.

Transport the patient and treat additional injuries en route. Consider rendezvousing with ALS if possible, and consider aeromedical transport.

Do not give the patient anything by mouth, no matter how urgently you are asked. To relieve the intense thirst that often accompanies shock, give the patient a moistened piece of gauze to chew or suck.

Accurately record the patient's vital signs approximately every 5 minutes throughout treatment and transport. It is essential to transport trauma patients to the ED as rapidly as possible for definitive treatment. The Golden Hour, also called the Golden Period, refers to the first 60 minutes after injury, which is thought to be a critically important period for the early resuscitation and treatment of severely injured trauma patients. This concept underscores the importance of rapid evaluation, stabilization, and transport. The goal of EMS is to limit on-scene time (time on scene until transport to hospital is started) to 10 minutes or less. Remember to speak calmly and reassuringly to a conscious patient throughout assessment, care, and transport.

Table 12-4 lists the general supportive measures for the major types of shock. Not every measure is used for every type of shock.

Treating Cardiogenic Shock

The patient who is in shock as a result of a heart attack simply cannot generate the necessary power to pump blood throughout the circulatory system.

Keep in mind that chronic lung disease will aggravate cardiogenic shock. If the patient has chronic obstructive pulmonary disease and heart disease, oxygenation of the blood passing through the lungs is impaired. Because fluid is collecting in the lungs, this patient is often able to breathe better in a sitting or semi-sitting position and may tell you so.

Usually, patients with cardiogenic shock do not have any injury, but they may be having chest pain. Such a patient may have taken nitroglycerin before your arrival and may want to take more. Patients in cardiogenic shock should not receive nitroglycerin; by definition they are hypotensive. In addition to low blood pressure, other signs include a weak, irregular pulse; cyanosis about the lips and underneath the fingernails; anxiety; and nausea.

YOU are the Provider — PART 4

The patient is placed onto the stretcher and loaded into the ambulance. You quickly gather the patient records from the clinic physician and begin transport to a hospital that is only 10 minutes away. En route, you continue with your treatment and reassess her condition.

Recording Time: 11 Minutes	
Level of consciousness	Responsive to pain only
Respirations	30 breaths/min; shallower
Pulse	130 beats/min; absent radial pulses (carotid pulse present)
Skin	Pale, cool, and diaphoretic
Blood pressure	84/44 mm Hg
Spo_2	89% (on oxygen)

6. How has your patient's condition changed?

7. Are adjustments in your current interventions required? If so, what?

Table 12-4 Types of Shock

Type of Shock	Examples of Potential Causes	Signs and Symptoms	Treatment
Cardiogenic	Inadequate heart function Disease of muscle tissue Impaired electrical system Disease or injury	Chest pain Irregular pulse Weak pulse Low blood pressure Cyanosis (lips, under nails) Cool, clammy skin Anxiety Crackles (rales) Pulmonary edema	Position comfortably Administer high-flow oxygen Assist ventilations Transport promptly Consider ALS

Obstructive	Mechanical obstruction of the cardiac muscle causing a decrease in cardiac output
	1. Tension pneumothorax
	2. Cardiac tamponade
	3. Pulmonary embolism
		Dependent on cause:
		▪ Dyspnea
		▪ Rapid, weak pulse
		▪ Rapid, shallow breaths
		▪ Decreased lung compliance
		▪ Unilateral, decreased, or absent breath sounds
		▪ Decreased blood pressure
		▪ Jugular vein distention
		▪ Subcutaneous emphysema
		▪ Cyanosis
		▪ Tracheal deviation toward unaffected side
		▪ Beck triad (cardiac tamponade):
		  ▪ Jugular vein distention
		  ▪ Narrowing pulse pressure
		  ▪ Muffled heart tones
			Dependent on cause:
			▪ ALS assist and/or rapid transport
			▪ Administer high-flow oxygen

Septic	Severe bacterial infection	Warm skin or fever Tachycardia Low blood pressure	Transport promptly Administer high-flow oxygen Assist ventilations Keep patient warm Consider ALS
Neurogenic	Damaged cervical spine, which causes widespread blood vessel dilation	Bradycardia (slow pulse) Low blood pressure Signs of neck injury	Secure airway Spinal immobilization Assist ventilations Administer high-flow oxygen Preserve body heat Transport promptly Consider ALS
Anaphylactic	Extreme life-threatening allergic reaction	Can develop within seconds Mild itching or rash Burning skin Vascular dilation Generalized edema Coma Rapid death	Manage the airway Assist ventilations Administer high-flow oxygen Determine cause Assist with administration of epinephrine Transport promptly Consider ALS

Type of Shock	Examples of Potential Causes	Signs and Symptoms	Treatment
Psychogenic (fainting)	Temporary, generalized vascular dilation Anxiety, bad news, sight of injury or blood, prospect of medical treatment, severe pain, illness, tiredness	Rapid pulse Normal or low blood pressure	Determine duration of unconsciousness Position the patient supine Record initial vital signs and mental status Suspect head injury if patient is confused or slow to regain consciousness Transport promptly
Hypovolemic	Loss of blood or fluid	Rapid, weak pulse Low blood pressure Change in mental status Cyanosis (lips, under nails) Cool, clammy skin Increased respiratory rate	Secure airway Assist ventilations Administer high-flow oxygen Control external bleeding Keep warm Transport promptly Consider ALS

Treatment of cardiogenic shock should begin by placing the patient in the position in which breathing is easiest as you give high-flow oxygen. Be ready to assist ventilations as necessary, and have suction nearby in case the patient vomits. Provide prompt transport to the emergency department (ED). If ALS is not already on the scene, consider a rendezvous en route to the hospital if available. Provide calm reassurance to a patient who has had a suspected heart attack. Frequently check for a pulse in an unresponsive patient to identify early whether CPR and an automated external defibrillator are needed.

Treating Obstructive Shock

As discussed previously, two of the most common examples of obstructive shock are cardiac tamponade and tension pneumothorax.

Increasing cardiac output should be the priority in treating cardiac tamponade. The preload must be increased because increasing pressure in the pericardium is squeezing the heart. Apply high-flow oxygen. The only definitive treatment for cardiac tamponade is surgery. Pericardiocentesis involves penetrating the pericardium with a needle to withdraw the accumulated blood from the pericardial sac. This procedure is an advanced skill, and it is rarely performed in the field.

To treat a tension pneumothorax, administer high-flow oxygen via nonrebreathing mask early to prevent hypoxia. Be cautious about providing positive-pressure ventilation to a patient with a tension pneumothorax, as the increase of air will increase the pressure in the chest. Usually the only action that can prevent eventual death from a tension pneumothorax is decompression of the injured side of the chest, relieving the pressure in the chest and allowing the heart to expand fully again. Chest decompression is an ALS skill. Ask for ALS assistance early in the call if available; however, do not delay transport waiting for the arrival of ALS.

Treating Septic Shock

The proper treatment of septic shock requires complex hospital management, including administration of antibiotics. If you suspect that a patient has septic shock, use appropriate standard precautions and transport as promptly as possible, administering high-flow oxygen during transport. Ventilatory support may be necessary to maintain adequate tidal volume. Use blankets to conserve body heat. Sepsis has become an increasingly common illness. Some hospitals have instituted specialized “sepsis teams,” which, when notified, will meet the potential septic patient in the ED. Sepsis teams have protocols that decrease the amount of time spent in identification of the infectious agent and initiation of the appropriate treatment, thereby decreasing the mortality from septic shock.

Treating Neurogenic Shock

Shock that accompanies spinal cord injury is best treated by a combination of all known supportive measures. The patient who has sustained this kind of injury usually will require hospitalization for a long time. Emergency treatment must be directed at obtaining and maintaining a proper airway, providing spinal immobilization, assisting inadequate breathing as needed, conserving body heat, and ensuring the most effective circulation possible.

A patient in neurogenic shock is usually not losing blood; however, the capacity of the blood vessels has become significantly larger than the available volume of the blood inside the vessels. Supplemental oxygen will boost the concentration of oxygen in the blood. If respirations are weak or inadequate, assist ventilations. Because the injury may have disabled the body's normal temperature controls, keep the patient as warm as possible with blankets. Transport the patient promptly to a facility capable of managing spinal injuries.

Treating Anaphylactic Shock

The only really effective treatment of a severe, acute allergic reaction is to administer epinephrine by way of intramuscular injection. For more information on the emergency care for allergic reactions, see Chapter 20, *Immunologic Emergencies*. A patient who is aware of having a specific sensitivity may carry a kit containing epinephrine **Figure 12-9**. If he or she is unable to inject the medication, you may have to do so if you are allowed by local protocol. If the patient's signs and symptoms recur or the patient's condition deteriorates, consult medical control for authorization to administer a repeat injection, if available.

A patient with anaphylaxis requires immediate transport to the ED. Additional emergency care includes high-flow oxygen (10 to 15 L/min via a nonrebreathing mask). Assist ventilations with a BVM if necessary. If possible, attempt to determine what agent caused the reaction (for example, a drug, an insect bite or sting, a food item) and how it was received (for example, by mouth, by inhalation, or by injection). The severity of allergic reactions can vary greatly, with symptoms ranging from mild itching to profound coma and rapid death. Keep in mind that a mild reaction may worsen suddenly or over time. Because of the potential for airway compromise, consider requesting ALS backup, if available.

Figure 12-9 Patients who are known to have anaphylaxis often carry kits with an intramuscular injector or auto-injector containing epinephrine. **A.** An EpiPen. **B.** An Auvi-Q EpiPen.

A: © Roel Smart/iStockphoto.
B: © PR NEWSWIRE/AP Photo.

▶ Treating Psychogenic Shock

In an uncomplicated case of fainting, once the patient collapses and becomes supine, circulation to the brain is usually restored and with it, a normal state of functioning. Remember that psychogenic shock can significantly worsen other types of shock. If it appears the patient fell as a result of psychogenic shock, check for injuries, especially in older patients. If the patient reports not being able to walk after a fall thought to be related to psychogenic shock, you should suspect another problem, such as head injury. Transport the patient promptly. It is not safe to assume based on EMT assessment that any fainting was caused by psychogenic shock alone. All patients with loss of consciousness, even brief, should be transported to the ED for evaluation even if they appear normal once you arrive on scene to evaluate them.

Be sure to record your initial observations of vital signs and level of consciousness. In addition, try to learn from bystanders whether the patient complained of anything before fainting and how long he or she was unconscious.

Treating Hypovolemic Shock

The emergency treatment of hypovolemic or hemorrhagic shock includes the control of all obvious external bleeding. The best initial method to control external bleeding is direct pressure. To prevent continued bleeding, you must apply sufficient pressure to control obvious external bleeding. If bleeding is not controlled with direct pressure, consider use of a tourniquet. Bleeding control, including application of a tourniquet, is discussed in detail in Chapter 25, *Bleeding*. Ensure that you use great care to handle the patient gently and keep him or her warm.

Although you cannot control internal bleeding in the field, it is important to recognize its existence and provide aggressive general support. Secure and maintain an airway, and provide respiratory support, including supplemental oxygen and, if needed, assisted ventilations. Start oxygen as soon as you suspect shock, and continue it during transport; with too little circulating blood, additional oxygen may be lifesaving. Watch to ensure that the patient does not aspirate blood or vomitus, and transport the patient as rapidly as possible to the ED.

Treating Respiratory Insufficiency

In treating the patient who has inadequate respiration, immediately secure and maintain the airway. Clear the mouth and throat of any obstructions including mucus, vomitus, and foreign material. If necessary, provide ventilations with a BVM. Administer supplemental oxygen, and transport the patient promptly.

Treating Shock in Older Patients

Use caution when caring for older patients. As a result of the aging process, older patients generally have more serious complications than younger patients. Although illness is a common complaint among older patients, you must understand that it is not just part of aging. In addition, many older patients take numerous medications that could either mask or mimic signs of shock. Keep in mind the following signs of the normal aging process when managing geriatric patients:

YOU are the Provider — PART 5

You ask your partner to call ahead to the hospital because you are busy caring for the patient and cannot free up your hands. The noninvasive automatic vital sign machine records another set of vital signs. With an estimated time of arrival at the hospital of 5 minutes, you reassess the patient.

Recording Time: 16 Minutes	
Level of consciousness	Responsive to pain only
Respirations	30 breaths/min and shallow (baseline); ventilations are being assisted
Pulse	128 beats/min; absent radial pulses (carotid pulse present)
Skin	Pale, cool, and diaphoretic
Blood pressure	80/40 mm Hg
Spo_2	96% (with assisted ventilation; on oxygen)

You arrive at the hospital and give your report to the charge nurse. Intravenous access is rapidly obtained, the attending physician quickly assesses the patient, and additional treatment is given.

8. What part of the patient's perfusion triangle has failed?
9. How does shock caused by content failure differ from shock caused by container failure?

- The central nervous system often has a delayed response.
- The cardiovascular system has a variety of changes that result in a decrease in the efficiency of the system. On assessment, be alert for higher resting heart rates and irregular pulse rates.
- The respiratory system undergoes significant changes as the elasticity of the lungs and their size and strength decrease. On assessment, be alert for higher respiratory rates, lower tidal volume, and a decreased gag reflex. In addition, remember that cervical arthritis may be present and that dentures may cause an airway obstruction.
- The skin becomes thinner, drier, less elastic, and more fragile, thus providing less protection and thermal regulation (cold and hot).
- The renal system decreases in function and may not respond well to unusual demands such as illness or dehydration.
- The gastrointestinal system sustains changes in gastric motility that may lead to slower gastric emptying.

Treating a pediatric or geriatric patient in shock is no different than treating any other shock patient:

1. Provide in-line spinal stabilization if indicated. If spinal immobilization is not indicated, maintain the patient in a position of comfort.
2. Control life-threatening hemorrhage immediately with direct pressure or tourniquet application when appropriate.
3. Suction as necessary and provide high-flow oxygen via a nonrebreathing mask.
4. Maintain body temperature.
5. Provide rapid transportation.

YOU are the Provider — SUMMARY

1. What additional information should you attempt to gather about the patient while en route to the clinic?

Information of "a woman going into shock" tells you very little. The patient could have a severe injury with internal bleeding, she could be experiencing a severe allergic reaction, or she may have simply fainted. When you are dispatched to any call with minimal information provided, attempt to gather additional information while you are en route. In many cases, the dispatch operator will provide additional patient information—without you asking for it—as it becomes available to him or her. In other cases, you will need to ask the dispatcher to try to make contact with the caller to obtain a patient update. Many EMS systems use an emergency medical dispatcher (EMD); if this is the case, he or she should be able to provide you with more detailed information, as well as give prearrival instructions to the caller.

2. What is shock and how does it relate to perfusion?

Perfusion is the delivery of blood and oxygen and other essential nutrients to the body's cells to keep them alive. While delivering these essential components to the body's cells, waste products such as carbon dioxide are removed from the cell and eliminated from the body. Adequate perfusion is the responsibility of the "perfusion triangle," which consists of three essential components—a functioning pump (the heart), adequate volume (the blood and water), and an intact container (the blood vessels). The respiratory system is also a critical component for adequate perfusion; if oxygen cannot get into the lungs, the heart cannot pump it through the blood vessels and to the cells. Shock is a state of inadequate perfusion (hypoperfusion) of blood through the body's tissues and to the cells and is the result of failure of one or more components of the perfusion triangle or the respiratory system. The type of shock that a patient is experiencing indicates the component of the perfusion triangle that has failed. Regardless of the type of shock, the end result is the same—inadequate perfusion of the body's tissues and cells, which will lead to death if untreated.

3. Based on your assessment, what changes, if any, in the patient's current treatment are required?

The patient clearly has signs of shock—restlessness; tachypnea; tachycardia; weak radial pulses; and cool, pale, diaphoretic skin—and the treatment that has been provided thus far is essentially appropriate. She is being kept warm, and she is receiving oxygen. However, patients with signs of shock need high-flow oxygen. She is presently receiving oxygen via a nasal cannula; this should be changed to a nonrebreathing mask with the flow rate set at 15 L/min. Based on this patient's presentation—abdominal pain and rectal bleeding—you should suspect blood loss (bleeding into the intestines) as the cause of her shock. Blood carries oxygen; if the blood volume decreases, so does the ability of oxygen to get to the cells. Providing a high concentration of oxygen will oxygenate the red blood cells that remain in the circulatory system. In addition to receiving high-flow oxygen, the patient needs IV access and volume replacement to help circulate the oxygenated blood. The physician has been unable to obtain IV access, and since IV therapy is beyond the EMT's level of training, you must prepare the patient for immediate transport. If your transport time to the hospital will be prolonged, you should consider an intercept with ALS, because ALS is trained to establish IV access.

4. How do the patient's signs and symptoms correlate with the body's response to inadequate perfusion?

During shock, the body mounts a physiologic response aimed at maintaining adequate perfusion, most of which is the result of increased activity of the sympathetic nervous system releasing greater quantities of epinephrine (adrenalin) and norepinephrine. Restlessness, perhaps one of the earliest signs of shock, is caused by a decrease in oxygen to the brain. As a result, the number of signals the brain sends to the respiratory muscles increases, which causes an increase in the patient's respiratory rate (tachypnea). Increased levels of epinephrine cause an increase in heart rate and cardiac contractility, and as a result, blood is pumped faster and with greater force throughout the body to compensate for decreased perfusion. Increased levels of norepinephrine cause the blood vessels to constrict (vasoconstriction), thus maintaining the patient's blood pressure. Early in shock, blood is shunted away from areas of lesser need (ie, the skin and muscles) to areas of greater need (ie, heart, lungs, liver, kidneys) by vasoconstriction. This causes the skin to turn pale (pallor) and become cool to the touch. When the sympathetic nervous system activity increases, sweat gland activity increases as well, resulting in diaphoresis (profuse sweating).

5. Is the patient in compensated or decompensated shock? How can you tell?

Signs of compensated shock include restlessness, anxiety, or agitation; tachycardia; rapid, weak (thready) peripheral pulses; tachypnea; and marked thirst. In compensated shock, however, the patient's systolic blood pressure is maintained—usually above 90 mm Hg in adults. Your patient's current blood pressure is 108/58 mm Hg. These signs and symptoms indicate that the patient is in compensated shock. Signs of decompensated shock include systolic blood pressure of 90 mm Hg or lower in an adult; absent peripheral pulses; dilated pupils; ashen, mottled, or cyanotic skin; and a decreasing level of consciousness. It is important to note that the patient's blood pressure is often the last measurable factor to change in shock. By the time a low blood pressure (hypotension) is detected, shock is well developed. In decompensated shock, the body's compensatory mechanisms are no longer able to maintain adequate perfusion. Survival is less likely—even with rapid transport and aggressive treatment at the hospital.

6. How has your patient's condition changed?

Your patient's condition has changed for the worse. Her level of consciousness has decreased (responsive to pain only), her respirations have increased in rate and decreased in depth (reduced tidal volume), her heart rate has increased and her radial pulses are no longer palpable, her blood pressure is below 90 mm Hg (84/44 mm Hg), and her oxygen saturation has fallen—despite the administration of high-flow oxygen. Based on these reassessment findings, your patient is now in decompensated shock with inadequate breathing. As previously discussed, decompensated shock occurs when the body's compensatory mechanisms begin to fail and are no longer able to maintain adequate perfusion. At the clinic, the patient had signs of shock; however, she was still conscious and alert, although restless, and her systolic blood pressure was maintained. Patients can decompensate within a matter of minutes; this fact underscores the criticality of frequent reassessments.

7. Are adjustments in your current interventions required? If so, what?

In terms of shock treatment, you are doing everything that you can. The patient is being kept warm with a blanket and she is receiving high-flow oxygen. An intercept with an ALS unit is not practical, because you are too close to the hospital. However, the patient's breathing is no longer adequate (30 breaths/min and shallow) and requires assistance. Because of her decreased level of consciousness, you should insert a nasopharyngeal airway, as she is responsive to pain and likely has an intact gag reflex. Begin assisting her ventilations with a BVM attached to high-flow oxygen and monitor her closely for signs of improvement or further deterioration. Many EMS systems carry noninvasive blood pressure monitoring devices that automatically take the patient's blood pressure and other vital signs. If you have this capability, set the device to reassess the patient's vital signs at least every 5 minutes or as deemed appropriate by the patient's condition. You are the only EMT in the back with the patient; managing her airway and assisting her ventilations clearly has priority over obtaining a manual blood pressure.

8. What part of the patient's perfusion triangle has failed?

There are three components to the perfusion triangle, each of which must function adequately at all times to maintain adequate perfusion: the heart (pump), the blood vessels (container), and the blood (content). Recalling the patient's chief complaint—abdominal pain and rectal bleeding—she is in shock secondary to blood loss (hemorrhagic shock).

Therefore, the content function of the perfusion triangle has failed. If there is enough blood or plasma loss, internally or externally, the volume of fluid that remains in the container (blood vessels) will not be able to carry sufficient amounts of oxygen to the cells to adequately perfuse them.

9. How does shock caused by content failure differ from shock caused by container failure?

Shock caused by content failure refers to insufficient oxygen delivery to the cells because of inadequate volume and is called hypovolemic shock. Hypovolemia is a generic term that simply means low volume; it could be blood, plasma, water, or a combination. Common causes of hypovolemic shock include blunt or penetrating trauma, burns, and dehydration. Shock that is caused by blood loss specifically is called hemorrhagic shock. The signs of hypovolemic shock include tachycardia; pale, cool, clammy skin; tachypnea; restlessness, agitation, or anxiety; and as a late sign, hypotension. Shock caused by container failure refers to inadequate perfusion because of excessive dilation of the blood vessels, resulting in a decrease in pressure within the circulatory system. Although the volume of blood has not changed, the container that it circulates within has increased; therefore the normal volume of blood is insufficient to fill the system and provide adequate perfusion. Common causes of shock caused by container failure include anaphylaxis, overdose with drugs that suppress the nervous system (ie, narcotics), and spinal cord injury. The classic signs of hypovolemic shock—specifically, tachycardia, pallor, and diaphoresis—will be absent. Instead, the patient’s skin is usually warm and dry, and the heart rate is normal or low.

EMS Patient Care Report (PCR)

Date: 7-21-16	**Incident No.:** 011009	**Nature of Call:** Woman in shock		**Location:** 1111 Cedar Hills Dr.	
Dispatched: 2022	**En Route:** 2023	**At Scene:** 2032	**Transport:** 2043	**At Hospital:** 2053	**In Service:** 2105

Patient Information

Age: 39 **Sex:** F **Weight (in kg [lb]):** 73 kg (160 lb)	**Allergies:** Codeine **Medications:** Amitiza, Bentyl **Past Medical History:** Irritable bowel syndrome **Chief Complaint:** Abdominal pain and rectal bleeding

Vital Signs

Time: 2036	**BP:** 108/58	**Pulse:** 120	**Respirations:** 24	**Spo_2:** 94%
Time: 2043	**BP:** 84/44	**Pulse:** 130	**Respirations:** 30	**Spo_2:** 89%
Time: 2048	**BP:** 80/40	**Pulse:** 128	**Respirations:** 30	**Spo_2:** 96%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Blanket for warmth

Narrative

9-1-1 dispatch to Cedar Hills Urgent Care Clinic for a "woman going into shock." Arrived on scene and found the patient, a 39-year-old female, lying supine on an exam table. She was conscious and alert, but restless. Her airway was patent and her breathing, although increased in rate, was producing adequate tidal volume. Her skin was cool, pale, and diaphoretic. According to the clinic physician, the patient presented 15 minutes earlier reporting abdominal pain and rectal bleeding, which began approximately 24 hours ago. Prior to EMS arrival, clinic personnel applied oxygen at 4 L/min via nasal cannula and applied a blanket. The physician advised that she attempted to establish IV access several times, but was unsuccessful. Further assessment of the patient revealed that her abdomen was diffusely tender to palpation, and she was actively bleeding from the rectum. Remainder of assessment was unremarkable. The patient denies abdominal trauma and states that she has a history of irritable bowel syndrome. Removed nasal cannula, applied high-flow oxygen via nonrebreathing mask, obtained vital signs, and moved the patient to the ambulance. Departed the scene and continued treatment en route. Reassessment revealed that the patient's mental status had decreased; she was now only responsive to painful stimuli. Her blood pressure had decreased, her radial pulses were absent (carotid pulse was present), her respirations were more rapid and shallow, and her Spo_2 had fallen to 89%. Inserted a nasopharyngeal airway and began assisting her ventilations with a BVM attached to high-flow oxygen. Partner notified the receiving facility and gave radio report. Continued to assist patient's ventilations and monitor her vital signs. She remained hypotensive and tachycardic; however, her Spo_2 increased to 96% with assisted ventilation. Delivered patient to the emergency department staff without incident and gave verbal report to charge nurse. Medic 4 returned to service at 2105.**End of report**

Prep Kit

Ready to Review

- Perfusion requires an intact cardiovascular system and a functioning respiratory system.
- Remember, most types of shock (hypoperfusion) are caused by dysfunction in one or more parts of the perfusion triangle:
  - The pump (the heart)
  - The pipes, or container (blood vessels)
  - The content, or volume (blood)
- Shock (hypoperfusion) is the collapse and failure of the cardiovascular system, when blood circulation slows and eventually stops.
- Blood is the vehicle for carrying oxygen and nutrients through the vessels to the capillary beds and tissue cells, where these supplies are exchanged for waste products.
- Blood contains red blood cells, white blood cells, platelets, and a liquid called plasma.
- The *systolic* pressure is the peak arterial pressure, or pressure generated every time the heart contracts; the *diastolic* pressure is the pressure maintained within the arteries while the heart rests between heartbeats.
- The various types of shock are cardiogenic, obstructive, septic, neurogenic, anaphylactic, psychogenic, and hypovolemic.
- Signs of compensated shock include anxiety or agitation; tachycardia; pale, cool, moist skin; increased respiratory rate; nausea and vomiting; and increased thirst. If there is any question on your part, treat for shock. Early recognition and rapid treatment are important.
- Signs of decompensated shock include labored or irregular respirations, ashen gray or cyanotic skin color, weak or absent distal pulses, dilated pupils, and profound hypotension (systolic blood pressure of 90 mm Hg or lower in an adult).
- Remember, by the time a drop in blood pressure is detected, shock is usually in an advanced stage.
- Anticipate shock in patients who may have the following conditions:
  - Severe infection
  - Significant blunt force trauma or penetrating trauma
  - Massive external bleeding or index of suspicion for major internal bleeding
  - Spinal cord injury
  - Chest or abdominal injury
  - Major heart attack
  - Anaphylaxis
- Treating a pediatric or geriatric patient in shock is no different than treating any other shock patient.
- Treat all patients suspected to be in shock from any cause as follows and in this order:
  - Open and maintain the airway.
  - Control life-threatening hemorrhage immediately with direct pressure or tourniquet application when appropriate.
  - Provide high-flow oxygen, and as needed, provide BVM-assisted ventilations.
  - Maintain normal body temperature with blankets.
  - Provide calm reassurance.
  - Provide prompt transport to the appropriate hospital.

Vital Vocabulary

afterload The force or resistance against which the heart pumps.

anaphylactic shock Severe shock caused by an allergic reaction.

anaphylaxis An extreme, life-threatening, systemic allergic reaction that may include shock and respiratory failure.

aneurysm A swelling or enlargement of a part of an artery, resulting from weakening of the arterial wall.

autonomic nervous system The part of the nervous system that regulates involuntary activities of the body, such as heart rate, blood pressure, and digestion of food.

cardiac tamponade Compression of the heart as the result of buildup of blood or other fluid in the pericardial sac, leading to decreased cardiac output.

cardiogenic shock A state in which not enough oxygen is delivered to the tissues of the body, caused by low output of blood from the heart. It can be a severe complication of a large acute myocardial infarction, as well as other conditions.

compensated shock The early stage of shock, in which the body can still compensate for blood loss.

cyanosis A blue skin discoloration that is caused by a reduced level of oxygen in the blood.

decompensated shock The late stage of shock when blood pressure is falling.

dehydration Loss of water from the tissues of the body.

distributive shock A condition that occurs when there is widespread dilation of the small arterioles, small venules, or both.

edema The presence of abnormally large amounts of fluid between cells in body tissues, causing swelling of the affected area.

homeostasis A balance of all systems of the body.

hypothermia A condition in which the internal body temperature falls below 95°F (35°C).

hypovolemic shock Shock caused by fluid or blood loss.

myocardial contractility The ability of the heart muscle to contract.

neurogenic shock Circulatory failure caused by paralysis of the nerves that control the size of the blood vessels, leading to widespread dilation; seen in patients with spinal cord injuries.

obstructive shock Shock that occurs when there is a block to blood flow in the heart or great vessels, causing an insufficient blood supply to the body's tissues.

perfusion The flow of blood through body tissues and vessels.

pericardial effusion A collection of fluid between the pericardial sac and the myocardium.

preload The precontraction pressure in the heart as the volume of blood builds up.

psychogenic shock Shock caused by a sudden, temporary reduction in blood supply to the brain that causes fainting (syncope).

pulmonary embolism A blood clot that breaks off from a large vein and travels to the blood vessels of the lung, causing obstruction of blood flow.

pulse pressure The difference between the systolic and diastolic pressures.

sensitization Developing a sensitivity to a substance that initially caused no allergic reaction.

septic shock Shock caused by severe infection, usually a bacterial infection.

shock A condition in which the circulatory system fails to provide sufficient circulation to enable every body part to perform its function; also called hypoperfusion.

sphincters Circular muscles that encircle and, by contracting, constrict a duct, tube, or opening.

syncope A fainting spell or transient loss of consciousness.

Assessment *in Action*

You are dispatched to a person who is reporting chest pain and shortness of breath. You arrive to find a conscious 58-year-old woman who is sitting up and reporting severe chest pain and shortness of breath. She is very anxious and tells you she feels like she is going to die. Physical examination shows that her skin is pale, cool, and clammy and her pulse is rapid, weak, and irregular. Her breathing is labored, with a respiratory rate of 28 breaths/ min. Her Spo_2 is 90%. Lung sounds show crackles in all fields. Blood pressure is 92/60 mm Hg.

1. What is your differential diagnosis of this patient?

   A. Hypovolemic shock
   B. Anaphylactic shock
   C. Cardiogenic shock
   D. Neurogenic shock

2. What stage of shock is this patient in? What signs and symptoms lead you to that conclusion?

   A. Compensated
   B. Decompensated
   C. Irreversible
   D. Psychogenic

3. What treatment should be initiated first for this patient?

   A. High-flow oxygen
   B. Administration of nitroglycerin
   C. Rapid transport
   D. Maintain warmth

4. The patient is having trouble breathing. What position should the patient be placed in?

   A. Supine

B. Fowler position
C. Prone
D. Left lateral recumbent

5. What part of the patient's cardiovascular system is failing?

   A. The fluid (blood)
   B. The container (vessels)
   C. The pump (heart)
   D. The control (nervous system)

6. Which of the following terms is used to describe a balance of all body systems?

   A. Hypothermia
   B. Autonomic nervous system
   C. Perfusion
   D. Homeostasis

7. You are watching your patient carefully to see if her condition deteriorates. What signs would alert you to the patient going into the next stage of shock?

8. Define shock.

9. Describe how carbon dioxide is transported from tissues to the lungs.

10. Why is it significant that the patient feels like she is going to die?

CHAPTER

13

BLS Resuscitation

National EMS Education Standard Competencies

Shock and Resuscitation

Applies a fundamental knowledge of the causes, pathophysiology, and management of shock, respiratory failure or arrest, cardiac failure or arrest, and post-resuscitation management.

Knowledge Objectives

1. Explain the elements of basic life support (BLS), how it differs from advanced life support (ALS), and why BLS must be applied rapidly. (pp 514–515)
2. Explain the goals of cardiopulmonary resuscitation (CPR) and when it should be performed on a patient. (p 515)
3. Explain the components of CPR, the five links in the American Heart Association (AHA) chain of survival, and how each one relates to maximizing the survival of a patient. (pp 515–516)
4. Discuss guidelines for circumstances that require the use of an automated external defibrillator (AED) on both adult and pediatric patients experiencing cardiac arrest. (pp 517–518)
5. Explain three special situations related to the use of an AED. (p 518)
6. Describe the proper way to position an adult patient to receive BLS care. (p 519)
7. Describe the purpose of external chest compressions. (p 519)
8. Describe the two techniques EMTs may use to open an adult patient's airway and the circumstances that would determine when each technique would be used. (pp 522–523)
9. Describe the recovery position and circumstances that would warrant its use as well as situations in which it would be contraindicated. (pp 523–524)
10. Describe the process of providing artificial ventilations to an adult patient, ways to avoid gastric distention, and modifications required for a patient with a stoma. (pp 524–526)

11. Explain the steps in providing single-rescuer adult CPR. (pp p 526)
12. Explain the steps in providing two-rescuer adult CPR, including the method for switching positions during the process. (p 526)
13. Describe the different mechanical devices that are available to assist emergency care providers in delivering improved circulatory efforts during CPR. (pp 529, 531–533)
14. Describe the different possible causes of cardiopulmonary arrest in children. (pp 533–534)
15. Explain the four steps of pediatric BLS procedures and how they differ from BLS procedures used in an adult patient. (pp 533–538)
16. Describe the ethical issues related to patient resuscitation, including examples of when not to start CPR on a patient. (pp 539–540)
17. Explain the various factors involved in the decision to stop CPR after it has been started on a patient. (pp 540–541)
18. Explain common causes of foreign body airway obstruction in both children and adults and how to distinguish mild or partial airway obstruction from complete airway obstruction. (pp 541–542)
19. Describe the different methods for removing a foreign body airway obstruction in an infant, child, and adult, including the procedure for a patient with an obstruction who becomes unresponsive. (pp 541–548)
20. Discuss how to provide grief support for a patient's family members and loved ones after resuscitation has ended. (pp 548–550)
21. Discuss the importance of frequent CPR training for EMTs, as well as public education programs that teach compression-only CPR. (p 550)

Skills Objectives

1. Demonstrate how to position an unresponsive adult for CPR. (p 519)
2. Demonstrate how to check for a pulse at the carotid artery in an unresponsive child or adult. (p 519)
3. Demonstrate how to perform external chest compressions on an adult. (pp 520–521, Skill Drill 13-1)
4. Demonstrate how to perform a head tilt–chin lift maneuver on an adult. (pp 522–523)
5. Demonstrate how to perform a jaw-thrust maneuver on an adult. (pp 522–523)
6. Demonstrate how to place a patient in the recovery position. (pp 523–524)
7. Demonstrate how to perform rescue breathing in an adult. (p 524)
8. Demonstrate how to perform one-rescuer adult CPR. (pp 526–527, Skill Drill 13-2)
9. Demonstrate how to perform two-rescuer adult CPR. (pp 526, 528, Skill Drill 13-3)
10. Demonstrate the use of mechanical devices that assist emergency responders in delivering improved circulatory efforts during CPR. (pp 531–533)
11. Demonstrate how to check for a pulse at the brachial artery in an unresponsive infant. (p 534)
12. Demonstrate how to perform external chest compressions on an infant. (p 535, Skill Drill 13-4)
13. Demonstrate how to perform CPR on a child who is between 1 year of age and the onset of puberty. (pp 535–537, Skill Drill 13-5)
14. Demonstrate how to perform a head tilt–chin lift maneuver on a pediatric patient. (p 537)
15. Demonstrate how to perform a jaw-thrust maneuver on a pediatric patient. (p 537)
16. Demonstrate how to perform rescue breathing on a child. (p 538)
17. Demonstrate how to perform rescue breathing on an infant. (p 538)
18. Demonstrate how to remove a foreign body airway obstruction in a responsive adult patient using abdominal thrusts (Heimlich maneuver). (p 543)
19. Demonstrate how to remove a foreign body airway obstruction in a responsive pregnant or obese patient using chest thrusts. (p 543)
20. Demonstrate how to remove a foreign body airway obstruction in a responsive child older than 1 year using abdominal thrusts (Heimlich maneuver). (pp 545–546)
21. Demonstrate how to remove a foreign body airway obstruction in an unresponsive child. (pp 546–547, Skill Drill 13-6)

22. Demonstrate how to remove a foreign body airway obstruction in an infant. (pp 546, 548)

Introduction

The principles of basic life support (BLS) were introduced in 1960. Since then, the specific techniques for the management of cardiac arrest and the delivery of emergency and cardiac care have been reviewed and revised every 5 to 6 years. The goal is to produce the best recommendations possible given the available scientific evidence. The updated guidelines are published in peer-reviewed journals: *Circulation* in the United States and *Resuscitation* in Europe. The most recent review was conducted by the International Liaison Committee on Resuscitation (ILCOR). This revision occurred as a result of a rigorous and systematic review of the newest scientific evidence surrounding the treatment of cardiac arrest and the provision of emergency and cardiac care, using validated, transparent, and scientifically rigorous methodology to produce the best recommendations possible given the available evidence.

This chapter begins with a definition and general discussion of BLS. It then reviews methods for opening and maintaining a patent (open) airway, providing artificial ventilation to a person who is not breathing, providing artificial circulation to a person with no pulse, and removing a foreign body airway obstruction. Each of these topics is followed by a review of the changes in technique that are necessary to treat infants and children. Chapter 2, *Workforce Safety and Wellness,* discusses the methods of preventing the transmission of infectious diseases during cardiopulmonary resuscitation (CPR). Chapter 6, *The Human Body,* discusses the anatomy and physiology of the respiratory and cardiovascular systems. Chapter 41, *The Team Approach to Health Care*, discusses how to work as an effective team in the health care setting. During any emergency, working as a team is critical to give the patient the best chance for a successful outcome.

Words of Wisdom

Although your chances of contracting a disease during CPR training or actual CPR on a patient are very low, both common sense and Occupational Safety and Health Administration guidelines demand that you take reasonable precautions to prevent unnecessary exposure to an infectious disease. Use standard safety precautions to decrease the risk of contracting a disease during CPR, as discussed in Chapter 2, *Workforce Safety and Wellness.*

YOU are the Provider — PART 2

At 1445 hours, you and your partner respond to a local supermarket at 123 Wilshire Avenue where a middle-aged man reportedly collapsed in the parking lot. While you are en route to the scene, dispatch advises you that bystander CPR is in progress. Your response time is less than 5 minutes.

1. What should you immediately do on receiving this update from dispatch?
2. What should be your initial actions on arriving at this scene?

Elements of BLS

Basic life support (BLS) is noninvasive emergency life-saving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest. BLS follows a specific sequence for adults and for infants and children. This care focuses on the ABCs: airway (obstruction), breathing (respiratory arrest), and circulation (cardiac arrest or severe bleeding). If the patient is in cardiac arrest, then a CAB sequence (compressions, airway, breathing) is used because chest compressions are essential and must be started as quickly as possible **Figure 13-1**. Ideally, only seconds should pass between the time you recognize that a patient needs BLS and the start of treatment. Remember, brain cells die every second that they are deprived of oxygen. Permanent brain damage is possible after only 4 to 6 minutes without oxygen **Figure 13-2**.

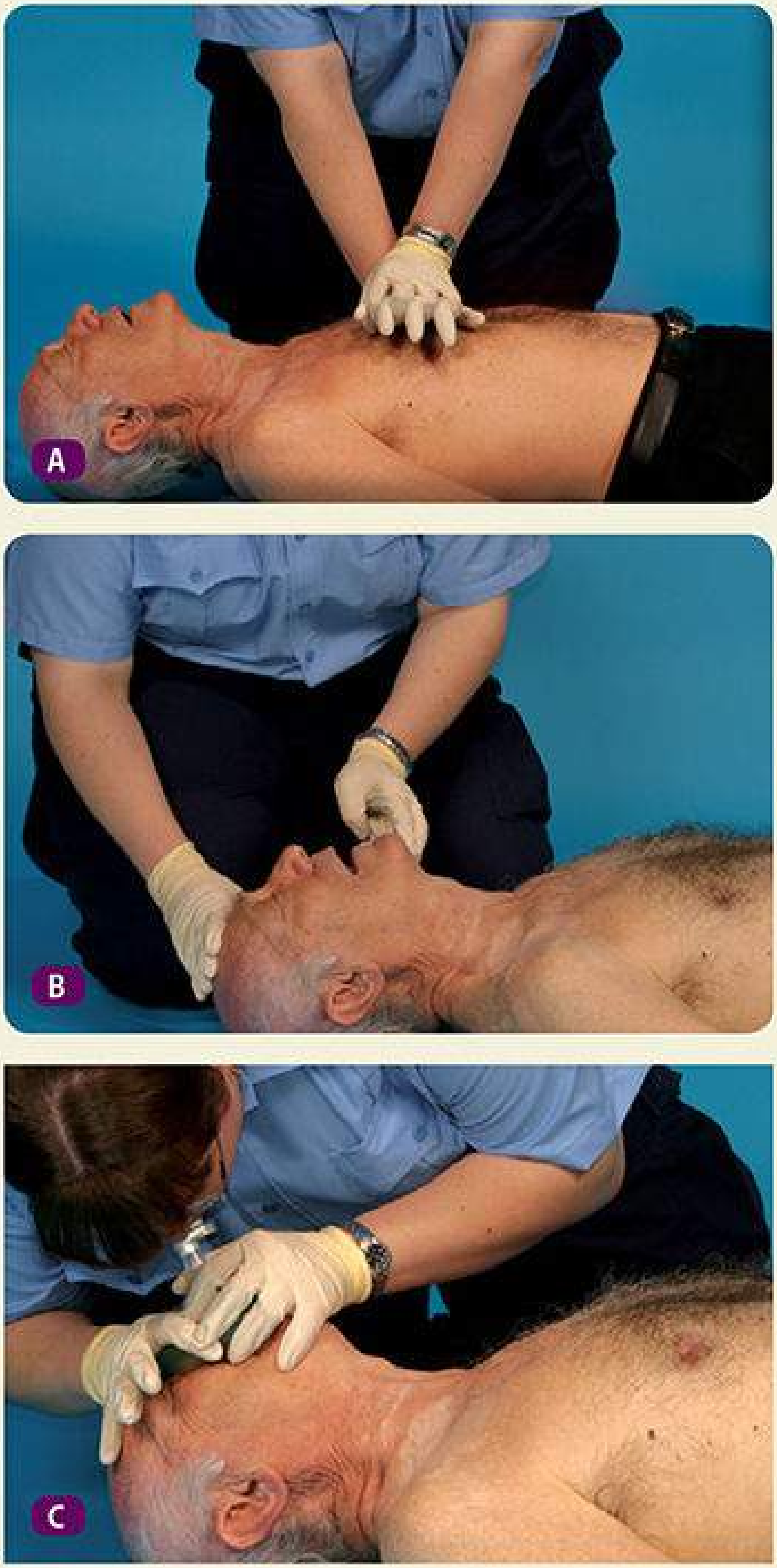


Figure 13-1 CAB: Chest compressions, airway, and breathing.

A, B, & C: © Jones & Bartlett Learning. Courtesy of MIEMSS.

If a patient is not breathing adequately or at all, then you may be able to restore normal breathing simply by opening the airway. However, if the patient has no pulse, then you must combine artificial ventilation with artificial circulation (chest compressions). If breathing stops before the heart stops, then the patient may have enough oxygen in the lungs to stay alive for several minutes. But when cardiac arrest occurs first, the heart and brain stop receiving oxygen immediately.

Cardiopulmonary resuscitation (CPR) is used to establish circulation and artificial ventilation in a patient who is not breathing and has no pulse. The steps for CPR include the following:

1. First, restore circulation by performing chest compressions to circulate blood to the vital organs of the body.
2. Next, perform 30 high-quality compressions to a depth of 2 inches to 2.4 inches (5 cm to 6 cm) in an adult at the rate of 100 to 120 per minute. Next, open the airway with the jaw-thrust or head tilt–chin lift maneuver.
3. Last, restore breathing by providing rescue breaths (via mouth-to-mask ventilation or a bag-valve mask [BVM]). Administer 2 breaths, each over 1 second, while visualizing for chest rise.

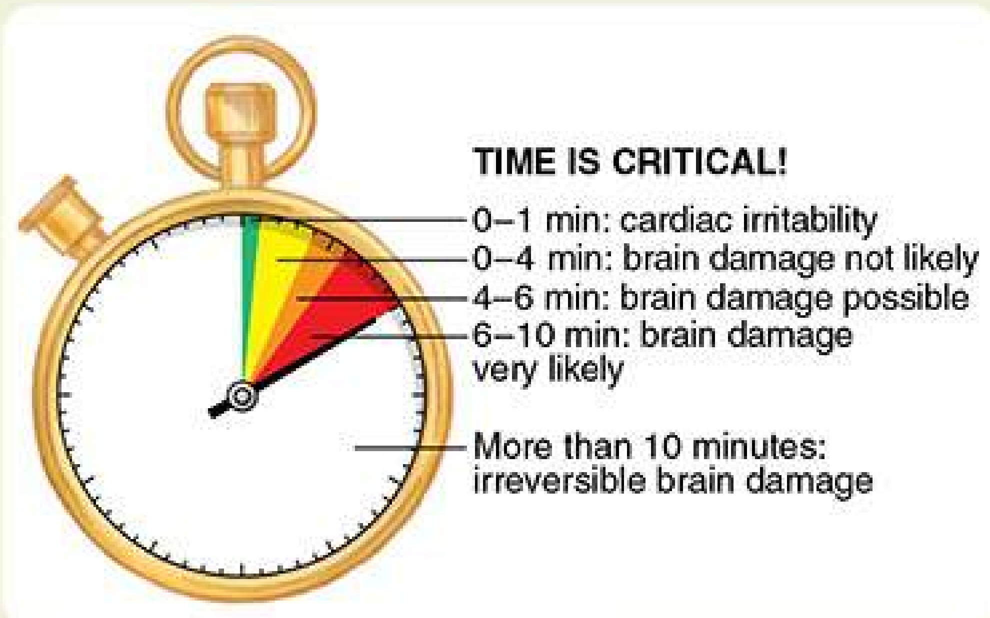


Figure 13-2 Time is critical for patients who are not breathing. If the brain is deprived of oxygen for 4 to 6 minutes, brain damage is possible.

The goal of CPR is to help restore spontaneous breathing and circulation; however, defibrillation and advanced interventions (ie, medication therapy) are often necessary to achieve this outcome. For CPR to be effective, you must be able to quickly identify a patient who is in respiratory and/or cardiac arrest and immediately begin BLS measures **Figure 13-3**.

BLS differs from **advanced life support (ALS)**, which involves advanced lifesaving procedures, such as cardiac monitoring, administration of intravenous (IV) fluids and medications, and the use of advanced airway adjuncts. However, when done correctly, BLS care can maintain life for a short time until ALS measures can be started. In some cases, such as choking, near drowning, or lightning injuries, early BLS measures may be all that is needed to restore a patient's pulse and breathing. Of course, these patients still require transport to the emergency department (ED) for evaluation.

Figure 13-3 You must quickly identify patients in respiratory and/or cardiac arrest so that BLS measures can begin immediately.

The BLS measures are only as effective as the person who is performing them. Your skills may be good immediately after training, but as time goes on, skills will deteriorate unless you practice them regularly.

To survive cardiac arrest, effective CPR at an adequate rate and depth with minimal interruptions is essential until defibrillation can be administered. Therefore, the BLS care you provide as an EMT is an extremely critical factor in the patient's chance for survival.

The Components of CPR

According to the American Heart Association (AHA), 88% of sudden cardiac arrests occur in the home. Few patients who experience cardiac arrest in the prehospital environment survive unless a rapid sequence of events takes place. The AHA has determined an ideal sequence of events, termed the chain of survival, that if taken can improve the chance of successful resuscitation of a patient who experiences sudden cardiac arrest **Figure 13-4**. A successful resuscitation is defined not only by the **return of spontaneous circulation (ROSC)**, but also the survival of the patient to hospital discharge. The five links in the chain of survival are as follows:

1. **Recognition and activation of the emergency response system.** The first step in the chain of survival requires public education and awareness. Laypeople must learn to recognize the early warning signs of a cardiac emergency and immediately activate EMS by calling 9-1-1. This step ensures that emergency responders are dispatched to the scene quickly, thus allowing the other links of the chain to be more effective. In modern EMS systems, the 9-1-1 dispatcher can provide prearrival instructions and direct the caller to provide CPR if needed.

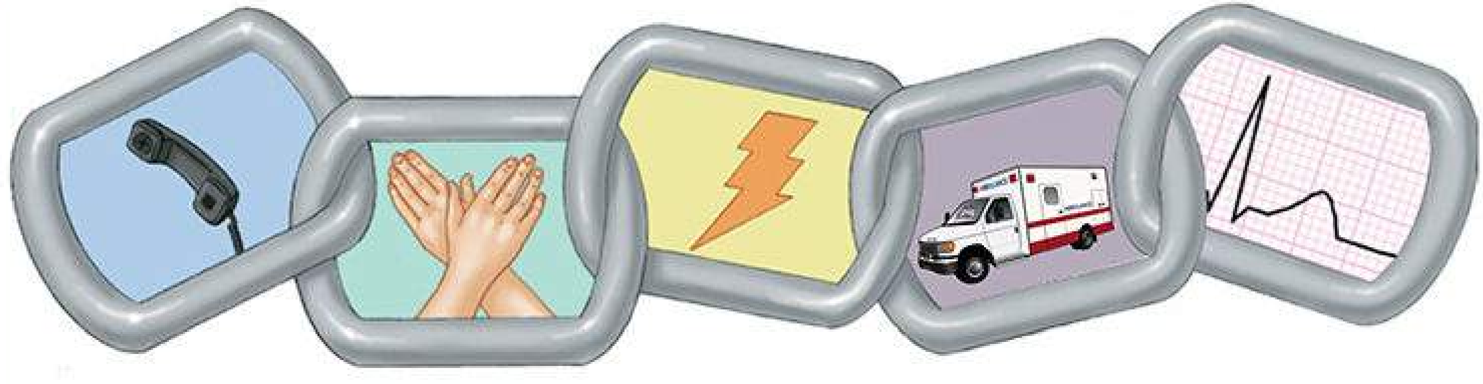


Figure 13-4 The five links of the chain of survival.

2. **Immediate, high-quality CPR.** The initiation of immediate CPR by a bystander is essential for successful resuscitation of a person in cardiac arrest. CPR will keep blood, and therefore oxygen, flowing to the vital organs to keep the patient alive until the other components of the chain are available. The more people trained in CPR in the community, the better the chances of CPR being administered quickly to a person in cardiac arrest. Immediate, high-quality CPR markedly increases the patient's chance of survival, whereas a delay in CPR leads to poor patient outcomes. The lay public as well as emergency responders should all be trained in CPR. Unfortunately, many bystanders are hesitant to perform CPR on a stranger for fear of contracting a disease from mouth-to-mouth breathing, or out of fear of liability. A perception that bystander CPR involves both mouth-to-mouth breathing and chest compressions persists. Laypeople should be educated in performing compression-only (hands-only) CPR.

   For chest compressions to be most effective, they must be given hard and fast. The AHA recommends that compressions be started as quickly as possible after onset of cardiac arrest. Compressions should be between 2 and 2.4 inches in depth (5 to 6 cm) and given at a rate of 100 to 120 per minute. The chest should completely recoil between each compression to maximize blood return to the heart. The rescuer should never lean on the chest between compressions. Interruptions between compressions for any reason should be minimized.
3. **Rapid defibrillation.** Provided that immediate, high-quality CPR with minimal interruption is performed, early defibrillation offers the best opportunity to achieve a successful patient outcome. Automated external defibrillators (AEDs) have become readily available in many schools, fitness clubs, concert venues, sports arenas, government buildings, and other mass gathering places. The simple design of the AED makes it easy for emergency medical providers and laypeople to use with very little training.
4. **Basic and advanced emergency medical services.** This link in the chain describes care provided by EMTs and ALS providers before the patient arrives at the ED. Such care includes continuing high-quality CPR; basic airway management (ie, oral airway insertion, BVM ventilation); advanced airway management (ie, endotracheal [ET] intubation or use of supraglottic airway devices); manual defibrillation; vascular access; transcutaneous pacing; and administration of medications. In addition to the care provided in the prehospital setting, be familiar with the cardiac resuscitation centers in your service area. Your agency should implement a process to ensure early notification and transport to the appropriate receiving facility.
5. **Advanced life support and postarrest care.** After your team delivers the patient to the ED, further cardiopulmonary and neurologic support is provided to improve the patient's recovery when indicated. This support can include additional medication therapy to support blood pressure; targeted temperature management (ie, therapeutic hypothermia); maintenance of blood glucose levels; cardiac catheterization; an electroencephalogram to detect seizure activity; and admission to the intensive care unit for critical care management.

If any one of the links in the chain is not maintained, then the patient is more likely to die. For example, few patients survive cardiac arrest if CPR is not administered within the first few minutes. Likewise, if the time from cardiac arrest to defibrillation is more than 10 minutes, the chance of survival is minimal. The patient's best chance of survival occurs when all links in the chain are continuously maintained.

Assessing the Need for BLS

As always, begin by surveying the scene. Is the scene safe? How many patients are present? What is your initial impression of the patient(s)? Are bystanders present who may have additional information? What is the mechanism of injury or nature of illness? Do you suspect trauma? If you were dispatched to the scene, then does the dispatch information match what you see?

Because of the urgent need to start CPR in a pulseless, nonbreathing patient, you must complete a primary assessment as soon as possible and begin CPR, starting with chest compressions. The first step is to determine unresponsiveness. Gently tap the patient on the shoulder and shout, "Are you okay?" **Figure 13-5**. Clearly, a patient who is responsive does not need CPR. A person who is unresponsive may or may not need CPR. Continue your assessment by simultaneously checking for breathing and a pulse; this step should take no more than 10 seconds. If the patient is in cardiac arrest, then begin CPR immediately.

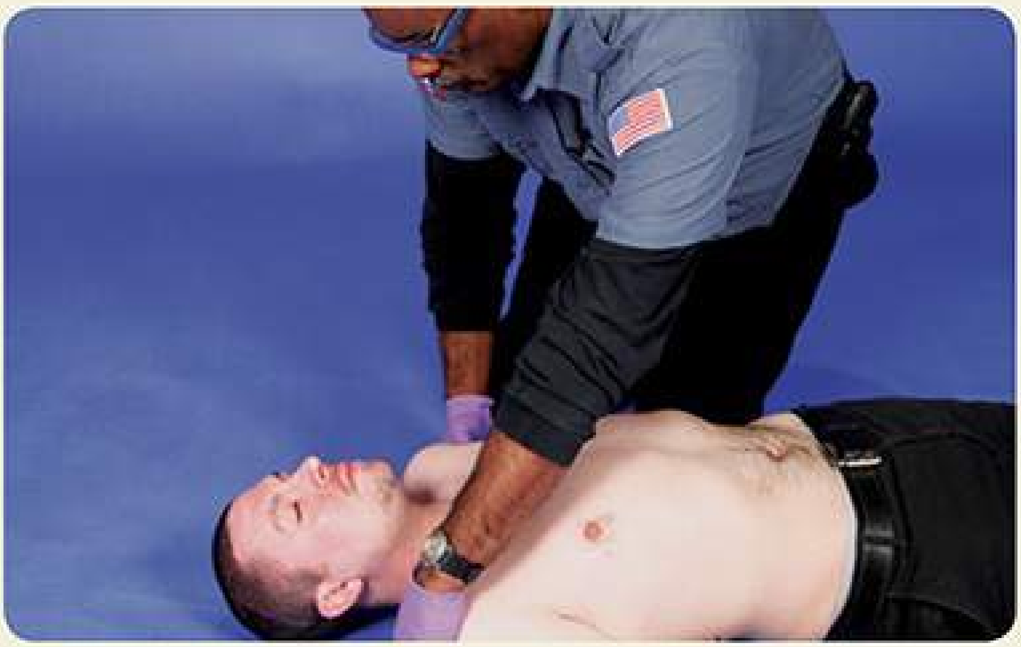


Figure 13-5 Assess an unresponsive patient by first attempting to rouse him or her by tapping on the shoulder.

In some EMS services, EMTs respond in squad units, before the ambulance. If this is the case in your area, then update the responding crew via two-way radio if possible. In other cases, you may encounter a cardiac arrest patient while off duty. If you are alone and off duty, use your mobile phone to call 9-1-1. Recall from Chapter 3, *Medical, Legal, and Ethical Issues,* that you must be familiar with the laws and policies that apply in your service area regarding your duty to act. If you are alone and do not have a mobile phone, then leave the patient to call 9-1-1 and then return to begin CPR. If you choose to intervene while off duty, then you must continue to provide competent care until an equal or higher medical authority assumes care of the patient.

Basic Principles of BLS

The basic principles of BLS are the same for infants, children, and adults. For the purposes of BLS, anyone younger than 1 year is considered an infant. A child is between 1 year of age and the onset of puberty (approximately 12 to 14 years of age), as signified by breast development in girls and underarm, chest, and facial hair in boys. Adulthood is from the onset of puberty and older. Children vary in size. Some small children may best be treated as infants, some larger children as adults. There are two basic differences in providing CPR for infants, children, and adults. The first is that the emergencies in which infants and children require CPR usually have different underlying causes. The second is that there are anatomic differences in adults, children, and infants, such as smaller airways in infants and children than in adults.

Although cardiac arrest in adults usually occurs before respiratory arrest, the reverse is true in infants and children. In most cases, cardiac arrest in children results from respiratory arrest. If untreated, respiratory arrest will quickly lead to cardiac arrest and death. Respiratory arrest in infants and children has a variety of causes, discussed later in this chapter.

Automated External Defibrillation

Most prehospital cardiac arrests occur as the result of a sudden cardiac rhythm disturbance (dysrhythmia), such as ventricular fibrillation (V-fib) or pulseless ventricular tachycardia (V-tach). The normal heart rhythm is known as normal sinus rhythm. V-fib is the disorganized quivering of the ventricles, resulting in no forward blood flow and a state of cardiac arrest. V-tach is a rapid contraction of the ventricles that does not allow for normal filling of the heart. As mentioned previously, according to the AHA, early defibrillation is the link in the chain of survival that is most likely to improve survival rates. The likelihood of survival decreases rapidly over time as long as V-fib or pulseless V-tach persists.

When a patient is in cardiac arrest, begin CPR, starting with high-quality chest compressions, and apply an AED as soon as it is available. If indicated, then defibrillate immediately. Chapter 16, *Cardiovascular Emergencies*, covers AED use in detail.

Words of Wisdom

If you witness a patient's cardiac arrest and an AED is available, then deploy the AED immediately and then begin CPR. However, if you did not witness the patient's cardiac arrest or if an AED is unavailable, then perform CPR and apply the AED as soon as it is available. If two or more rescuers are present, one rescuer should begin CPR while the other prepares to defibrillate using the AED.

AED Usage in Children

AEDs can safely be used in children using the pediatric-sized pads and a dose-attenuating system (energy reducer). However, if these items are unavailable, use adult-sized AED pads. Apply the AED to infants or children after the first five cycles of CPR have been completed. Recall that cardiac arrest in children is usually the result of respiratory failure; therefore, oxygenation and ventilation are vitally important. After the first five cycles of CPR, use the AED to deliver shocks in the same manner as with an adult patient.

If the patient is an infant (between 1 month and 1 year of age), then a manual defibrillator is preferred to an AED; however, this is an ALS skill. As with any cardiac arrest situation, call for ALS backup immediately. If ALS backup with a manual defibrillator is unavailable, then an AED equipped with pediatric-sized pads and a dose attenuator is preferred. If neither is available, then use an AED with adult-sized pads.

If you use adult-sized AED pads on an infant or small child, then do not cut the pads to adjust the size. Instead, use the anterior-posterior placement, following the manufacturer's recommendation.

Words of Wisdom

AEDs are becoming more accessible in the community. Be familiar with your local protocols on pediatric defibrillation. Your service may use a pediatric AED or an AED with a pediatric adapter.

Remember, if the child is past the onset of puberty, follow the adult CPR sequence, including the use of adult-sized AED pads.

Special AED Situations

It is essential to ensure the safety of yourself, others at the scene, and the patient. As such, keep the following factors in mind when using an AED.

Pacemakers and Implanted Defibrillators

You may encounter a patient who has an automated implanted cardioverter-defibrillator (AICD) or pacemaker that delivers shocks directly to the heart if necessary. These devices are used in patients who are at a high risk for certain cardiac dysrhythmias and cardiac arrest. It is easy to recognize AICDs or pacemakers because they create a hard lump beneath the skin, usually on the upper left side of the chest (just below the clavicle). If the AED pads are placed directly over the device, then the effectiveness of the shock delivered by the AED may be reduced, and the shock could potentially damage the implanted device. Therefore, if you identify an AICD or pacemaker, then you should place the AED pads at least 1 inch (2.5 cm) away from the device.

Occasionally, the implanted device will deliver shocks to the patient. If you observe the patient's muscles twitching as if he or she was just shocked, then continue CPR and wait 30 to 60 seconds before delivering a shock from the AED.

Wet Patients

Water conducts electricity. Therefore, the AED should not be used in water. If the patient's chest is wet, then the electrical current may move across the skin rather than between the pads to the patient's heart. If the patient is submerged in water, then pull him or her out of the water and quickly dry the skin before attaching the AED pads. Do not delay CPR to dry the patient thoroughly; instead, quickly wipe off as much moisture as possible from the chest. If the patient is lying in a small puddle of water or in the snow, the AED can be used, but again, the patient's chest should be quickly dried as much as possible.

Transdermal Medication Patches

You may encounter a patient who is receiving medication through a transdermal medication patch, such as nitroglycerin. The medication is absorbed through the skin. The patch could reduce the flow of the electrical current from the AED to the heart and may burn the skin. If the medication patch interferes with AED pad placement, then remove the patch with your gloved hands and wipe the skin to remove any residue prior to attaching the AED pad.

Words of Wisdom

Be familiar with social media platforms and mobile phone dispatch systems used in your service area. For example, free smartphone apps are available that use global positioning system (GPS) technology to alert CPR-trained subscribers that a nearby person is in cardiac arrest. Social media notification systems have not been shown to improve survival from out-of-hospital cardiac arrest. However, the potential benefit of increased bystander-initiated CPR makes it reasonable for you to advocate for the use of such technology.

Positioning the Patient

For CPR to be effective, the patient must be lying supine on a firm, flat surface, with enough clear space around the patient for two rescuers to perform CPR and use the AED. If the patient is crumpled up or lying facedown (prone), then you will need to move him or her to a supine position. Be mindful that you cannot rule out a spinal injury in an unresponsive patient; therefore, protect the patient's neck and move him or her as a unit, without twisting **Figure 13-6**. If the patient is found in a bed, then move him or her to the floor.

If possible, log roll the patient onto a long backboard as you position him or her for CPR; do this as quickly and safely as possible. A backboard will provide support during transport and emergency care. After the patient is properly positioned, you can easily assess the patient to determine whether CPR and defibrillation are necessary.

Check for Breathing and a Pulse

After you have determined that the patient is unresponsive, quickly check for breathing and a pulse. These assessments can occur simultaneously and should take no longer than 10 seconds in total.

Visualize the chest for signs of breathing while palpating for a carotid pulse. Feel for the carotid artery by locating the larynx at the front of the neck and then sliding two fingers toward one side (the side closest to you). The pulse is felt in the groove between the larynx and sternocleidomastoid muscle, with the pads of the index and middle fingers held side by side **Figure 13-7**. Light pressure is sufficient to palpate the pulse.

Figure 13-6 Ensure that the patient is in a supine position. Protect the patient's neck in case a spinal injury is present, and move him or her as a unit, without twisting.

Provide External Chest Compressions

If the patient is not breathing (or is breathing only slowly or occasionally, known as agonal gasps) and does not have a pulse, then begin CPR, starting with chest compressions. It is critical to perform compressions properly. Chest compressions are administered by applying rhythmic pressure and relaxation to the lower half of the sternum. The heart is located slightly to the left of the middle of the chest between the sternum and the spine **Figure 13-8**. Compressions squeeze the heart, thereby acting as a pump to circulate blood. Allow the chest to completely recoil between compressions, which enhances blood return to the heart. Do not lean on the chest between compressions. When artificial ventilation is provided, the blood that is circulated through the lungs during chest compressions is likely to receive adequate oxygen to maintain tissue perfusion. However, even when external chest compressions are performed properly, they circulate only one-third of the blood that is normally pumped by the heart.

Figure 13-7 Feel for the carotid artery by locating the larynx, then slide your index and middle fingers toward one side. You can feel the pulse in the groove between the larynx and sternocleidomastoid muscle.

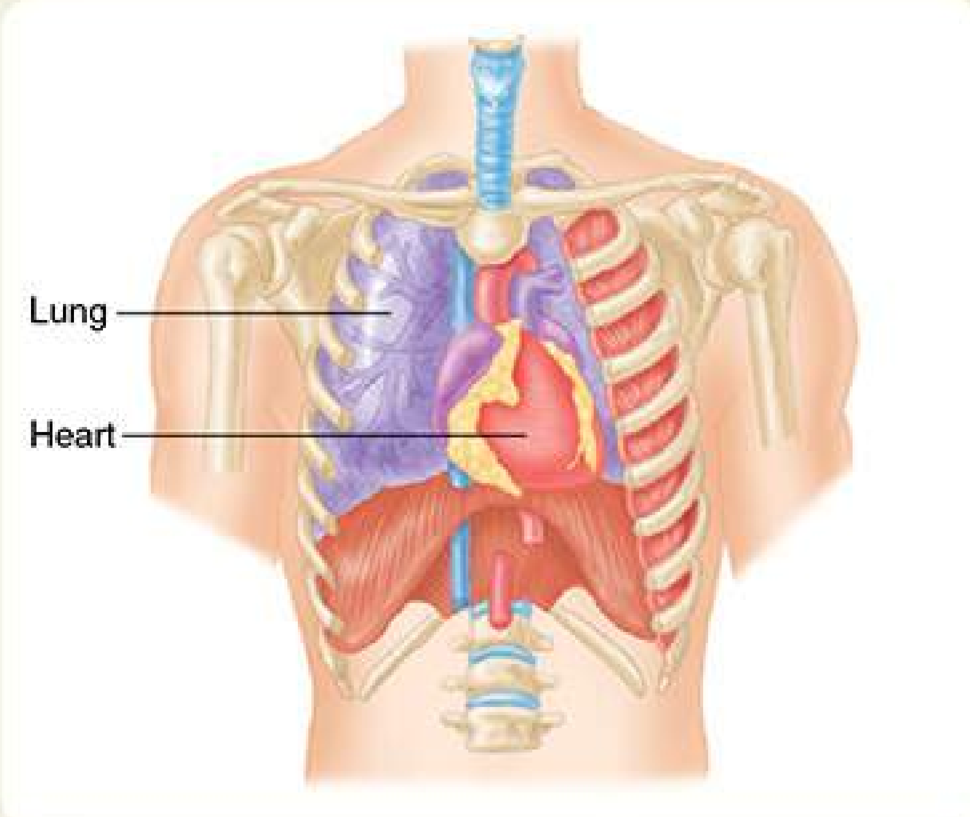


Figure 13-8 The heart lies slightly to the left of the middle of the chest between the sternum and spine.

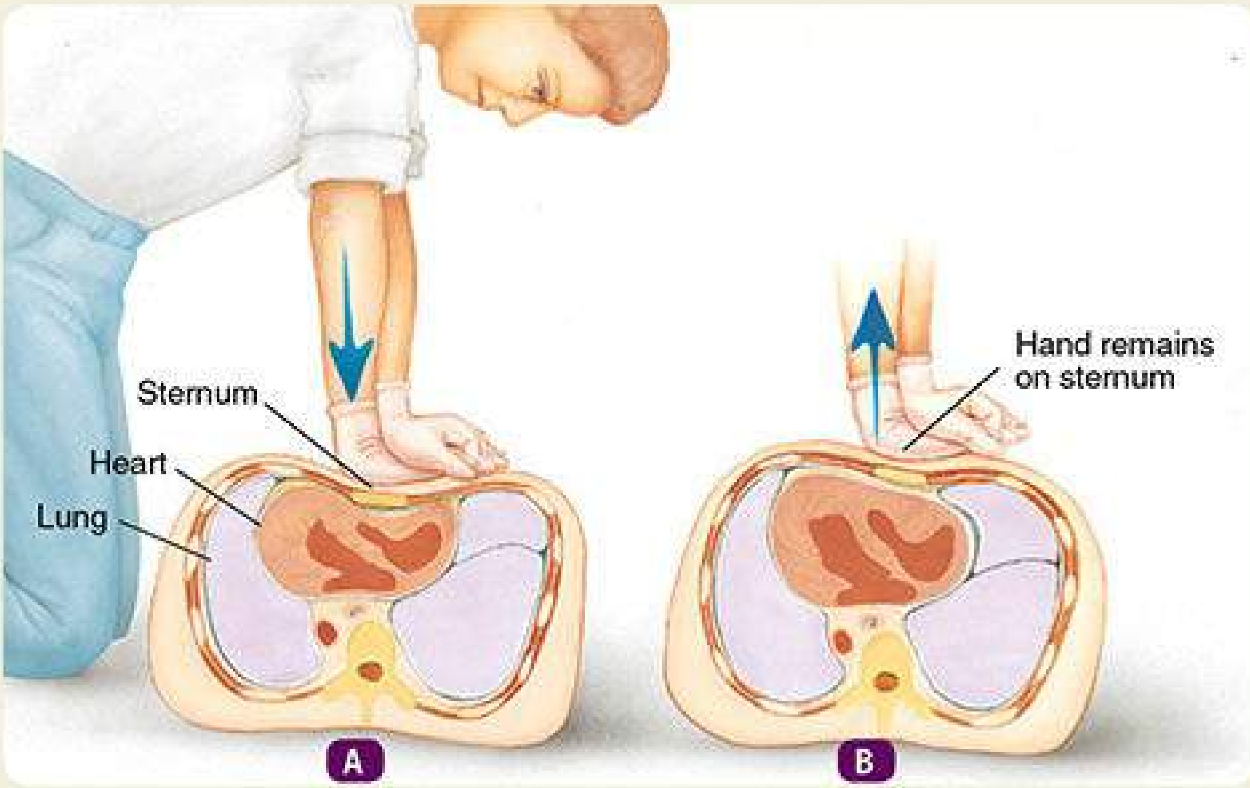


Figure 13-9 **A.** Compression and relaxation should be rhythmic and of equal duration (a 1:1 ratio). **B.** Pressure on the sternum must be released so that the sternum can return to its normal resting position between compressions.

A & B: © Jones & Bartlett Learning.

▶ Proper Hand Position and Compression Technique

With the adult patient, correct hand position is established by placing the heel of one hand on the sternum in the center of the chest (lower half of the sternum). Follow the steps in **Skill Drill 13-1**:

1. Take standard precautions.
2. Place the heel of one hand on the center of the chest over the lower half of the sternum **Step 1**.
3. Place the heel of your other hand over the first hand **Step 2**.
4. With your arms straight, lock your elbows and position your shoulders directly over your hands, so that the thrust of each compression is straight down on the sternum. Your technique may be improved or made more comfortable if you interlock the fingers of your lower hand with the fingers of your upper hand; either way, keep your fingers off the patient's ribs.
5. Depress the sternum to a depth of 2 inches to 2.4 inches (5 cm to 6 cm), using direct downward movement and then rising gently upward **Step 3**. This motion allows pressure to be delivered vertically from your shoulders. Downward pressure produces a compression that must be followed immediately by an equal period of relaxation. The ratio of time devoted to compression versus relaxation should be 1:1. It is important that you allow the chest to return to its normal position; do not lean on the patient's chest between compressions. Compression and relaxation should be of equal duration.

Complications from chest compressions are rare but can include fractured ribs, a lacerated liver, and a fractured sternum. Although these injuries cannot be entirely avoided, you can minimize the chance that they will occur if you use good technique and proper hand placement. Your motions must be smooth, rhythmic, and uninterrupted **Figure 13-9A**. Short, jabbing compressions are not effective in producing artificial blood flow. Do not remove the heel of your hand from the patient's chest during relaxation, but make sure that you completely release pressure on the sternum so that it can return to its normal resting position between compressions Figure 13-9B.

Skill Drill 13-1 Performing Chest Compressions

Step 1

Take standard precautions. Place the heel of one hand on the center of the chest (lower half of the sternum).

Step 2

Place the heel of your other hand over the first hand.

Step 3

With your arms straight, lock your elbows and position your shoulders directly over your hands. Depress the sternum at a rate of 100 to 120 compressions per minute, and to a depth of 2 inches to 2.4 inches (5 cm to 6 cm) using a downward movement. Allow the chest to return to its normal position; do not lean on the chest between compressions. Compression and relaxation should be of equal duration.

Words of Wisdom

When performing chest compressions on an adult, compress the chest to a depth of at least 2 inches (5 cm), but not more than 2.4 inches (6 cm). It is difficult to achieve such a precise depth without the use of a monitoring device that provides immediate feedback Figure 13-10. If such a device is available to you, then use it.

It is more dangerous to compress the chest too lightly than it is to compress too forcefully. Compressing hard can lead to fatigue, and as you become tired, your compressions will become shallower. Therefore, it is critical to push hard and push fast and switch compressors (the person providing chest compressions) every 2 minutes—even if the compressor does not feel tired. CPR feedback devices help ensure a consistent rate and depth of compressions.

Figure 13-10 CPR feedback devices help ensure a consistent rate and depth of compressions.

Words of Wisdom

Chest compressions create blood flow to the heart through filling of the coronary arteries. Every time compressions are stopped, blood flow—and thus, perfusion—to the heart (and brain) drops to zero. It takes 5 to 10 compressions to reestablish effective blood flow to the heart after chest compressions are resumed. Avoid frequent or prolonged interruptions in chest compressions, which lead to poor patient outcomes.

Opening the Airway and Providing Artificial Ventilation

Opening the Airway in Adults

Without an open airway, rescue breathing will not be effective. As discussed in Chapter 10, *Airway Management*, the two techniques for opening the airway in adults are the head tilt–chin lift maneuver and the jaw-thrust maneuver. These manual maneuvers are designed to bring the tongue forward and off the back of the throat. The **head tilt–chin lift maneuver** is effective for opening the airway in most patients when there is no indication of a spinal injury **Figure 13-11**.

In patients who have not sustained trauma, this simple maneuver is sometimes all that is required for the patient to resume breathing. If the patient has any foreign material or vomitus in the mouth, then quickly remove it. Remove any liquid materials from the mouth with a suction device; use your hooked index finger to remove any solid material. **Figure 13-12** reviews how to perform the head tilt-chin lift maneuver in an adult.

If spinal injury is suspected, then use the **jaw-thrust maneuver**. Do not tilt the patient's head back, because you want to minimize movement of the patient's neck. To perform a jaw-thrust maneuver, place your fingers behind the angles of the patient's lower jaw and then move the jaw upward. Keep the head in a neutral position as you move the jaw upward and open the mouth. If the patient's mouth remains closed, then you can use your thumbs to pull down the patient's lower lip to allow breathing. If the jaw thrust fails to open the airway, then the head tilt–chin lift should be used to open the airway. An open airway is the primary goal when caring for trauma patients, and you must ensure an open airway to improve survival. **Figure 13-13** reviews how to perform the jaw-thrust maneuver in an adult.

YOU are the Provider — PART 2

You arrive at the scene and find two bystanders performing CPR on the patient, who appears to be in his late 40s. A second BLS ambulance is en route to the scene and will arrive in about 5 minutes. You perform a primary assessment as your partner opens the AED.

Recording Time: 0 Minutes	
Appearance	Motionless; cyanosis of the face
Level of consciousness	Unresponsive
Airway	Open; clear of secretions or foreign bodies
Breathing	Absent
Circulation	No carotid pulse; skin, cool and pale; no gross bleeding

Your partner takes over performing CPR. One of the bystanders tells you that the patient was about to get into his vehicle when he suddenly grabbed his chest, slumped against the vehicle, and eased himself to the ground. By the time the bystander reached him, he was unresponsive and not breathing. The bystander further tells you that he immediately called 9-1-1 and then began CPR.

3. What links in the chain of survival have been maintained at this point?

4. Why is it so critical to minimize interruptions in CPR?

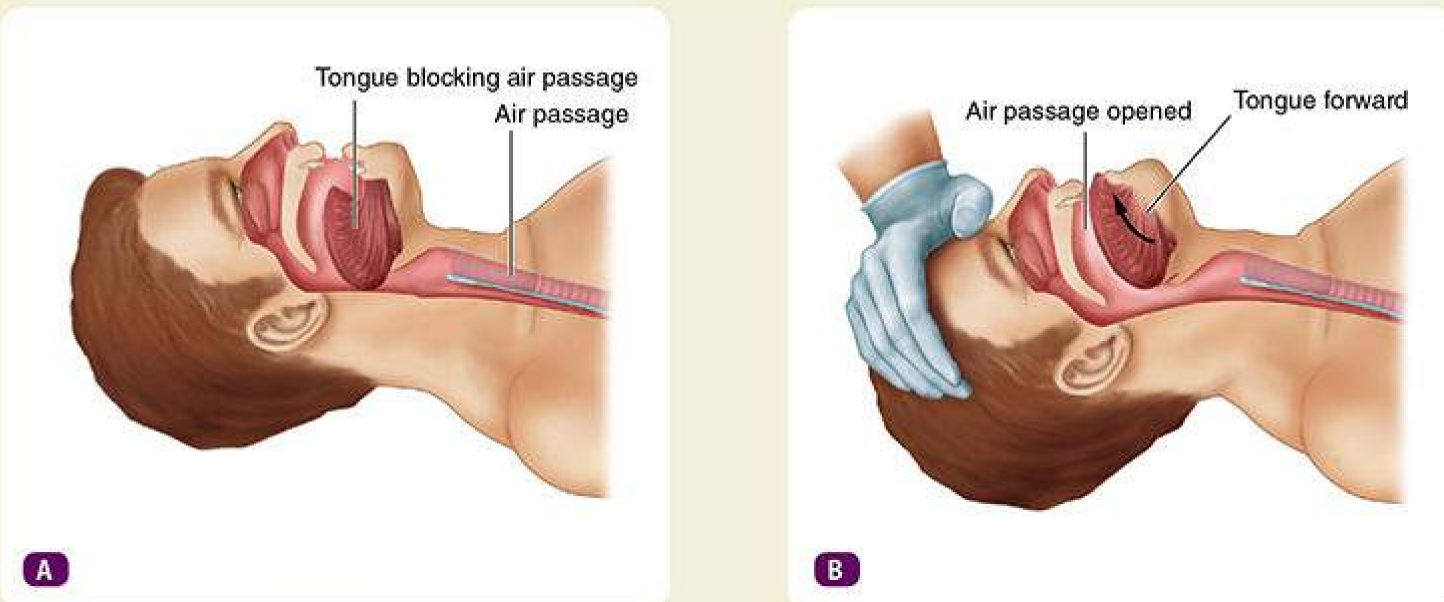


Figure 13-11 **A.** Relaxation of the tongue back into the throat causes airway obstruction. **B.** The head tilt–chin lift maneuver combines two movements of opening the airway; head tilt is shown here.

Figure 13-12 To perform the head tilt–chin lift maneuver, place one hand on the patient's forehead and apply firm backward pressure with your palm to tilt the head back. Next, place the tips of the index and middle fingers of your other hand under the lower jaw near the bony part of the chin. Lift the chin upward, bringing the entire lower jaw with it, helping to tilt the head back.

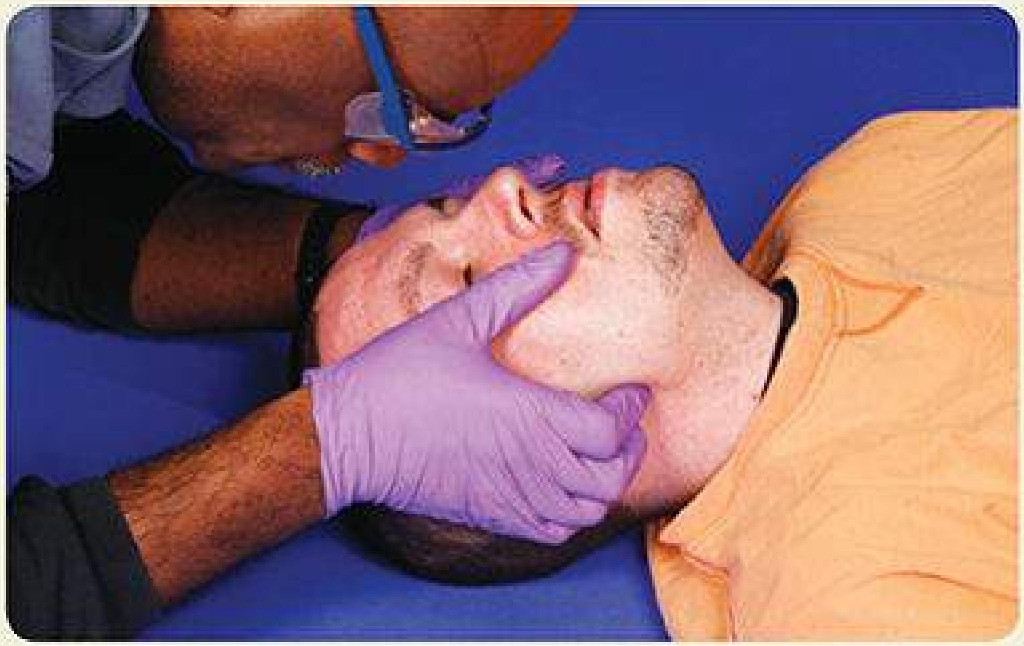


Figure 13-13 To perform the jaw-thrust maneuver, maintain the head in neutral alignment and place your fingers behind the angles of the lower jaw, and move the jaw upward. The completed maneuver should look like this.

Recovery Position

If the patient is breathing adequately on his or her own and has no signs of injury to the spine, hip, or pelvis, then place him or her in the **recovery position**. This position helps to maintain a clear airway in a patient with a decreased level of consciousness who has not sustained traumatic injuries and is breathing adequately on his or her own **Figure 13-14**. It also allows vomitus to drain from the mouth. Roll the patient onto his or her side so that the head, shoulders, and torso move as a unit, without twisting. Then place the top hand under his or her cheek. Never place a patient who has a suspected head or spinal injury in the recovery position because in this position, the spine is not aligned, spinal stabilization is not possible, and further spinal injury could result. Likewise, if the patient has a hip or pelvic injury, then positioning the patient on his or her side could cause fractured bone ends to compress or sever large arteries and veins, resulting in severe internal bleeding. You should suspect an associated spinal injury in any unresponsive patient with a hip or pelvic injury until proven otherwise.

Figure 13-14 The recovery position is used to maintain an open airway in an adequately breathing patient with a decreased level of consciousness who has no spine, hip, or pelvic injuries. It allows vomitus, blood, and any other secretions to drain from the mouth.

Breathing

A lack of oxygen (hypoxia), combined with too much carbon dioxide in the blood (hypercarbia), is lethal. To correct this condition, you must provide slow, deliberate ventilations that last 1 second. This gentle, slow method of ventilating the patient prevents air from being forced into the stomach (discussed later in the chapter).

Provide Artificial Ventilations

Ventilations can be given by one or two EMS providers. Use a barrier device when you administer ventilations in the prehospital environment, such as a pocket mask with a one-way valve or a BVM **Figure 13-15**. Use devices that supply supplemental oxygen when possible. Devices with an oxygen reservoir will provide higher percentages of oxygen to the patient. Regardless of whether you ventilate the patient with or without supplemental oxygen, you should observe the chest for visible rise to assess the effectiveness of your ventilations.

Figure 13-15 When you provide ventilations, use a BVM (shown here) or a pocket mask with one-way valve.

The specific steps of CPR are discussed later in this chapter. Adult BLS procedures are summarized in Table 13-1. Pediatric BLS procedures are summarized in Table 13-2 later in this chapter. Resuscitation of a neonate is discussed in Chapter 33, *Obstetrics and Neonatal Care*.

Recall from Chapter 10, *Airway Management*, that **hyperventilation** (ventilating too fast or with too much force) may cause increased intrathoracic pressure (pressure inside the chest cavity). Increased intrathoracic pressure reduces the amount of blood that returns to the heart, thus decreasing the effectiveness of chest compressions and resulting in the heart and brain receiving decreased amounts of oxygen.

Words of Wisdom

Ventilation is the physical act of moving air in and out of the lungs. Ventilation is required for adequate respiration. Examples of conditions that hinder ventilation include trauma such as flail chest, foreign body airway obstruction, and an injury to the spinal cord that disrupts the phrenic nerve that innervates the diaphragm.

Table 13-1 Review of Adult BLS Procedures

Procedure	
Circulation	
Pulse check	Carotid artery
Compression area	In the center of the chest, in between the nipples
Compression depth	2 in. to 2.4 in. (5 cm to 6 cm)
Compression rate	100 to 120/min
Compression-to-ventilation ratio (until advanced airway is inserted)	30:2
Foreign body obstruction	Responsive: abdominal thrusts (Heimlich maneuver); chest thrusts if patient is pregnant or has obesity Unresponsive: CPR
Airway	
Airway positioning	Head tilt–chin lift; jaw-thrust maneuver if spinal injury is suspected
Breathing	
Ventilations	1 breath every 5 to 6 seconds (10 to 12 breaths/min); about 1 second per breath; visible chest rise
Ventilations with advanced airway placed	1 breath every 6 seconds (a rate of 10 breaths/min)

Stoma Ventilation

Patients who have undergone a laryngectomy (surgical removal of the larynx) often have a permanent tracheal stoma at the midline in the neck. In this case, a stoma is an opening that connects the trachea directly to the skin Figure 13-16. Because it is at the midline, the stoma is the only opening that will move air into the patient's lungs. Patients with a stoma should be ventilated with a BVM or pocket mask device placed directly over the stoma.

Not all stomas are disconnected from the nose and mouth. If air leakage through the nose and mouth interferes with ventilation through the stoma, then cover the nose and mouth with your hand to make a seal. Use a pediatric or infant mask to ventilate through the stoma.

Gastric Distention

Artificial ventilation may result in the stomach becoming filled with air, a condition called gastric distention. Although it occurs more easily in children, this condition also happens frequently in adults. Gastric distention is likely to occur if you hyperventilate the patient. If you ventilate too forcefully, or if the patient's airway is not opened adequately, then the excess gas opens up the collapsible tube (the esophagus) and allows gas to enter the stomach. Therefore, it is important for you to give slow, gentle breaths. Such breaths are also more effective in ventilating the lungs. Excessive inflation of the stomach is dangerous because it can cause the patient to vomit during CPR. It can also reduce lung volume by elevating the diaphragm.

Figure 13-16 **A.** This stoma connects the trachea directly to the skin. **B.** Use a BVM or pocket mask device to ventilate a patient with a stoma.

A & B: © Jones & Bartlett Learning. Courtesy of MIEMSS.

If massive gastric distention interferes with adequate ventilation, then contact medical control. Check the airway again and reposition the patient, watch for rise and fall of the chest, and avoid giving forceful breaths. Have a suction unit available in case the patient vomits. Remember, mortality increases significantly if aspiration occurs. If an ALS provider is available, then he or she can insert an orogastric or nasogastric tube to decompress the stomach.

One-Rescuer Adult CPR

When you provide CPR alone, you must provide a continuous cycle of 30 chest compressions followed by 2 artificial ventilations (a ratio of 30:2). To perform one-rescuer adult CPR, follow the steps in Skill Drill 13-2:

1. Take standard precautions. Establish unresponsiveness and call for additional help; use your mobile phone if needed Step 1.
2. Position the patient properly (supine) on a flat surface.

3. Quickly visualize the chest for signs of breathing while simultaneously palpating for a carotid pulse. Take no more than 10 seconds in total to do this **Step 2**.
4. If pulse and breathing are absent, then perform CPR until an AED is available. Place your hands in the proper position for delivering external chest compressions, as described previously **Step 3**. Give 30 chest compressions at a rate of 100 to 120 per minute for an adult. Each set of 30 compressions should take about 17 seconds.
5. Open the airway according to your suspicion of spinal injury **Step 4**.
6. Give two ventilations of 1 second each and observe for visible chest rise **Step 5**.
7. Continue cycles of 30 chest compressions and two ventilations until additional personnel arrive or the patient starts to move.

Two-Rescuer Adult CPR

You and your team should be able to perform one-rescuer and two-rescuer CPR with ease. Two-rescuer CPR is always preferable because it is less tiring and it facilitates effective chest compressions. In fact, a team approach to CPR and AED use is far superior to the one-rescuer approach. Once one-rescuer CPR is in progress, additional rescuers can be added to the procedure easily. Before assisting with CPR, a second rescuer should apply the AED and then set up airway adjuncts, including a BVM and suction, and insert an oropharyngeal (oral) airway. If CPR is in progress, then the second rescuer should enter the procedure after a cycle of 30 compressions and two ventilations. To perform two-rescuer adult CPR, follow the steps in **Skill Drill 13-3**:

1. Take standard precautions. Establish unresponsiveness while your partner moves to the patient's side to be ready to deliver chest compressions **Step 1**.
2. If the patient is unresponsive, then simultaneously check for breathing and palpate for a carotid pulse; take no more than 10 seconds to do this **Step 2**.
3. If the patient is not breathing and has no pulse, then begin CPR, starting with chest compressions. Give 30 chest compressions at a rate of 100 to 120 per minute. If an AED is available, then apply it and follow its voice prompts. Do *not* interrupt chest compressions to apply the AED pads **Step 3**.
4. Open the airway according to your suspicion of spinal injury **Step 4**.
5. Give two ventilations of 1 second each and observe for visible chest rise **Step 5**.
6. Perform five cycles of 30 compressions and two ventilations (this should take about 2 minutes). After 2 minutes of CPR, the compressor and ventilator should switch positions. The switch time should take no longer than 5 seconds. Reanalyze the patient's cardiac rhythm with the AED every 2 minutes and deliver a shock if indicated.
7. Continue cycles of 30 chest compressions and two ventilations until ALS providers take over or the patient starts to move.

Words of Wisdom

When CPR is in progress on a patient who has an advanced airway device in place (ie, ET tube, King LT supraglottic airway, i-gel supraglottic airway), cycles of CPR are not indicated. Compressions should be continuous at a rate of 100 to 120 per minute and ventilations should occur at a rate of one breath every 6 seconds (10 breaths/min). Do not attempt to synchronize compressions and ventilations; do not pause between compressions to deliver breaths.

Skill Drill 13-2 Performing One-Rescuer Adult CPR

Step 1

Take standard precautions. Establish unresponsiveness and call for help. Use your mobile phone if needed.

Step 2

Check for breathing and a carotid pulse for no more than 10 seconds.

Step 3

If breathing and pulse are absent, then perform CPR until an AED is available. Give 30 chest compressions at a rate of 100 to 120 per minute.

Step 4

Open the airway according to your suspicion of spinal injury.

Step 5

Give two ventilations of 1 second each and observe for visible chest rise. Continue cycles of 30 chest compressions and two ventilations until additional personnel arrive or the patient starts to move.

Skill Drill 13-3 Performing Two-Rescuer Adult CPR

Step 1

Take standard precautions. Establish unresponsiveness and take positions.

Step 2

Check for breathing and a carotid pulse.

Step 3

Begin CPR, starting with chest compressions. Give 30 chest compressions at a rate of 100 to 120 per minute. If the AED is available, then apply it and follow the voice prompts.

Step 4

Open the airway according to your suspicion of spinal injury.

Step 5

Give two ventilations of 1 second each and observe for visible chest rise. Continue cycles of 30 chest compressions and two ventilations (switch roles every five cycles [2 minutes]) until ALS providers take over or the patient starts to move. Reanalyze the patient's cardiac rhythm with the AED every 2 minutes and deliver a shock if indicated.

Switching Positions

It is critical to switch rescuers during CPR to maintain high-quality compressions. After five cycles of CPR (about 2 minutes), the rescuer providing compressions to the patient (the compressor) will begin to tire, and compression quality will decrease. Therefore, compressors should switch positions every 2 minutes. If there are only two rescuers on scene, then the two rescuers will alternate positions. If additional rescuers are available, the compressor should rotate every 2 minutes. During switches, every effort should be made to minimize the time that no compressions are being administered. It should take less than 5 seconds to switch compressors.

The switch between the two rescuers can be easily accomplished. Rescuer one (the first compressor) should finish the cycle of 30 compressions while the second rescuer moves to the opposite side of the chest and moves into position to begin compressions. Rescuer one should deliver two rescue breaths and then rescuer two should take over compressions by administering 30 chest compressions. Rescuer one will then deliver two ventilations and the CPR cycles will continue as needed until the next 2-minute mark (five cycles) is reached, at which time the process will be repeated.

A summary of how to manage cardiac arrest in adults is shown in **Figure 13-17**.

Devices and Techniques to Assist Circulation

The effectiveness of CPR depends on the amount of blood circulated throughout the body as a result of chest compressions. Even under ideal conditions, however, manual chest compressions cannot equate to normal cardiac output. In addition, factors such as rescuer fatigue or inaccurate depth or rate of compressions can further impede the resuscitation process. Before you consider the use of mechanical devices to assist circulation, ensure that your manual chest compressions are of consistently high quality.

Words of Wisdom

Many EMS systems have implemented a pit crew approach to the management of cardiac arrest. The term originated in motor racing, in which teams of technicians rapidly assess and repair vehicles in a matter of seconds. Following this model, each resuscitation team member is assigned a specific role before beginning care of the cardiac arrest patient. For example:

- EMT 1 will be the team leader.
- EMT 2 and EMT 3 will perform CPR.
- EMT 4 will operate the AED.

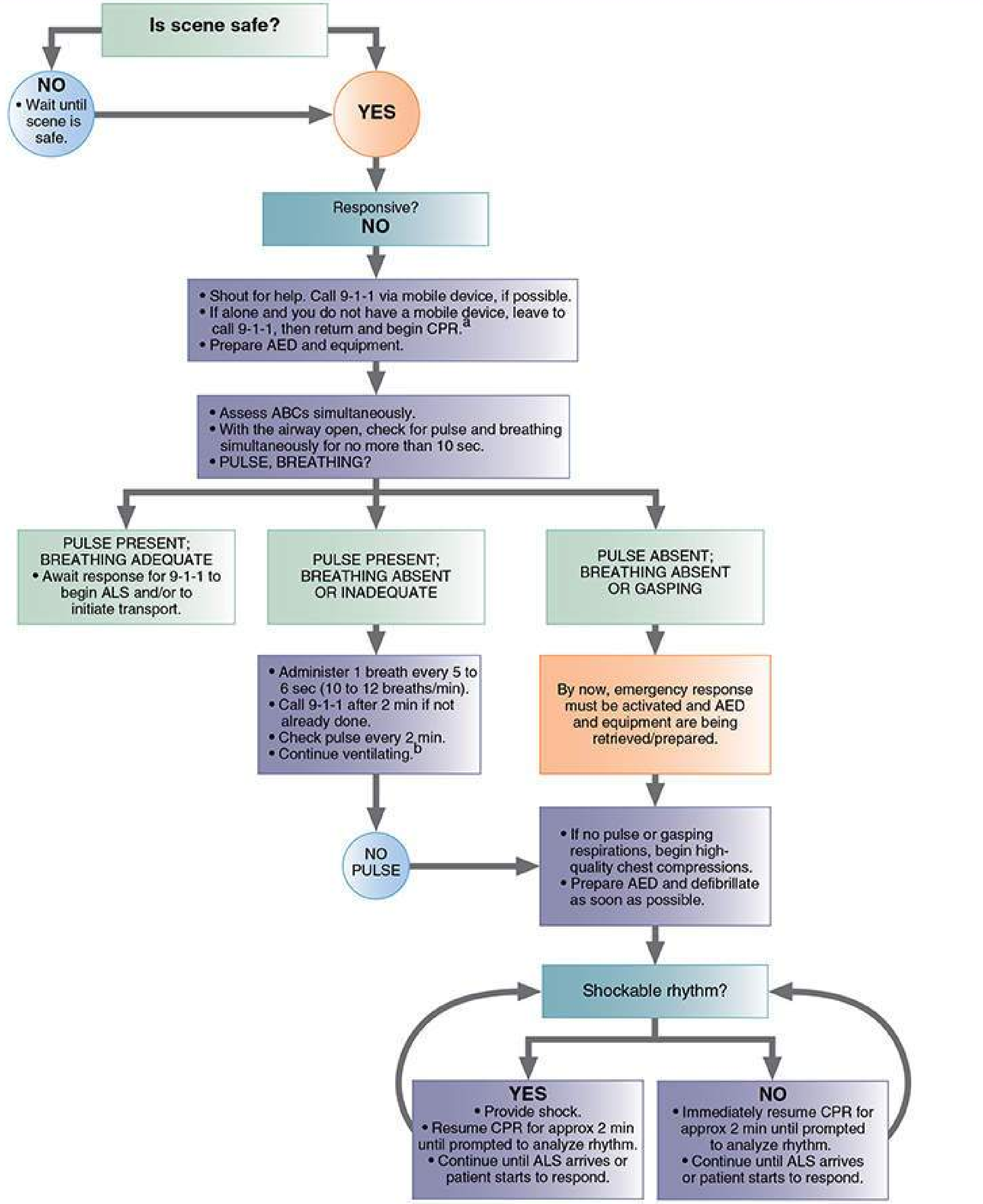
This model clarifies each team member's role and responsibilities, and minimizes confusion on the scene. If there are only two EMTs on scene initially—as is the situation in many cases—then a plan should be developed to integrate additional rescuers into the resuscitation effort as they arrive. This preplanned approach allows rescuers to accomplish multiple steps and assessments simultaneously, rather than the slower, sequential manner used by individual rescuers. Therefore, the pit crew model minimizes the time to first compression. The success of this team approach depends on preplanning, practice, and thorough familiarity with the cardiac arrest algorithm. See Chapter 41, A Team Approach to Health Care, for more information.

Special Populations

On occasion, you may encounter a patient who has a left ventricular assist device (LVAD). The LVAD is a mechanical pump that is implanted in the chest and helps pump blood from the left ventricle to the aorta. A tube from the device passes through the skin and is attached to an external power source that the patient wears on their belt or an over-the-shoulder harness. The LVAD is commonly implanted in patients with severe heart failure or in those who are awaiting a heart transplant. If the LVAD is working, then you will hear a humming sound when listening to the chest with a stethoscope. Blood flows continuously through the LVAD, and the more assistance the LVAD is providing to the heart, the weaker the patient's pulse will be. In some LVAD patients, you may not feel a pulse at all, even though they are responsive and alert. When transporting a patient who has an LVAD, be sure to bring all of the LVAD equipment with you and ensure that the receiving facility is capable of caring for the patient's specific needs.

You should know the location of LVAD patients in your service area. If possible, visit with the patient prior to any emergency to determine his or her specific device and to obtain instructions. Family members are usually knowledgeable about the device; use them as a source of information.

LVAD coordinators are usually available for consult 24 hours a day. These medical professionals typically work at the same facility that placed the device, so they should also be familiar with the patient. Follow your local protocols or contact medical control regarding the treatment of a patient with an LVAD.



[a]If the patient is a child or infant, perform 2 minutes of CPR if needed, then call 9-1-1.

[b]If life-threatening opioid overdose is suspected, administer naloxone, if available, per local protocols and see opioid life-threatening overdose algorithm in Chapter 21, *Toxicology*.

Figure 13-17 Adult cardiac arrest algorithm. Pediatric cardiac arrest follows the same algorithm with the exception of the compression depth and compression-to-ventilation ratio. When performing CPR on pediatric patients, compress to a depth of at least one-third the anterior-posterior diameter of the chest, at a ratio of 30:2 compressions to ventilations (one rescuer) or 15:2 compressions to ventilations (two rescuers).

Several mechanical devices are available to assist emergency responders in maximizing blood flow during CPR. Although improved patient outcomes have not yet been documented, these devices may be considered for use as an adjunct to CPR in select settings when used by properly trained personnel for patients in cardiac arrest in the prehospital or in-hospital setting. These specific settings include instances when limited rescuers are available, when CPR is prolonged, or when CPR is required in a moving ambulance.

Active Compression-Decompression CPR

Active compression-decompression CPR is a technique that involves compressing the chest and then actively pulling it back up to its neutral position or beyond (decompression). This technique may increase the amount of blood that returns to the heart, and thus, the amount of blood ejected from the heart during the compression phase. **Figure 13-18** shows an active compression-decompression CPR device. It features a suction cup that is placed in the center of the chest. After compressing the chest to the proper depth, the rescuer pulls up on the handle of the device to provide active decompression of the chest, thus ensuring that the chest returns to at least its neutral position or even beyond neutral.

Figure 13-18 An active compression-decompression CPR device.

Provided with permission by ZOLL Medical.

▶ Impedance Threshold Device

An **impedance threshold device (ITD)** is a valve device placed between the ET tube and a BVM; it may also be placed between the bag and mask if an ET tube is not in place. The ITD is designed to limit the air entering the lungs during the recoil phase between chest compressions **Figure 13-19**. This results in negative intrathoracic pressure that may draw more blood toward the heart, ultimately resulting in improved cardiac filling and circulation during each chest compression. The ITD may be considered when used together with devices that provide active compression-decompression CPR. It is *not* currently recommended for use with conventional CPR. If ROSC occurs, then the ITD should be removed. You should understand research trends regarding the effectiveness of the ITD.

Figure 13-19 An impedance threshold device.

Courtesy of Advanced Circulatory Systems, Inc.

Mechanical Piston Device

A **mechanical piston device** is a device that depresses the sternum via a compressed gas-powered or electric-powered plunger mounted on a backboard **Figure 13-20**. The patient is positioned supine on the backboard, with the piston positioned on top of the patient with the plunger centered over the patient's thorax in the same manner as with manual chest compressions. The device is then secured to the backboard.

The mechanical piston device allows rescuers to configure the depth and rate of compressions, resulting in consistent delivery. This frees the rescuer to complete other tasks and eliminates rescuer fatigue that results from continuous delivery of manual chest compressions. These devices have been available for many years. The latest versions of these devices offer you the option of providing compressions using a battery instead of an oxygen tank or a compressed air system, thus eliminating the tanks and hoses.

Load-Distributing Band CPR or Vest CPR

The **load-distributing band (LDB)** is a circumferential chest compression device composed of a constricting band and backboard **Figure 13-21**. The device is either electrically or pneumatically driven to compress the heart by putting inward pressure on the thorax.

As with the mechanical piston device, use of the LDB frees the rescuer to complete other tasks. The device weighs less than the early-version mechanical piston devices and can be easier to apply.

Figure 13-20 **A.** A mechanical piston device. **B.** The device in use.

A: Courtesy of LUCAS CPR (Physio Control Inc.); B: © Jones & Bartlett Learning.

YOU are the Provider — PART 2

With CPR ongoing, you open the AED pads and prepare to apply them to the patient's chest. You note that the patient has a medication patch on the right upper part of his chest. You also see a bulge with a scar over it on the left upper part of his chest. You apply the AED pads, analyze the patient's cardiac rhythm, and receive a "shock advised" message. After delivering the shock, you and your partner resume CPR. The backup ambulance arrives and one of the EMTs assesses the quality of your CPR.

Recording Time: 4 Minutes	
Level of consciousness	Unresponsive
Respirations	Absent (baseline); 2 breaths are being given after every 30 chest compressions; chest rise is visible with each breath
Pulse	Absent (baseline); femoral pulse is palpable with chest compressions
Skin	Pale
Blood pressure	Not measurable
Oxygen saturation (Spo_2)	Not measurable

5. Should you remove the medication patch or leave it in place? Why or why not?
6. What does the bulge and scar over the patient's left chest indicate? How will this affect the way you treat the patient?

Figure 13-21 A load-distributing band.

Provided with permission by ZOLL Medical.

Although a mechanical CPR device may be a reasonable alternative to conventional CPR in specific settings, manual chest compressions remain the standard of care. If your EMS service uses a mechanical CPR device, then it is critical to practice frequently to ensure that you can apply it rapidly. Remember to minimize interruptions to chest compressions while the device is being applied.

Infant and Child CPR

In most cases, cardiac arrest in infants and children follows respiratory arrest, which triggers hypoxia and **ischemia** (decreased oxygen supply) of the heart. Children consume oxygen two to three times as rapidly as adults, so you must first focus on opening the airway and providing artificial ventilation. Often, this will be enough to allow the child to resume spontaneous breathing and, thus, prevent cardiac arrest. Therefore, airway and breathing are the focus of pediatric BLS **Table 13-2**.

Table 13-2 Review of Pediatric BLS Procedures

Procedure	Infants (between age 1 month and 1 year[a])	Children (1 year to onset of puberty[b])
Circulation		
Pulse check	Brachial artery	Carotid or femoral artery
Compression area	Just below the nipple line	In the center of the chest, in between the nipples
Compression width	Two-finger technique or two-thumb-encircling-hands technique	Heel of one or both hands
Compression depth	At least one-third anterior-posterior diameter (about 1.5 in. [4 cm])	At least one-third anterior-posterior diameter (about 2 in. [5 cm])
Compression rate	100 to 120/min	100 to 120/min
Compression-to-ventilation ratio (until advanced airway is inserted)	30:2 (one rescuer); 15:2 (two rescuers)[c]	30:2 (one rescuer); 15:2 (two rescuers)[c]
Foreign body obstruction	Responsive: Back slaps and chest thrusts Unresponsive: CPR	Responsive: Abdominal thrusts (Heimlich maneuver) Unresponsive: CPR
Airway		
	Head tilt–chin lift; jaw-thrust maneuver if spinal injury is suspected	Head tilt–chin lift; jaw-thrust maneuver if spinal injury is suspected
Breathing		
Ventilations	1 breath every 3 to 5 seconds (12 to 20 breaths/min); about 1 second per breath; visible chest rise	1 breath every 3 to 5 seconds (12 to 20 breaths/min); about 1 second per breath; visible chest rise
Ventilations with advanced airway placed	1 breath every 6 seconds (a rate of 10 breaths/min)	1 breath every 6 seconds (a rate of 10 breaths/min)

[a]The AHA defines neonatal patients as birth to age 1 month, and infants as age 1 month to 1 year. Neonatal resuscitation is covered in Chapter 33, *Obstetrics and Neonatal Care.*

[b]Onset of puberty is approximately 12 to 14 years of age, as defined by secondary characteristics (eg, breast development in girls and armpit hair in boys).

[c]Pause compressions to deliver ventilations.

As discussed in Chapter 34, *Pediatric Emergencies,* respiratory issues leading to cardiopulmonary arrest in children can have a number of different causes, including:

- Injury, both blunt and penetrating
- Infections of the respiratory tract or another organ system (croup, epiglottitis)
- A foreign body in the airway
- Submersion (drowning)
- Electrocution
- Poisoning or drug overdose
- Sudden infant death syndrome (SIDS)

Determining Responsiveness

Never shake a child to determine whether he or she is responsive, especially if the possibility of a neck or back injury exists. Instead, gently tap the child on the shoulder, and say loudly, "Are you okay?" **Figure 13-22**. With an infant, gently tap the soles of the feet. If a child is responsive but struggling to breathe, then allow him or her to remain in whatever position is most comfortable.

If you find an unresponsive, apneic, and pulseless child while you are alone and off duty, and you did not witness the child's collapse, perform CPR beginning with chest compressions for approximately five cycles (about 2 minutes), and then stop to call 9-1-1 and retrieve an AED. Do not call 9-1-1 right away, as you would with an adult. Remember that cardiopulmonary arrest in children is most often the result of respiratory failure, not a primary cardiac event. Therefore, children will require immediate restoration of oxygenation, ventilation, and circulation, which can be accomplished by immediately performing five cycles (about 2 minutes) of CPR before activating the EMS system.

Figure 13-22 Never shake a child to determine responsiveness. Rather, gently tap on the shoulder (child) or tap the soles of the feet (infant), and speak loudly.

Words of Wisdom

Although uncommon, you may encounter a child whose cardiac arrest was caused by a primary cardiac event rather than a respiratory problem. If an otherwise healthy child without an apparent respiratory condition suddenly collapses and you witness it, then first confirm that the child is in cardiac arrest. If you are alone without a mobile phone, then leave the child to call 9-1-1 and get an AED before beginning CPR. If you are not alone, then send someone to call 9-1-1 and get an AED while you begin CPR. The sudden collapse of an otherwise healthy child does not indicate a respiratory problem; instead, it suggests a primary cardiac event that may respond to defibrillation. Therefore, it is critical to get the AED to the child's side as soon as possible.

Check for Breathing and a Pulse

After you establish responsiveness, you need to assess breathing and circulation. As with an adult, this assessment can occur simultaneously and should take no longer than 10 seconds. Visualize the chest for signs of breathing and palpate for a pulse in a large central artery. You can usually palpate the carotid or femoral pulse in children older than 1 year, but it is difficult in infants. Therefore, in infants, palpate the brachial artery, which is located on the inner side of the arm, midway between the elbow and shoulder. Place your thumb on the outer surface of the arm between the elbow and shoulder. Then place the tips of your index and middle fingers on the inside of the biceps, and press lightly toward the bone. CPR will be required if the infant or child is not breathing or is not breathing normally (agonal gasps), and a pulse is absent (or less than 60 beats/min).

As with an adult, an infant or child must be lying on a hard, flat surface for effective chest compressions. If you need to carry an infant while providing CPR, then your forearm and hand can serve as the flat surface. Use your palm to support the infant's head. In this way, the infant's shoulders are elevated, and the head is slightly tilted back in a position that will keep the airway open. Ensure that the infant's head is not higher than the rest of the body.

The technique for chest compressions in infants and children differs from adults because of a number of anatomic differences, including the position of the heart, the size of the chest, and the fragile organs of a child. The liver (immediately under the right side of the diaphragm) is relatively large and fragile, especially in infants. The spleen, on the left, is smaller and more fragile in children than in adults. These organs are easily injured if you are not careful in performing chest compressions, so be sure that your hand position is correct before you begin. The chest of an infant is smaller and more pliable than that of an older child or adult; therefore, you should use only two fingers to compress the chest. If two rescuers are performing CPR on an infant, use the two-thumb-encircling-hands technique to deliver chest compressions. In children, especially those older than 8 years, you can use the heel of one or both hands to compress the chest.

Follow these steps to perform infant chest compressions **Skill Drill 13-4** :

1. Take standard precautions. Place the infant on a firm surface, using one hand to keep the head in an open airway position. You can also use a pad or wedge under the shoulders and upper body to keep the head from tilting forward.
2. Imagine a line drawn between the nipples. Place two fingers in the middle of the sternum, just below the nipple line **Step 1**.
3. Using two fingers, compress the sternum at least one-third the anterior-posterior diameter of the chest (approximately 1.5 inches [4 cm] in most infants). Compress the chest at a rate of 100 to 120 per minute.
4. After each compression, allow the sternum to return briefly to its normal position. Allow equal time for compression and relaxation of the chest. Do not remove your fingers from the sternum, and avoid jerky movements **Step 2**.

Coordinate compressions and ventilations in a 30:2 ratio if you are working alone, and 15:2 if you are working with a trained bystander or another health care provider. Ensure the infant's chest fully recoils in between compressions and that the chest visibly rises with each ventilation. You will find this easier to do if you use your free hand to keep the head in the open airway position. If the chest does not rise, or rises only a little, then use a head tilt–chin lift to open the airway. Reassess the infant for signs of spontaneous breathing or a pulse after five cycles (about 2 minutes) of CPR.

Skill Drill 13-5 shows the steps for performing CPR in children between 1 year of age and the onset of puberty:

1. Take standard precautions. Place the child on a firm surface. Place the heel of one or two hands in the center of the chest, in between the nipples. Avoid compression over the lower tip of the sternum, which is called the xiphoid process **Step 1**.

Skill Drill 13-4 Performing Infant Chest Compressions

Step 1

Take standard precautions. Position the infant on a firm surface while maintaining the airway. Place two fingers in the middle of the sternum with one finger just below the nipple line.

Step 2

Use two fingers to compress the chest at least one-third its depth at a rate of 100 to 120 per minute. Allow the sternum to return to its normal position between compressions.

Skill Drill 13-5 Performing CPR on a Child

Step 1

Take standard precautions. Place the child on a firm surface. Identify the location for hand placement, as shown here. Place the heel of one or two hands in the center of the chest, in between the nipples, avoiding the xiphoid process.

Step 2

Compress the chest at least one-third the anterior-posterior diameter of the chest at a rate of 100 to 120 times/min. Coordinate compressions with ventilations in a 30:2 ratio (one rescuer) or 15:2 (two rescuers), pausing for two ventilations. Reassess for a pulse after 2 minutes. If there is no pulse and an AED is available, then resume CPR and apply the AED pads.

Step 3

If the child regains a pulse of greater than 60 beats/min and resumes effective breathing, then place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport.

2. Compress the chest at least one-third the anterior-posterior diameter of the chest (approximately 2 inches [5 cm] in most children) at a rate of 100 to 120 per minute. With pauses for ventilation, the actual number of compressions delivered will be about 80 per minute. In between compressions, allow the chest to fully recoil; do not lean on the chest. Compression and relaxation time should be the same duration. Use smooth movements. Hold your fingers off the child's ribs, and keep the heel of your hand(s) on the sternum.
3. Coordinate compressions and ventilations in a 30:2 ratio for one rescuer and 15:2 for two rescuers, making sure the chest rises with each ventilation. At the end of each cycle, pause for two ventilations **Step 2**.
4. After five cycles (about 2 minutes) reassess for a pulse. If there is no pulse and you have an AED, continue CPR and

apply the AED pads.
5. If the child regains a pulse of greater than 60 beats/min and resumes effective breathing, place him or her in a position that allows for frequent reassessment of the airway and vital signs during transport **Step 3**.

Switching rescuer positions is the same for children as it is for adults, every five cycles (2 minutes) of CPR. Remember, if the child is past the onset of puberty, use the adult CPR sequence, including the use of the AED.

Airway

Infants and toddlers often put toys and other objects, as well as food, in their mouths; therefore, foreign body obstruction of the upper airway is common. You must make sure that the upper airway is open when managing pediatric respiratory emergencies or cardiopulmonary arrest. If the child is unresponsive and lying in a supine position, then the airway may become obstructed when the tongue and throat muscles relax and the tongue falls backward.

If the child is unresponsive but breathing adequately, then place him or her in the recovery position to maintain an open airway and allow drainage of saliva, vomitus, or other secretions from the mouth **Figure 13-23**. Do not use this position if you suspect injury to the spine, hips, or pelvis unless you can secure the child to a backboard that can be tilted to the side. If the child is responsive and breathing, but in a labored fashion, then provide prompt transport to the closest appropriate hospital.

Opening the airway in an infant or child is done by using the same techniques as used for an adult. However, because a child's neck is so flexible, the techniques should be slightly modified. The jaw-thrust maneuver is the best method to use if you suspect a spinal injury in a child. If a second rescuer is present, he or she should immobilize the child's cervical spine. If spinal injury is not suspected, then use the head tilt–chin lift maneuver but modified so that, as you tilt the head back, you are moving it only into the neutral position or a slightly extended position **Figure 13-24**.

Figure 13-23 A child who is unresponsive but breathing adequately should be placed in the recovery position to allow saliva or vomitus to drain from the mouth.

Head Tilt–Chin Lift Maneuver

Perform the head tilt–chin lift maneuver in a child in the following manner:

1. Place one hand on the child's forehead, and tilt the head back gently, with the neck slightly extended.
2. Place two or three fingers (not the thumb) of your other hand under the child's chin, and lift the jaw upward and outward. Do not close the mouth or push under the chin; either move may obstruct rather than open the airway.
3. Remove any visible foreign body or vomitus.

Jaw-Thrust Maneuver

Perform the jaw-thrust maneuver in a child in the following manner:

1. Place two or three fingers under each side of the angle of the lower jaw; lift the jaw upward and outward.
2. If the jaw thrust alone does not open the airway and cervical spine injury is not a consideration, then tilt the head slightly. If cervical spine injury is suspected, then use a second rescuer to immobilize the cervical spine.

Remember that the head of an infant or young child is disproportionately large in comparison with the chest and shoulders. As a result, when a child is lying flat on his or her back, especially on a backboard, the head will bend forward (hyperflexion) onto the upper chest. This position can partially or completely obstruct the upper airway. To avoid this possibility, place a wedge of padding under the child's upper chest and shoulders (torso).

Figure 13-24 Use the head tilt–chin lift maneuver to open the airway in a child who has not sustained a traumatic injury. Do not overextend the neck.

Provide Rescue Breathing

If the child is not breathing but has a pulse, then open the airway and deliver one breath every 3 to 5 seconds (12 to 20 breaths/min) **Figure 13-25**. If the child is not breathing and does not have a pulse, then deliver 2 rescue breaths after every 30 chest compressions (15 chest compressions if two rescuers are present). Each ventilation should last about 1 second and should produce visible chest rise. Use the proper-sized mask and ensure an adequate mask-to-face seal.

If an infant or small child is breathing, then provide prompt transport. Again, a child who is in respiratory distress should be allowed to stay in whatever position is most comfortable. Children who are unresponsive but breathing with difficulty should be kept in a position that allows you to manage the airway and provide ventilatory support, if needed.

In a child with a tracheostomy tube in the neck, remove the mask from the BVM and connect it directly to the tracheostomy tube to ventilate the child. If a BVM is unavailable, a face mask with one-way valve or other barrier device over the tracheostomy site can be used. Place your hand firmly over the child's mouth and nose to prevent the artificial breaths from leaking out of the upper airway.

Figure 13-25 Open the child's airway and provide rescue breathing.

Words of Wisdom

An injured child with a serious airway or breathing problem is likely to need full-time attention from two EMTs. Therefore, it is important for you to arrange for backup from another unit as soon as possible—perhaps even before you arrive at the scene. In such cases, you will need a driver and often additional help with patient care.

Interrupting CPR

CPR is a crucial, lifesaving procedure that provides minimal circulation and ventilation until the patient can receive defibrillation, ALS treatment, and definitive care at the ED. No matter how well CPR is performed, however, it is rarely enough to save a patient's life. If ALS is unavailable at the scene, you must provide transport based on your local protocols and continue CPR on the way. En route to the ED, consider requesting a rendezvous with ALS providers, if available. This will provide ALS care to the patient sooner, improving his or her chance for survival. However, not all EMS systems have ALS support available to them, especially in rural settings.

Special Populations

Children in respiratory distress are often struggling to breathe. As a result, they usually position themselves in a way that keeps the airway open enough for air to move. Let the child stay in that position as long as his or her breathing remains adequate. If you and your partner arrive at the scene and find that the infant or child is not breathing or has cyanosis, then immediate management (including rescue breathing and supplemental oxygen) is essential. Consider requesting additional assistance, if available.

Remember, too, that a child's airway is smaller than that of an adult. Therefore, there is greater resistance to air flow. As a result, you will need to use *slightly* more ventilatory pressure to inflate the lungs. You will know you are giving the correct tidal volume when you see the chest rise. Infants and children should be ventilated once every 3 to 5 seconds, (at a rate of 12 to 20 breaths/min). Do not ventilate too fast or use too much force.

If air enters freely with your initial breaths and the chest rises, then the airway is clear. If air does not enter freely, then check the airway for obstruction. Reposition the patient to open the airway, and attempt to give another breath. If air still does not enter freely, then you must take steps to relieve the obstruction.

Try not to interrupt CPR for more than a few seconds, except when it is absolutely necessary. For example, if you have to move a patient up or down stairs, you should continue CPR until you arrive at the head or foot of the stairs, interrupt CPR at a mutually agreed-on signal, and move quickly to the next level where you can resume CPR. Do not move the patient until all transport arrangements are made so that interruptions to CPR can be kept to a minimum. See Chapter 8, *Lifting and Moving Patients*, to review patient lifting and moving techniques.

Chest compression fraction is the total percentage of time during a resuscitation attempt in which chest compressions are being performed. Make every effort to maintain a chest compression fraction of at least 60% (the higher the better). The more frequent the interruptions in chest compressions, the lower the compression fraction will be. Low compression fractions lead to worse patient outcomes. Most modern cardiac monitors will provide information about chest compression fraction that you can review after a cardiac arrest. If possible, routinely review this information after every arrest so that you can learn ways to improve the chest compression fraction and improve on other key performance indicators.

When Not to Start CPR

As an EMT, it is your responsibility to start CPR on virtually all patients who are in cardiac arrest. There are only three general exceptions to the rule.

First, do not start CPR if the scene is unsafe. The concept of ensuring scene safety applies in cardiac arrest situations, just as it does on any other call.

Second, do not start CPR if the patient has obvious signs of death. Recall from Chapter 3, *Medical, Legal, and Ethical Issues,* that obvious signs of death include an absence of a pulse and breathing, along with any one of the following findings:

- **Rigor mortis**, or stiffening of the body after death
- **Dependent lividity** (livor mortis), a discoloration of the skin caused by pooling of blood **Figure 13-26**
- Putrefaction (decomposition of the body tissues)
- Evidence of nonsurvivable injury, such as decapitation, dismemberment, or being burned beyond recognition.

Rigor mortis and dependent lividity develop after a patient has been dead for a long period.

YOU are the Provider — PART 4

After 2 minutes of CPR, you reanalyze the patient's cardiac rhythm and receive a "no shock advised" message. You and your partner immediately resume CPR. During CPR, your partner ventilates the patient with a BVM and high-flow oxygen. As she attempts to insert an oral airway, the patient starts to gag. You quickly reassess him.

Recording Time: 7 Minutes	
Level of consciousness	Unresponsive
Respirations	Occasional agonal gasps; 4 breaths/min
Pulse	100 beats/min; strong carotid pulse; absent radial pulses
Skin	Skin color is improving
Blood pressure	70/40 mm Hg
Spo_2	82% (on oxygen)

7. How should you continue to treat this patient?

8. Because the patient is no longer in cardiac arrest, should you remove the AED pads? Why or why not?

Figure 13-26 Dependent lividity is an obvious sign of death, caused by blood settling to the areas of the body not in firm contact with the ground. The lividity in this figure is seen as purple discoloration of the back, except in areas that are in firm contact with the ground (scapula and buttock).

Third, do not start CPR if the patient and his or her physician have previously agreed on a do not resuscitate (DNR) order or no-CPR order **Figure 13-27**. DNR orders give you permission not to attempt resuscitation. This may apply only to situations in which the patient is known to be in the terminal stage of an incurable disease. In this situation, CPR would only prolong the patient's death. However, end-of-life issues can be complicated. Advance directives, such as living wills, may express the patient's wishes; however, these documents may not be readily producible by the patient's family or caregiver. In such cases, the safest course is to begin CPR under the rule of implied consent and then contact medical control for further guidance. However, if a valid DNR document or living will is produced, resuscitative efforts may be withheld. Learn your local protocols and the standards in your EMS system for treating terminally ill patients. Some EMS systems have electronic notes on patients who are preregistered with the system. These notes usually specify the amount and extent of treatment that is desired. Other states have specific DNR forms that allow EMS providers to withhold care when the patient, family, and physician have agreed in advance that such a course is most appropriate. It is essential that you understand your local protocols and are aware of the specific restrictions these advance directives imply.

You may also encounter Physician Orders for Life-Sustaining Treatment (POLST) or Medical Orders for Life-Sustaining Treatment (MOLST) forms. These legal documents describe acceptable interventions for the patient in the form of medical orders and must be signed by an authorized medical provider to be valid. Be familiar with POLST or MOLST forms, and learn your local protocols and state laws with regard to withholding end-of-life medical interventions. If you are presented with a POLST or MOLST form, then contact medical control for guidance.

In all other cases, begin CPR on anyone who is in cardiac arrest. It is usually impossible to know how long the patient's brain and vital organs have gone without oxygen. Factors such as air temperature and the basic health of the patient's tissues and organs can affect his or her ability to survive. Therefore, most legal advisers recommend that, when in doubt, always give too much care rather than too little care. Therefore, always start CPR if any doubt exists.

When to Stop CPR

As an EMT, you are generally not responsible for making the decision to stop CPR. After you begin CPR in the field, you must continue until one of the following events occurs (the STOP mnemonic):

S The patient *Starts* breathing and has a pulse.

T The patient's care is *Transferred* to another provider of equal or higher-level training.

O You are *Out* of strength or too tired to continue CPR.

P A *Physician* who is present or providing online medical direction assumes responsibility for the patient and gives direction to discontinue CPR.

Out of strength does not mean merely weary; rather, it means that you are no longer physically able to perform CPR. In short, always continue CPR until the patient's care is transferred to a physician or higher medical authority in the field. In some cases, your medical director or a designated medical control physician may order you to stop CPR on the basis of the patient's condition.

Words of Wisdom

Patients who do not achieve ROSC may be potential kidney or liver donors in select situations (ie, short transport times, rapid access to an organ recovery program). Follow your local protocols regarding the care of potential organ donors.

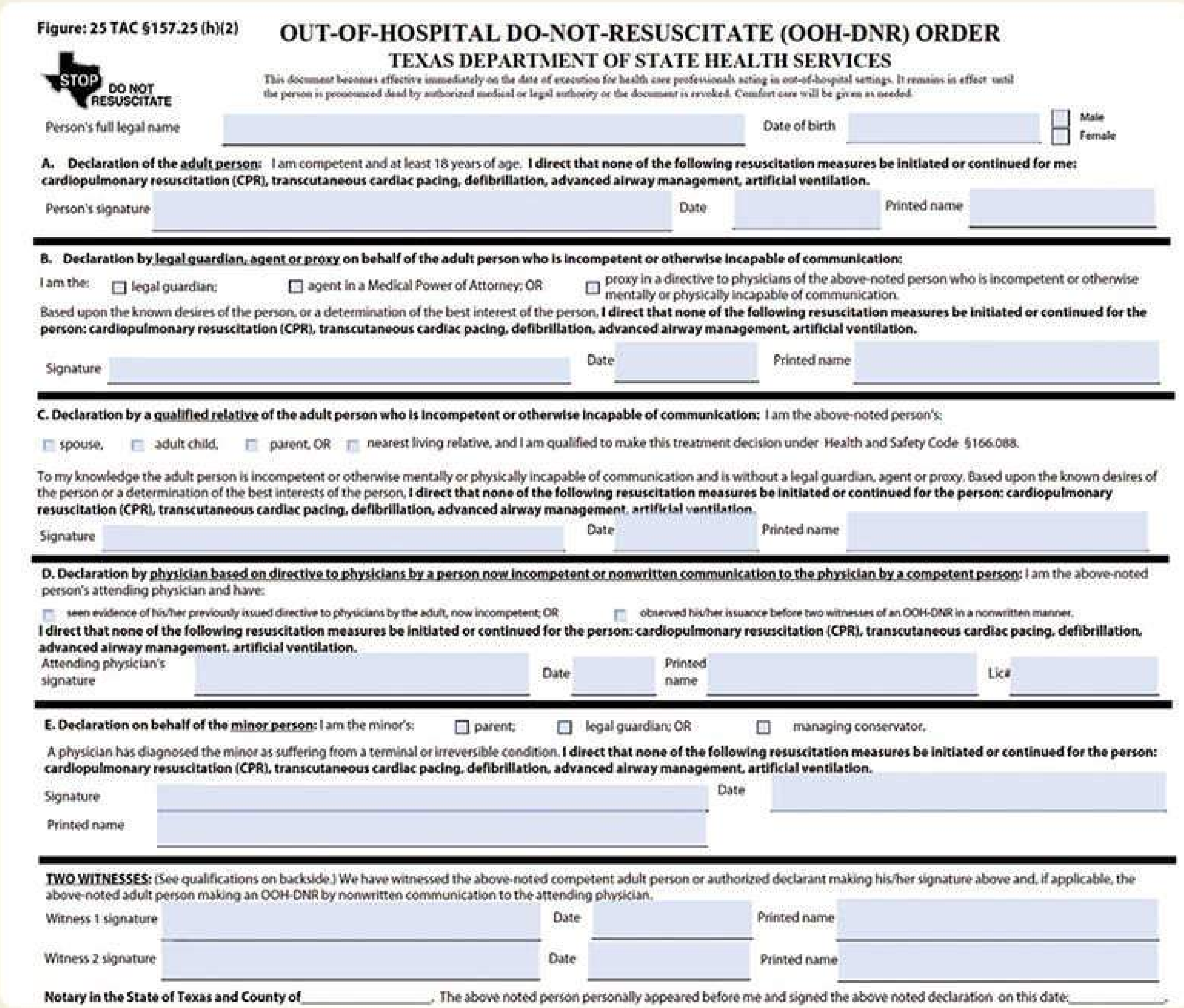


Figure: 25 TAC §157.25 (h)(2)

OUT-OF-HOSPITAL DO-NOT-RESUSCITATE (OOH-DNR) ORDER

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

STOP DO NOT RESUSCITATE

This document becomes effective immediately on the date of execution for health care professionals acting in out-of-hospital settings. It remains in effect until the person is pronounced dead by authorized medical or legal authority or the document is revoked. Comfort care will be given as needed.

Person's full legal name ____ Date of birth ____ ☐ Male ☐ Female

A. Declaration of the adult person: I am competent and at least 18 years of age. **I direct that none of the following resuscitation measures be initiated or continued for me: cardiopulmonary resuscitation (CPR), transcutaneous cardiac pacing, defibrillation, advanced airway management, artificial ventilation.**

Person's signature ____ Date ____ Printed name ____

B. Declaration by legal guardian, agent or proxy on behalf of the adult person who is incompetent or otherwise incapable of communication:

I am the: ☐ legal guardian; ☐ agent in a Medical Power of Attorney; OR ☐ proxy in a directive to physicians of the above-noted person who is incompetent or otherwise mentally or physically incapable of communication.

Based upon the known desires of the person, or a determination of the best interest of the person, **I direct that none of the following resuscitation measures be initiated or continued for the person: cardiopulmonary resuscitation (CPR), transcutaneous cardiac pacing, defibrillation, advanced airway management, artificial ventilation.**

Signature ____ Date ____ Printed name ____

C. Declaration by a qualified relative of the adult person who is incompetent or otherwise incapable of communication: I am the above-noted person's:

☐ spouse, ☐ adult child, ☐ parent, OR ☐ nearest living relative, and I am qualified to make this treatment decision under Health and Safety Code §166.088.

To my knowledge the adult person is incompetent or otherwise mentally or physically incapable of communication and is without a legal guardian, agent or proxy. Based upon the known desires of the person or a determination of the best interests of the person, **I direct that none of the following resuscitation measures be initiated or continued for the person: cardiopulmonary resuscitation (CPR), transcutaneous cardiac pacing, defibrillation, advanced airway management, artificial ventilation.**

Signature ____ Date ____ Printed name ____

D. Declaration by physician based on directive to physicians by a person now incompetent or nonwritten communication to the physician by a competent person: I am the above-noted person's attending physician and have:

☐ seen evidence of his/her previously issued directive to physicians by the adult, now incompetent; OR ☐ observed his/her issuance before two witnesses of an OOH-DNR in a nonwritten manner.

I direct that none of the following resuscitation measures be initiated or continued for the person: cardiopulmonary resuscitation (CPR), transcutaneous cardiac pacing, defibrillation, advanced airway management, artificial ventilation.

Attending physician's signature ____ Date ____ Printed name ____ Lic# ____

E. Declaration on behalf of the minor person: I am the minor's: ☐ parent; ☐ legal guardian; OR ☐ managing conservator.

A physician has diagnosed the minor as suffering from a terminal or irreversible condition. **I direct that none of the following resuscitation measures be initiated or continued for the person: cardiopulmonary resuscitation (CPR), transcutaneous cardiac pacing, defibrillation, advanced airway management, artificial ventilation.**

Signature ____ Date ____

Printed name ____

TWO WITNESSES: (See qualifications on backside.) We have witnessed the above-noted competent adult person or authorized declarant making his/her signature above and, if applicable, the above-noted adult person making an OOH-DNR by nonwritten communication to the attending physician.

Witness 1 signature ____ Date ____ Printed name ____

Witness 2 signature ____ Date ____ Printed name ____

Notary in the State of Texas and County of ____. The above noted person personally appeared before me and signed the above noted declaration on this date: ____.

Figure 13-27 Do not start CPR if the patient and his or her physician have previously agreed on DNR or no-CPR orders. Learn your local protocols for treating terminally ill patients.

Courtesy of Texas Department of State Health Services.

Words of Wisdom

If you choose not to start CPR on a patient in cardiac arrest, then always comply with your local protocols and provide detailed documentation. In particular, record the physical examination signs that led to your decision and reference the protocol that states these signs are a reason not to start CPR. If special circumstances physically prevent you from making resuscitation attempts (for example, if the patient is entrapped in a vehicle), then document the scene conditions thoroughly. These decisions occasionally raise questions that can be put to rest immediately with reference to a well-written report. See Chapter 4, *Communications and Documentation, for more information*.

Every EMS system should have clear standing orders or protocols that provide guidelines for starting and stopping CPR. Your medical director and your system's legal adviser should agree on these protocols, which should be closely administered and reviewed by your medical director.

Foreign Body Airway Obstruction in Adults

Occasionally, a large foreign body will be aspirated and block the upper airway. An airway obstruction may be caused by various factors, including relaxation of the throat muscles in an unresponsive patient, vomited or regurgitated stomach contents, blood, damaged tissue after an injury, dentures, or foreign bodies such as food or small objects.

Large objects that are visible but cannot be removed from the airway with suction, such as loose dentures, large pieces of food, or blood clots, should be swept forward and out with your gloved index finger. Suctioning can then be used as needed to keep the airway clear of thinner secretions such as blood, vomitus, and mucus.

Recognizing Foreign Body Airway Obstruction

An airway obstruction by a foreign body in an adult usually occurs during a meal. In children, it usually occurs during mealtime or at play. If the foreign body is not removed quickly, then the lungs will use up their oxygen supply, and unconsciousness and death will follow. Management is based on the severity of the airway obstruction.

Mild Airway Obstruction

Patients with a mild (partial) airway obstruction are able to exchange adequate amounts of air, but still have signs of respiratory distress. Breathing may be noisy; however, the patient usually has a strong, effective cough. Leave these patients alone! Your main concern is to prevent a mild airway obstruction from becoming a severe (complete) airway obstruction. Abdominal thrusts are *not* indicated for patients with a mild airway obstruction.

For the patient with a mild airway obstruction, first encourage him or her to cough or to continue coughing if they are already doing so. Do not interfere with the patient's own attempts to expel the foreign body. Instead, give supplemental oxygen if needed and provide prompt transport to the ED. Closely monitor the patient and observe for signs of a severe airway obstruction (weak or absent cough, decreasing level of consciousness, cyanosis).

Responsive Patients

A sudden, severe airway obstruction is usually easy to recognize in someone who is eating or has just finished eating. The person is suddenly unable to speak or cough, grasps his or her throat, turns cyanotic, and makes exaggerated efforts to breathe. Either air is not moving into and out of the airway, or the air movement is so slight that it is not detectable. At first, the patient will be responsive and able to clearly indicate the problem. Ask the patient, "Are you choking?" The patient will usually answer by nodding yes. Alternatively, he or she may use the universal sign to indicate airway blockage **Figure 13-28**.

Figure 13-28 Placing the hands at the throat is the universal sign to indicate choking.

If there is a minimal amount of air movement, then you may hear a high-pitched sound called stridor. This occurs when the object is not fully blocking the airway, but the small amount of air entering the lungs is not enough to sustain life and the patient will eventually become unconscious if the obstruction is not relieved.

Unresponsive Patients

When you discover an unresponsive patient, your first step is to determine whether he or she is breathing and has a pulse. The unconsciousness may be caused by airway obstruction, cardiac arrest, or a number of other conditions. If the patient has a pulse, but is not breathing, then you must make sure that the airway is open and unobstructed.

You should suspect an airway obstruction if the standard maneuvers to open the airway and ventilate the lungs are ineffective. If you feel resistance when attempting to ventilate, the patient probably has some type of obstruction.

▶ Removing a Foreign Body Airway Obstruction in an Adult

The manual maneuver recommended for removing severe airway obstructions in responsive adults and children older than 1 year is the abdominal-thrust maneuver (also called the Heimlich maneuver). This technique creates an artificial cough by causing a sudden increase in intrathoracic pressure when thrusts are applied to the subdiaphragmatic region; it is a very effective method for removing a foreign body obstruction from the airway. If the patient with a severe airway obstruction is unresponsive, then perform chest compressions.

Responsive Patients

Abdominal-Thrust Maneuver. The goal of the abdominal-thrust maneuver is to compress the lungs upward and force residual air from the lungs to flow upward and expel the object. In responsive patients with a severe airway obstruction, repeat abdominal thrusts until the foreign body is expelled or the patient becomes unresponsive. Each thrust should be deliberate, with the intent of relieving the obstruction.

To perform abdominal thrusts on a responsive adult Figure 13-29, use the following technique:

1. Stand behind the patient, and wrap your arms around his or her abdomen. Straddle your legs outside the patient's legs. This will allow you to easily slide the patient to the ground if he or she becomes unresponsive.
2. Make a fist with one hand; grasp the fist with the other hand. Place the thumb side of the fist against the patient's abdomen just above the umbilicus and well below the xiphoid process.
3. Press your fist into the patient's abdomen with a quick inward and upward thrust.
4. Continue abdominal thrusts until the object is expelled from the airway or the patient becomes unresponsive.

Figure 13-29 The abdominal-thrust maneuver in a responsive adult. Stand behind the patient and wrap your arms around the patient's abdomen. Place the thumb side of one fist against the patient's abdomen while holding your fist with your other hand. Press your fists into the patient's abdomen, using inward and upward thrusts.

Chest Thrusts. You can perform the abdominal-thrust maneuver safely on all adults and children. However, for women in advanced stages of pregnancy and patients who have obesity, use chest thrusts instead.

To perform chest thrusts on the responsive adult, use the following technique Figure 13-30:

1. Stand behind the patient with your arms directly under the patient's armpits, and wrap your arms around the patient's chest.
2. Make a fist with one hand; grasp the fist with the other hand. Place the thumb side of the fist against the patient's sternum, avoiding the xiphoid process and the edges of the rib cage.
3. Press your fist into the patient's chest with backward thrusts until the object is expelled or the patient becomes unresponsive.
4. If the patient becomes unresponsive, then begin CPR, starting with chest compressions Figure 13-31.

Figure 13-30 Removal of a foreign body obstruction in a responsive adult using chest thrusts. Stand behind the patient and wrap your arms around the patient's chest. Place the thumb side of one fist against the chest while holding your fist with your other hand. Press your fists into the patient's chest with backward thrusts.

Figure 13-31 An unresponsive patient with an airway obstruction requires CPR.

Words of Wisdom

If a responsive choking patient is found lying on the floor, then administer abdominal thrusts by straddling the patient's legs, placing your hands just above the umbilicus, and giving rapid thrusts inward and upward under the rib cage, using the heel of your hand with your other hand on top of it.

Responsive Patients Who Become Unresponsive

A patient with an airway obstruction may become unresponsive while you are attempting to remove the obstruction. In this case, begin CPR, starting with chest compressions. Use the following steps to manage the patient's airway obstruction:

1. Carefully support the patient to the ground and immediately call for help (or send someone to call for help).
2. Perform 30 chest compressions, using the same landmark as you would for CPR (center of the chest, between the nipples). Do not check for a pulse before performing chest compressions.
3. Open the airway and look in the mouth. If you see an object that can easily be removed, then remove it with your fingers and attempt to ventilate. If you do not see an object, then resume chest compressions.
4. Repeat steps 2 and 3 until the obstruction is relieved or ALS providers take over.

If you are able to remove an object from the mouth, then attempt to ventilate. If ventilation produces chest rise, then continue to ventilate and check for a pulse. If a pulse is present but the patient is not breathing, then continue rescue breathing and monitor the pulse. If a pulse is absent, then continue CPR (compressions and ventilations) and apply the AED as soon as it is available.

YOU are the Provider — PART 2

You package the patient, load him into the ambulance, and begin transport to a hospital located 5 miles away. An EMT from the backup ambulance accompanies you in the back and continues rescue breathing. En route, you reassess the patient and then call your radio report to the receiving hospital.

Recording Time: 12 Minutes	
Level of consciousness	Unresponsive
Respirations	8 breaths/min; shallow depth
Pulse	94 beats/min; strong carotid pulse, weak radial pulses
Skin	Pink, cool, and dry
Blood pressure	86/66 mm Hg
Spo_2	95% (on oxygen)

9. Would an ITD benefit your patient at this point?

10. What further treatment, if any, is indicated for this patient?

Unresponsive Patients

When a patient is found unresponsive, it is unlikely you will know what caused the problem. Begin CPR by determining unresponsiveness and checking for breathing and a pulse. If a pulse is present but breathing is absent, then open the airway and attempt to ventilate. If the first ventilation does not produce visible chest rise, then reposition the airway and reattempt to ventilate. If both ventilation attempts do not produce visible chest rise, then perform 30 chest compressions, and then open the airway and look in the mouth. If an object is visible and can easily be removed, then remove it with your fingers and attempt to ventilate. Never perform blind finger sweeps on any patient; doing so may push the obstruction farther into the airway. If an object is not visible or cannot easily be removed, then resume chest compressions. Continue the sequence of chest compressions, opening the airway, and looking inside the mouth until the airway is clear or ALS providers arrive.

Foreign Body Airway Obstruction in Infants and Children

As mentioned previously, airway obstruction is a common problem in infants and children, usually caused by a foreign body (such as food or a toy) or by an infection, resulting in swelling and narrowing of the airway. Try to identify the cause of the obstruction as soon as possible. In patients who have signs and symptoms of an airway infection, do not waste time trying to dislodge a foreign body. Administer supplemental oxygen if needed and immediately transport the child to the ED.

A previously healthy child who is eating or playing with small toys or an infant who is crawling about the house and who suddenly has difficulty breathing has probably aspirated a foreign body. As in adults, foreign bodies may cause a mild or a severe airway obstruction.

With a mild airway obstruction, the child can cough forcefully, although he or she may wheeze between coughs. As long as the patient can breathe, cough, or talk, do not interfere with his or her attempts to expel the foreign body. As with the adult, encourage the child to continue coughing. Administer supplemental oxygen if needed (and tolerated) and provide transport to the ED.

You should intervene only if signs of a severe airway obstruction develop, such as a weak, ineffective cough; cyanosis; stridor; absent air movement; or a decreasing level of consciousness.

Removing a Foreign Body Airway Obstruction in a Child

Responsive Child

If you determine a child older than 1 year has an airway obstruction, then stand or kneel behind the child and provide abdominal thrusts in the same manner as an adult, but use less force, until the object is expelled or the child becomes unresponsive. If the child becomes unresponsive, then follow the same steps as for the unresponsive adult.

To perform the abdominal-thrust maneuver in a responsive child who is in a standing or sitting position, follow these steps **Figure 13-32**:

1. Kneel on one knee behind the child, and circle both of your arms around the child's body. Prepare to give abdominal thrusts by placing your fist just above the patient's umbilicus and well below the xiphoid process. Place your other hand over that fist.

Figure 13-32 To perform the abdominal-thrust maneuver on a child, kneel behind the child on one knee, wrap your arms around his or her body, and place your fist just above the umbilicus and well below the lower tip of the sternum.

2. Give the child abdominal thrusts in an upward direction. Avoid applying force to the lower rib cage or sternum.
3. Repeat this technique until the child expels the foreign body or becomes unresponsive.
4. If the child becomes unresponsive, position the child on a hard surface and immediately call for help (or send someone to call for help).
5. Perform 30 chest compressions (15 compressions if two rescuers are present), using the same landmark as you would for CPR. Do not check for a pulse before performing chest compressions.
6. Open the airway and look inside the mouth. If you see an object that can easily be removed, then remove it with your fingers and attempt to ventilate. If you do not see an object, then resume chest compressions.
7. Repeat steps 5 and 6 until the obstruction is relieved or ALS providers take over.

If you manage to clear the airway obstruction in an unresponsive child but he or she still has no spontaneous breathing or circulation, then perform CPR (compressions and ventilations) and apply the AED as soon as it is available.

Unresponsive Child

If a child older than one year with an airway obstruction becomes unresponsive, he or she is managed in the same manner as an adult. **Skill Drill 13-6** demonstrates the steps for removing a foreign body airway obstruction in an unresponsive child:

1. Take standard precautions. Carefully place the child in a supine position on a firm, flat surface **Step 1**.
2. Perform 30 chest compressions (15 compressions if two rescuers are present), using the same landmark as you would for CPR (lower half of the sternum). Do not check for a pulse before performing chest compressions **Step 2**.
3. Open the airway and look in the mouth **Step 3**.
4. If you see an object that can easily be removed, then remove it with your fingers and attempt to ventilate **Step 4**.
5. If you do not see an object, then resume chest compressions.
6. Repeat the sequence of chest compressions, opening the airway, and looking inside the mouth until the obstruction is relieved or ALS providers take over **Step 5**.

Removing a Foreign Body Airway Obstruction in Infants

Responsive Infants

Do not use abdominal thrusts on a responsive infant with an airway obstruction because of the risk of injury to the immature organs of the abdomen. Instead, perform back slaps and chest thrusts to try to clear a severe airway obstruction in a responsive infant, as follows **Figure 13-33**:

1. Hold the infant facedown, with the body resting on your forearm. Support the infant's jaw and face with your hand, and keep the head lower than the rest of the body.
2. Deliver five back slaps between the shoulder blades, using the heel of your hand.

Figure 13-33 **A.** Hold the infant facedown with the body resting on your forearm. Support the jaw and face with your hand, and keep the head lower than the rest of the body. Give the infant five back slaps between the shoulder blades, using the heel of your hand. **B.** Give the infant five quick chest thrusts, using two fingers placed on the lower half of the sternum.

Skill Drill 13-6

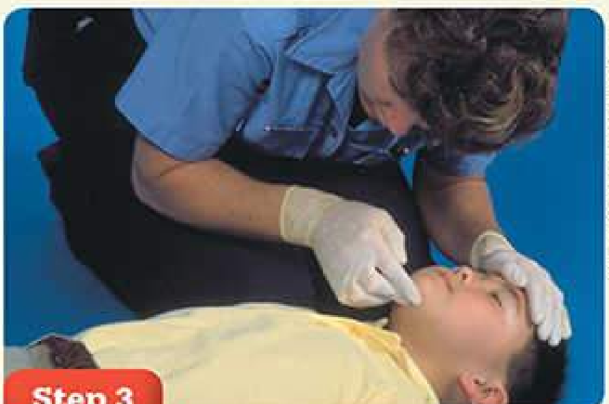
Removing a Foreign Body Airway Obstruction in an Unresponsive Child

Step 1

Take standard precautions. Position the child on a firm, flat surface.

Step 2

Perform chest compressions using the same landmark as you would for CPR.



Step 3

Open the airway and look inside the mouth.

Step 4

If an object is visible and can easily be removed, then remove it with your fingers and attempt rescue breathing.

Step 5

If you do not see an object in the mouth, then resume chest compressions. Continue the sequence of chest compressions, opening the airway, and looking inside the mouth until the obstruction is relieved or ALS providers take over.

3. Place your free hand behind the infant's head and back, and turn the infant faceup on your other forearm and thigh, sandwiching the infant's body between your two hands and arms. The infant's head should remain below the level of the body.
4. Give five quick chest thrusts in the same location and manner as chest compressions, using two fingers placed on the lower half of the sternum. For larger infants, or if you have small hands, you can perform this step by placing the infant in your lap and turning the infant's whole body as a unit between back slaps and chest thrusts.
5. Check the airway. If you can see the foreign body, then remove it. If not, then repeat the cycle as often as necessary.
6. If the infant becomes unresponsive, then begin CPR and follow the same sequence as for a child and adult.

Unresponsive Infants

If the infant becomes unresponsive during your attempts to relieve an airway obstruction, then perform CPR starting with chest compressions. Do not check for a pulse before starting compressions. Open the airway and look in the mouth. If you see an object that can easily be removed, then remove it with your finger and attempt to ventilate; if you do not see an object, then resume chest compressions. Continue the sequence of chest compressions, opening the airway, and looking inside the mouth until the obstruction is relieved or ALS providers take over.

Special Resuscitation Circumstances

Opioid Overdose

An opioid is a narcotic drug that, when taken in excess, depresses the central nervous system and causes respiratory arrest followed by cardiac arrest. Examples of opioids include heroin and oxycodone. In situations where opioid overdose is the suspected cause of a patient's cardiac arrest, bystanders may have administered the antidote naloxone (Narcan) to the patient prior to EMS arrival. Naloxone blocks opiate receptors in the body and reverses the effect of opioid overdose. Naloxone auto-injector devices, intended for use by laypeople (as well as health care providers), are now available in the United States. If you respond to a patient who has possibly overdosed on an opioid, and naloxone was administered by a bystander prior to your arrival, then determine how much of the medication was given and the route by which it was given.

Your EMS medical director may implement a protocol that allows BLS providers to administer naloxone in cases of suspected opioid overdose. The recommended algorithm for implementing naloxone into the cardiac arrest management sequence is discussed in Chapter 21, *Toxicology*.

Standard resuscitative measures (ie, high-quality chest compressions, ventilation, defibrillation) take priority over naloxone administration; do not delay other interventions while awaiting the patient's response to naloxone therapy. Many patients who have overdosed on an opioid have a pulse (although slow) but are not breathing. In these patients, BVM ventilation is the most critical treatment, followed by administration of naloxone if it is available.

Cardiac Arrest in Pregnancy

If you encounter a pregnant patient who is in cardiac arrest, then your priorities are to provide high-quality CPR and relieve pressure off the aorta and vena cava. When the patient lies supine, the pregnant uterus can compress the aorta and vena cava (aortocaval compression). Compression of the vena cava causes a significant decrease in blood return to the heart and, secondarily, in the forward flow of blood to the vital organs.

If the pregnant patient is not in cardiac arrest, then position her on her left side to relieve pressure on the great vessels. However, if she is in cardiac arrest, then this approach is impractical, because she must remain in a supine position to maximize the effectiveness of compressions. Therefore, if the top of the patient's uterus (fundus) can be felt at or above the level of the umbilicus, perform manual displacement of the uterus to the patient's left to relieve aortocaval compression while CPR is being performed. This step will improve the effectiveness of compressions **Figure 13-34**.

Grief Support for Family Members and Loved Ones

Whenever you assist a patient, remember his or her loved ones may also be affected by the emergency. Serious illness, injury, and pediatric patients create an especially high level of anxiety for family members. A health emergency is often hard for family members to understand. In some cases, family members may experience a psychologic crisis that turns into a medical crisis, and may become patients themselves.

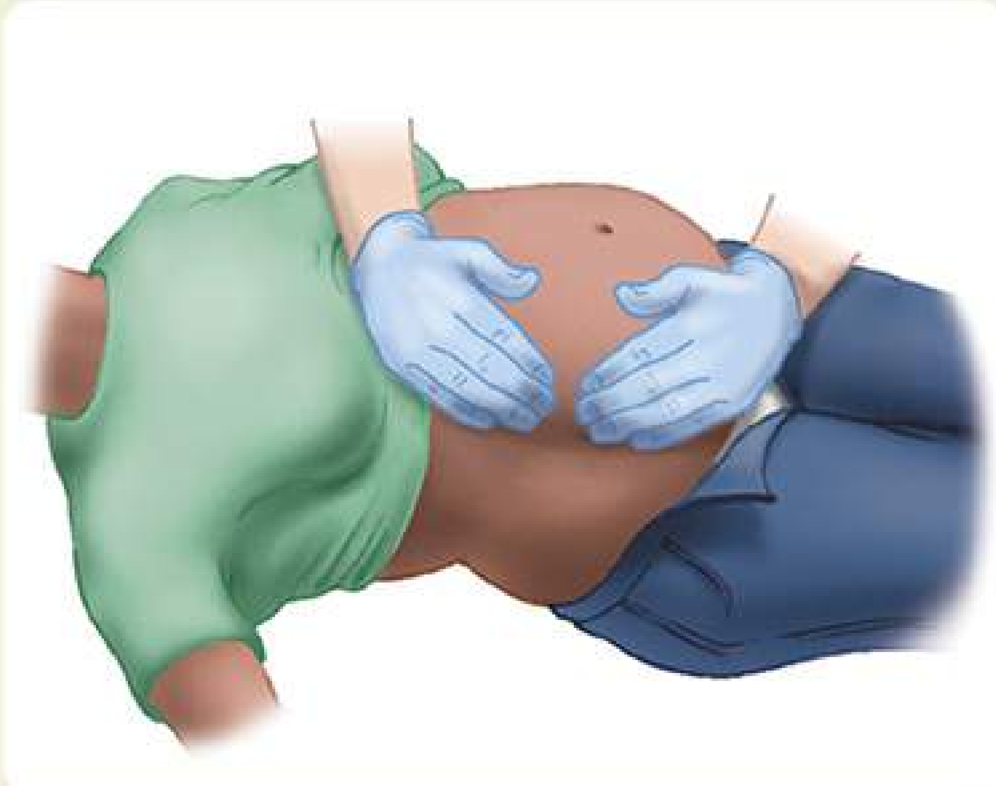


Figure 13-34 Manual left displacement of the uterus. The two-handed technique is shown. Alternatively, one hand can be used.

Consider the scenario of a cardiac arrest in an otherwise healthy 57-year-old man. The family is watching your team perform CPR. They may assume you will bring him back, or, at the very least, will expect you to transport. After 30 minutes or so, you stop resuscitation and start packing your gear, then turn the scene over to the police. The patient is lying dead on the floor.

A trend in cardiac arrest care is to stay on the scene and perform the entire resuscitation in the location where the patient was found, particularly when ALS care is provided at the scene. Many EMS systems advocate this practice because continuous compressions are an important part of an effective resuscitation effort. CPR in the back of an ambulance is generally not as effective. If the patient has not responded to treatment after 20 to 30 minutes (or longer), then many protocols suggest discontinuing resuscitative efforts and not transporting. However, this may create an uncomfortable situation at the scene.

For EMS crews, wanting to help but not knowing what to do can be very stressful. Is it the responsibility of EMS to explain the death to the family? Would you consider the bereaved widow the legal or moral responsibility of EMS? How is good customer care defined here? If you consider a spouse and perhaps other family members to be your patients as well, then it is appropriate to interact with them. Using the above scenario as an example, consider the following things that may make grief support in the field a little easier.

Whereas this cardiac arrest may be one of many similar calls in your career, family members and loved ones will remember this event in detail for the rest of their lives. Your reaction to them will form a lasting impression. Conversely, a mismanaged death notification or poor interaction could leave the family feeling disrespected or ignored. A compassionate and sensitive approach will leave a positive impression of you and your agency. Most important, appropriate and supportive care at the onset of grief may positively affect the family’s grieving process.

Families do not typically expect EMS providers to stop resuscitation and leave their loved one on scene. When death appears imminent and resuscitative efforts are unsuccessful, make the family members aware the patient is not responding to treatment. Discuss with them what is happening so they may be better prepared for the inevitable. Keep the family informed throughout the resuscitation process because it may also help them feel more in control.

Sequential notification starts during resuscitative efforts; family members should be updated as the resuscitation progresses, if possible. Designate one provider to communicate the patient's status to family members, so that information is streamlined from one source rather than from multiple providers. Be concise and clear. For example, say, "Your husband is not breathing and his heart has stopped. We are attempting to restart his heart with the AED." After resuscitation efforts have stopped, it is appropriate to tell them, "As you know, when we arrived, your husband wasn't breathing and did not have a pulse. He has not responded to any of our treatments. I'm sorry, but he has died." Avoid euphemisms such as "passed away" or "passed on," because these expressions may be confusing or misinterpreted. Law enforcement personnel may be involved in the official death declaration and will likely be responsible for what happens next, such as determining whether the medical examiner should be notified.

In a situation where ROSC occurs prior to transport, family members may wish to interact with the patient. This can give them comfort, especially if the patient ultimately does not survive.

After resuscitation has stopped, these other measures can be helpful:

- Take the family to a quiet, private place.
- Introduce yourself and anyone with you.
- Use clear language and speak in a warm, sensitive, and caring manner.
- Try to exhibit calm, reassuring authority.
- Use the patient's name.
- Use eye contact and appropriate touch.
- Expect that family members will show emotion as they begin the grieving process. Be prepared for different reactions, including anger.
- While you are still on scene, be supportive but do not hover.
- Ask if a friend or family member can be called to come and help support them.
- When you need to leave, turn the family over to someone else; for example, a police officer.

Some family members will want to see the deceased. Being able to touch or talk to their loved one may be helpful to them. This may not be advisable in a medical examiner's case. Law enforcement personnel will need to make that determination. It is appropriate to make the body presentable, but follow local protocols regarding movement of the patient or removal of resuscitation equipment.

Another consideration is to ensure that children are not ignored. They may not understand death. Preschool-aged children may be less affected, whereas older children understand death but do not expect it to happen to someone they know. Younger children tend to blame themselves. Teenagers may be highly affected but may mask their feelings.

It is never easy to be the bearer of bad news, but it can help to know you did your best for the family during a difficult situation. Lastly, consider your own feelings in this stressful situation and make sure you seek assistance if needed. See Chapter 2, *Workforce Safety and Wellness*, for a discussion of the emotional aspects of emergency care and stress management.

Education and Training for the EMT

You may go weeks or months without performing CPR on a human, depending on how busy your EMS system is. Like any skill, CPR skills can deteriorate over time. You must practice them often using manikin-based training—ideally more frequently than the standard retraining that occurs every 2 years.

The use of high-fidelity manikins for CPR training is encouraged, if your system's budget allows. If this is not an option, then CPR devices that provide corrective feedback are preferred over devices that only provide voice prompts (ie, a metronome).

CPR self-instruction through video and/or computer-based modules with hands-on practice may be a reasonable alternative to instructor-led courses, because it may facilitate frequent retraining.

Education and Training for the Public

As an EMT, you are a patient advocate. Not only are you responsible for providing the best possible care for your patient, but you must also do your part to facilitate the training of laypeople in the critical skills of CPR and AED operation. Training in CPR and AED usage should not be limited to health care providers. Not enough laypeople are trained to perform these lifesaving skills. Ask yourself, “Who is the *real* first responder?” Obviously, the layperson is likely to be at the scene before you and your team arrive.

As discussed previously, many laypeople assume CPR requires both mouth-to-mouth rescue breathing and chest compressions. As long as this misconception remains, fewer people will be willing to help during an emergency, which means that fewer lives will be saved. If you are asked to train members of your community how to perform compression-only CPR, then you should consider it your professional responsibility and be willing to assist.

It is likely that some citizens in your service area are at increased risk for cardiac arrest. Your agency should make an effort to identify these potential patients and educate their families to recognize cardiac arrest and to train them to perform compression-only CPR.

YOU are the Provider — SUMMARY

1. What should you immediately do on receiving this update from dispatch?

After you are informed that CPR is in progress, you should immediately request additional assistance. Effective treatment of a patient in cardiac arrest requires adequate personnel at the scene and during transport. As an EMT, you must be familiar with the resources that are available to you and know when it is appropriate to request them.

The type of backup you receive (ie, BLS versus ALS) will depend on your EMS system and the resources that are available to you. Combined with high-quality CPR and defibrillation, early advanced care increases the patient’s chance for survival.

If you do not have access to other EMTs or to ALS providers, then request assistance from the fire department. Fire departments are often staffed with at least one or two emergency medical responders who are able to perform CPR and assist with certain BLS interventions.

Regardless of the resources available to you, request them as soon as possible—in this case, as soon as you are advised that CPR is in progress. One EMT cannot effectively treat a cardiac arrest patient during transport; you would have to perform continuous CPR while your partner drives the ambulance (or vice versa), which could result in rescuer fatigue and decreased effectiveness of chest compressions.

2. What should be your initial actions on arriving at this scene?

After ensuring your own safety, approach this patient as you would any other patient, by performing a primary assessment. Although the dispatcher has advised you that bystander CPR is in progress, you must still assess the patient to confirm he is indeed apneic and pulseless and requires CPR.

Your primary assessment should take only a few seconds, just long enough to confirm the patient is in cardiac arrest. If he is in cardiac arrest, then begin CPR immediately, apply the AED as soon as it is available, and analyze the patient’s cardiac rhythm. To avoid interrupting CPR, you should apply the AED pads around your partner’s hands as he or she is performing chest compressions (do not stop compressions to do this).

If the AED advises you to shock, then deliver the shock and immediately resume CPR, starting with chest compressions. If the AED does not advise you to shock, then immediately resume CPR, starting with chest compressions. During CPR, ask the two bystanders if they witnessed the event and determine whether they know anything about the patient (ie, past medical history, events leading up to the arrest).

Regardless of how a call is dispatched and whether or not you are assuming patient care from bystanders or other health care providers, it is important for you to always perform a primary assessment of the patient.

3. What links in the chain of survival have been maintained at this point?

The following links in the chain of survival have been maintained:

- *Recognition and activation of the emergency response system*, because the bystanders quickly recognized the patient was experiencing a cardiac emergency and immediately called 9-1-1.
- *Immediate, high-quality CPR*, because the bystanders began CPR directly after calling 9-1-1.
- *Basic and advanced emergency medical services*, because EMS providers are at the scene providing specialized care to the patient.

The following links in the chain of survival have not been maintained:

- *Rapid defibrillation*, because it has not yet occurred. Of all the links in the chain of survival, early defibrillation has the most profound impact on patient survival. With early access and early CPR, defibrillation may successfully terminate lethal cardiac dysrhythmias in a significant number of patients. For each minute that defibrillation is delayed, the patient's chance for survival decreases by 7% to 10%.
- *Advanced life support and postarrest care*, because ROSC has not been established and the patient has not arrived at the hospital.

4. Why is it so critical to minimize interruptions in CPR?

Even when CPR is performed correctly (that is, at a rate of 100 to 120 compressions per minute and a depth of 2 inches to 2.4 inches [5 cm to 6 cm] in the adult), chest compressions only deliver about one-third of a person's normal cardiac output. When CPR is performed properly and with minimal interruption, it is often enough to keep the patient's vital organs viable until defibrillation and more advanced care can be provided at the ED. Of course, this assumes that defibrillation and advanced care are provided within a short period of time.

Within a few seconds of stopping chest compressions, the pressure generated in the arteries drops to near zero; therefore, frequent or prolonged interruptions in chest compressions will not even provide the minimum perfusion needed to keep the vital organs viable. This has been clearly linked to low survival rates from cardiac arrest. Remember to maintain a chest compression fraction of at least 60%.

As soon as cardiac arrest has been confirmed, it is crucial to begin CPR immediately and apply the AED as soon as it is available. Even when the AED pads are being applied, your partner should continue chest compressions; you should apply the pads around your partner's hands.

5. Should you remove the medication patch or leave it in place? Why or why not?

The patch is located on the patient's right upper chest, which is where you will place one of the AED pads. Because of its location, the patch could interfere with the electrical current to the heart and may cause burns to the patient's skin. To prevent this complication, remove the patch, wipe any residue from the skin, and then apply the AED pads. Remember to take standard precautions!

6. What does the bulge and scar over the patient's left chest indicate? How will this affect the way you treat the patient?

A hard lump or bulge on the patient's chest, usually with a corresponding scar, indicates an AICD or pacemaker. These devices are used in patients who are at high risk for certain cardiac dysrhythmias and cardiac arrest. The AICD will deliver shocks directly to the heart if it detects a lethal cardiac dysrhythmia. Implanted pacemakers are used to increase the patient's heart rate if it falls below a given value.

If the AED pads are placed directly over the device, then shocks delivered by the AED may be less effective. Therefore, if you identify an AICD or pacemaker, place the AED pad at least 1 inch (2.5 cm) away from the device. Because most of these devices are implanted in the upper left chest, this should not be an issue. The pads are placed to the right of the upper sternum and to the lower left chest, just below the nipple, so they should be well beyond 1 inch (2.5 cm) from the device. Follow your local protocols regarding patients with AICDs or implanted pacemakers.

7. How should you continue to treat this patient?

You have restored a pulse in your patient; however, his breathing is not adequate. Agonal gasps are ineffective and do not produce adequate minute volume.

Some patients may have an intact gag reflex, despite being unresponsive; in these cases, an oropharyngeal airway is contraindicated. Insert a nasopharyngeal (nasal) airway and continue to provide rescue breathing. Deliver one breath every 5 to 6 seconds (10 to 12 breaths/min); each breath should be delivered over 1 second (just enough to produce visible chest rise). Closely and carefully monitor the patient's pulse and be prepared to resume CPR if necessary.

Assume the patient has a full stomach and have a suction unit ready in case he regurgitates. Remember that mortality increases significantly if aspiration occurs. It is also important to avoid hyperventilating the patient.

8. Because the patient is no longer in cardiac arrest, should you remove the AED pads? Why or why not?

Although the patient is not in cardiac arrest, he is still at high risk for redeveloping cardiac arrest. Therefore, do not remove the AED pads; simply turn the AED off, continue rescue breathing, and prepare the patient for prompt transport.

9. Would an ITD benefit your patient at this point?

An ITD is a valve device that is placed between the ET tube and resuscitation bag; it can also be placed in between the resuscitation bag and mask if the patient is not intubated. It is only used for patients who are apneic and pulseless. At this point, your patient has a pulse and is breathing (albeit slowly and shallowly); therefore, the ITD is not indicated. Furthermore, the ITD may be of benefit when used during active compression-decompression CPR, but it is not recommended for use during conventional CPR. If ROSC occurs, the ITD must be removed.

10. What further treatment, if any, is indicated for this patient?

Further treatment of your patient should consist of careful monitoring because he remains at high risk for recurrence of cardiac arrest. In patients who are responsive and alert, the presence of a pulse is obvious; however, when a patient is unresponsive, you must frequently reassess for a pulse.

Unresponsive patients are at increased risk for regurgitation, which could lead to aspiration and increased mortality. Vigilantly monitor the patient’s airway status and be prepared to turn his head to the side if he regurgitates. Maintain his airway with manual positioning and a basic airway adjunct; in this case, a nasal airway.

Although the patient is breathing, his breaths are slow and shallow. Slow, shallow (reduced tidal volume) respirations will not produce adequate minute volume; therefore, continue to assist the patient’s ventilations with a BVM, but do not hyperventilate him. Deliver each breath over 1 second while observing for visible chest rise. Monitor his oxygen saturation (SpO_2) level and heart rate to help you determine if your assisted ventilations are adequate.

As mentioned earlier, do not remove the AED pads. Turn the AED off, but be prepared to stop the ambulance if cardiac arrest redevelops.

The patient’s blood pressure (86/66 mm Hg) is still low. Follow your local protocols regarding positioning of the patient to improve his blood pressure.

EMS Patient Care Report (PCR)

Date: 12-29-16	**Incident No.:** 011109	**Nature of Call:** Cardiac arrest		**Location:** 123 Wilshire Ave.	
Dispatched: 1445	**En Route:** 1447	**At Scene:** 1454	**Transport:** 1508	**At Hospital:** 1518	**In Service:** 1528

Patient Information

Age: 48 **Sex:** M **Weight (in kg [lb]):** 77 kg (170 lb)	**Allergies:** Unknown **Medications:** Unknown **Past Medical History:** Unknown **Chief Complaint:** Cardiac arrest

Vital Signs

Time: 1454	**BP:** N/A	**Pulse:** 0	**Respirations:** 0	**Spo_2:** N/A
Time: 1458	**BP:** N/A	**Pulse:** 0	**Respirations:** 0	**Spo_2:** N/A
Time: 1501	**BP:** 70/40	**Pulse:** 100	**Respirations:** 4	**Spo_2:** 82%
Time: 1508	**BP:** 86/66	**Pulse:** 94	**Respirations:** 8	**Spo_2:** 95%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:**

Narrative

Medic 51 dispatched to grocery store parking lot for "CPR in progress." On arrival at the scene, found two bystanders performing CPR on the patient, a 48-year-old male. Medic 48 was dispatched to the scene to assist. Primary assessment revealed that the patient was apneic and pulseless. Continued one-rescuer CPR for 2 minutes while the AED was being prepared. Per one of the bystanders, the patient was about to get in his vehicle when he suddenly grabbed his chest, slumped against the vehicle, and eased himself to the ground. There was no trauma involved. The bystander further stated that by the time he got to the patient, he was unresponsive and without pulse or breathing. After 2 minutes of CPR, EMS analyzed patient's cardiac rhythm with the AED and received a shock advised message. Delivered single shock and immediately resumed CPR. Medic 48 arrived at scene and assisted with CPR and airway management. The patient's past medical history was unknown, although he had an AICD and was wearing a medication patch, which was removed. Continued CPR for 2 minutes, reanalyzed the patient's cardiac rhythm, and received a no shock advised message. Continued CPR and attempted to insert an oral airway; however, the patient began to gag. Immediate reassessment revealed that he had a strong carotid pulse, but was not breathing adequately. Inserted a nasal airway, continued ventilations at 12 breaths/min, packaged the patient, and loaded him into the ambulance. EMT Smith from Medic 48 assisted with patient care en route to the hospital. En route, reassessed patient and found that he remained unresponsive; his respiratory rate increased, but the depth of his breathing remained shallow. Continued assisted ventilation and called in radio report to the receiving facility. Monitored the patient's pulse, provided additional supportive care, and delivered him to the ED without incident. Gave verbal report to attending physician. Medic 51 cleared the hospital and returned to service at 1528.
End of report

Prep Kit

Ready for Review

- BLS is noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest.
- BLS care focuses on the ABCs: airway (obstruction), breathing (respiratory arrest), and circulation (cardiac arrest or severe bleeding). If the patient is in cardiac arrest, a CAB sequence (compressions, airway, breathing) should be used.
- CPR is used to establish artificial ventilation and circulation in a patient who is not breathing and has no pulse.
- The goal of CPR is to help restore spontaneous breathing and circulation; however, advanced procedures such as medications and defibrillation are often necessary for this to occur.
- ALS involves advanced lifesaving procedures, such as cardiac monitoring, administration of IV fluids and medications, and use of advanced airway adjuncts.
- The five links in the chain of survival are (1) recognition and activation of the emergency response system; (2) immediate, high-quality CPR; (3) rapid defibrillation; (4) basic and advanced emergency medical services; and (5) ALS and postarrest care.
- The AED should be applied to any nontrauma cardiac arrest patient as soon as it is available.
- When using an AED on a child between ages 1 and 8 years, use pediatric-sized pads and a dose-attenuating system (energy reducer). If these items are unavailable, then use adult-sized AED pads. In infants (age 1 month to 1 year), manual defibrillation is preferred. If a manual defibrillator is unavailable, then use an AED equipped with pediatric-sized pads and a dose attenuator. If neither option is available, then use adult-sized AED pads.
- As an EMT, it is your responsibility to start CPR in virtually all patients who are in cardiac arrest. The three general exceptions to the rule are as follows: (1) You should not start CPR if the scene is unsafe; (2) You should not start CPR if the patient has obvious signs of death; and (3) You should not start CPR if the patient and his or her physician have a previously agreed-on DNR or no-CPR order.
- As an EMT, you are generally not responsible for making the decision to stop CPR. After you begin CPR in the field, you must continue until one of the following events occurs (the STOP mnemonic):
  - **S**, the patient *Starts* breathing and has a pulse.
  - **T**, the patient's care is *Transferred* to another provider of equal or higher-level training.
  - **O**, you are *Out* of strength or too tired to continue.
  - **P**, a *Physician* who is present or providing online medical direction assumes responsibility for the patient and gives direction to discontinue CPR.
- An airway obstruction may have various causes, including relaxation of the throat muscles in an unresponsive patient; vomited or regurgitated stomach contents; blood; damaged tissue after an injury; dentures; or foreign bodies such as food or small objects.
- The manual maneuver recommended for removing severe airway obstructions in the responsive adult and child is the abdominal-thrust maneuver (the Heimlich maneuver). Use back slaps and chest thrusts to treat a responsive infant with a severe airway obstruction.
- If the adult, child, or infant with a severe airway obstruction is unresponsive, then perform CPR, starting with chest compressions.
- As an EMT, you will encounter situations in which grief support for family and loved ones will be part of your role. After resuscitation has stopped, turn your attention to the family and loved ones, and provide clear communication and emotional support.

Vital Vocabulary

abdominal-thrust maneuver The preferred method to dislodge a severe airway obstruction in adults and children; also called the Heimlich maneuver.

active compression-decompression CPR A technique that involves compressing the chest and then actively pulling it back up to its neutral position or beyond (decompression); may increase the amount of blood that returns to the heart and, thus, the amount of blood ejected from the heart during the compression phase.

advanced life support (ALS) Advanced lifesaving procedures used to treat medical conditions, such as cardiac monitoring, administration of intravenous fluids and medications, and the use of advanced airway adjuncts. EMTs may be trained in some of these areas.

basic life support (BLS) Noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest.

cardiopulmonary resuscitation (CPR) The combination of chest compressions and rescue breathing used to establish adequate ventilation and circulation in a patient who is not breathing and has no pulse.

chest compression fraction The total percentage of time during a resuscitation attempt in which active chest compressions are being performed.

dependent lividity Blood settling to the lowest point of the body, causing discoloration of the skin; a definitive sign of death.

gastric distention A condition in which air fills the stomach, often as a result of high volume and pressure during artificial ventilation.

head tilt–chin lift maneuver A combination of two movements to open the airway by tilting the forehead back and lifting the chin; not used for trauma patients.

hyperventilation Rapid or deep breathing that lowers the blood carbon dioxide level below normal; may lead to increased intrathoracic pressure, decreased venous return, and hypotension when associated with BVM use.

impedance threshold device (ITD) A valve device placed between the endotracheal tube and a bag-valve mask that limits the amount of air entering the lungs during the recoil phase between chest compressions.

ischemia A lack of oxygen that deprives tissues of necessary nutrients, resulting from partial or complete blockage of blood flow; potentially reversible because permanent injury has not yet occurred.

jaw-thrust maneuver Technique to open the airway by placing the fingers behind the angle of the jaw and bringing the jaw forward; used for patients who may have a cervical spine injury.

load-distributing band (LDB) A circumferential chest compression device composed of a constricting band and backboard that is either electrically or pneumatically driven to compress the heart by putting inward pressure on the thorax.

mechanical piston device A device that depresses the sternum via a compressed gas-powered or electric-powered plunger mounted on a backboard.

recovery position A side-lying position used to maintain a clear airway in unresponsive patients who are breathing adequately and do not have suspected injuries to the spine, hips, or pelvis.

return of spontaneous circulation (ROSC) The return of a pulse and effective blood flow to the body in a patient who previously was in cardiac arrest.

rigor mortis Stiffening of the body muscles; a definitive sign of death.

stridor A harsh, high-pitched respiratory sound, generally heard during inspiration, that is caused by partial blockage or narrowing of the upper airway; may be audible without a stethoscope.

ventilation Exchange of air between the lungs and the environment, spontaneously by the patient or with assistance from another person, such as an EMT.

Assessment *in Action*

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Your EMS supervisor is conducting a so-called tabletop exercise with your crew in preparation for the next cardiac arrest call and wants to assess your crew's knowledge of cardiac arrest management. She presents your crew with the following scenario questions.

1. Which intervention(s) would have the MOST positive impact on the cardiac arrest patient's outcome?

   A. Advanced airway management
   B. Early CPR and defibrillation
   C. IV fluid administration
   D. Cardiac medications

2. The AED gives a "no shock" message to a patient who is in cardiac arrest. You should:

   A. resume chest compressions.
   B. check for a carotid pulse.
   C. reanalyze the cardiac rhythm.
   D. deliver two rescue breaths.

3. What is the maximum amount of time that should be spent checking for spontaneous breathing in an unresponsive child?

   A. 5 seconds
   B. 10 seconds
   C. 15 seconds
   D. 20 seconds

4. When performing CPR on an adult, you should compress the chest to a depth of ___ at a rate of ___ compressions per minute.

   A. 1 inch to 1.4 inches (2.5 cm to 3.5 cm); 80 to 100
   B. 2 inches to 2.4 inches (5 cm to 6 cm); 80 to 100

C. 1 inch to 1.4 inches (2.5 cm to 3.5 cm); 100 to 120
D. 2 inches to 2.4 inches (5 cm to 6 cm); 100 to 120

5. What is the proper compression-to-ventilation ratio for adult two-rescuer CPR?

A. 15:2
B. 30:2
C. 50:2
D. 75:2

6. When checking for a pulse in an infant, you should palpate which of the following arteries?

A. Carotid
B. Femoral
C. Brachial
D. Dorsalis pedis

7. When you are performing CPR on an adult or child, you should reassess the patient for return of respirations and/or circulation approximately every __________ minutes.

A. 5
B. 3
C. 2
D. 1

8. What is the preferred method of removing a foreign body in an unresponsive child?

A. Back slaps
B. Abdominal thrusts
C. Chest compressions
D. Manual removal

9. After you have started CPR in the field, under what circumstances can you stop?

10. Explain why the presence of gastric distention is dangerous to the patient.

SECTION

6

Medical

CHAPTER 14

Medical Overview

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National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Medical Overview

Assessment and management of a

› Medical complaint (pp 561–568)

Pathophysiology, assessment, and management of medical complaints to include

› Transport mode (pp 567–568)
› Destination decisions (p 568)

Infectious Diseases

Awareness of

› A patient who may have an infectious disease (pp 568–576)

Assessment and management of

› A patient who may have an infectious disease (pp 568–576)

Knowledge Objectives

1. Differentiate between medical emergencies and trauma emergencies, remembering that some patients may have both. (p 561)
2. Name the various categories of common medical emergencies and give examples. (p 561)
3. Describe the evaluation of the nature of illness (NOI). (p 562)
4. Discuss the assessment of a patient with a medical emergency. (pp 562–566)
5. Explain the importance of transport time and destination selection for a medical patient. (p 567)
6. Define infectious disease and communicable disease. (p 569)
7. Discuss diseases of special concern and their routes of transmission, including influenza, herpes simplex, HIV/ AIDS, hepatitis, meningitis, tuberculosis, whooping cough, MRSA, MERS-CoV, and Ebola. (pp 569–575)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

Patients who need EMS assistance generally have experienced either a medical emergency or trauma emergency; in some cases both have occurred. **Trauma emergencies** involve injuries resulting from physical forces applied to the body. **Medical emergencies** involve illnesses or conditions caused by disease. While it is important for you to be able to make the distinction between medical and trauma patients, it is equally important for you to remember that patients may have a combination of medical and trauma conditions affecting their health. For example, a person who has a heart attack while driving may be involved in a crash, or a diabetic patient whose blood glucose level is too low may fall and be injured. This chapter discusses medical emergencies. Chapter 24, *Trauma Overview*, discusses trauma emergencies.

Types of Medical Emergencies

There are many types of medical emergencies Table 14-1. Respiratory emergencies occur when patients have trouble breathing or when the amount of oxygen supplied to the tissues is inadequate. Diseases that can lead to respiratory emergencies include asthma, emphysema, and chronic bronchitis. Cardiovascular emergencies are caused by conditions affecting the circulatory system. The most common examples that require EMS intervention include heart attacks and congestive heart failure. Neurologic emergencies involve the brain and may be caused by a seizure, stroke, or fainting (syncope). Many gastrointestinal conditions can result in a call to EMS for help. The most well-known condition is appendicitis, although there are many others, including diverticulitis and pancreatitis. A urologic emergency can involve kidney stones. The most common endocrine emergencies are caused by complications of diabetes mellitus. Hematologic (blood) emergencies may be the result of sickle cell disease or various types of blood clotting disorders such as hemophilia. Immunologic emergencies involve the body's response to foreign substances. When the body overreacts to a foreign substance, it is commonly referred to as an allergic reaction. Allergic reactions are a type of immunologic medical emergency that can range from fairly minor to life threatening. Toxicologic emergencies, including poisoning and substance abuse, result in other types of medical emergencies. Some medical emergencies are caused by psychological or behavioral problems. Behavioral emergencies may be especially difficult to manage because patients often do not present with typical signs and symptoms. Gynecologic conditions are a special category of medical emergencies that involve the female reproductive organs. These conditions will most likely be very challenging for you because there is little that you can do to treat patients with gynecologic conditions in the prehospital setting. The chapters in this section discuss each of these medical emergencies.

Table 14-1 Common Medical Emergencies

Type of Medical Emergency	Examples of Condition
Respiratory	Asthma, emphysema, chronic bronchitis
Cardiovascular	Heart attack, congestive heart failure
Neurologic	Seizure, stroke, syncope
Gastrointestinal	Appendicitis, diverticulitis, pancreatitis
Urologic	Kidney stones
Endocrine	Diabetes mellitus
Hematologic	Sickle cell disease, hemophilia
Immunologic	Anaphylactic reaction (severe allergy to bee stings, food, or other substances)
Toxicologic	Substance abuse, food, plant, or chemical poisoning
Psychiatric	Alzheimer disease, schizophrenia, depression
Gynecologic	Vaginal bleeding, sexually transmitted disease, pelvic inflammatory disease, ectopic pregnancy

Patient Assessment

Assessment of a medical patient is similar to the assessment of a trauma patient but with a different focus. Whereas trauma assessments focus on the mechanism of injury or physical injuries, most of which are visible through a physical examination, medical patient assessment focuses on the **nature of illness (NOI)**, symptoms, and the patient's chief complaint. When you are assessing a patient, establish an accurate medical history. Information received from dispatch can be helpful in anticipating what you might find when you arrive on scene, but it is conceivable that what appears to be a traumatic emergency may in fact be a medical emergency or vice versa. Use the dispatch information to guide your initial response, but do not get locked into a preconceived idea of the patient's condition strictly from what the dispatcher tells you. During assessment, be aware of several challenges. It is possible that a patient has sustained an injury that distracts you from an underlying condition. For example, a patient may have a medical condition that resulted in a motor vehicle crash, or the patient may have sustained a large laceration and you fail to recognize that the patient has had a hypoglycemic event. Tunnel vision occurs when you become focused on one aspect of the patient's condition and exclude all others, which may cause you to miss an important injury or illness.

Patients may sometimes be uncooperative or even hostile toward those who respond to care for them. Patients may be fearful, angry, and confused and may take out their frustrations on you. It is important that you maintain a professional, calm, nonjudgmental demeanor at all times.

You are obligated as a medical professional to refrain from labeling patients and displaying personal biases. Never assume that you know what the problem is, even when you are treating patients who frequently call for EMS. This attitude could result in missing a serious condition. For example, an intoxicated patient may call 9-1-1 regularly and then call at another time after a fall resulting in a serious head injury. The head injury may be overlooked if you assume the call is a response only to intoxication. Labeling a patient is dangerous, demeaning, and detrimental to you and the patient. Personal biases should never affect your management of a patient. Any biases you may have need to be resolved before you respond to calls. As discussed in Chapter 9, *Patient Assessment*, the major components of patient assessment include the following:

- Scene size-up
- Primary assessment
- History taking
- Secondary assessment
- Reassessment

Scene Size-up

You must complete a scene size-up. The most important aspect of this step is to make sure the scene is safe. Although hazards are not as obvious with medical emergencies as with trauma situations, they still exist and must be considered. Therefore, remain conscious of your safety and the safety of your crew and patient before you enter a scene and throughout the call.

It is also important that you use standard precautions when you respond to an emergency, including wearing gloves and other protective equipment. As soon as possible after your arrival, determine the number of patients who need assistance. In most medical cases, there will be only one patient, but anticipate the possibility of more patients and be prepared. Finally, consider whether you need additional help. If you anticipate needing air transport, an advanced life support (ALS) unit, or police assistance, call for them immediately if you have not already done so, so that they will arrive as soon as possible.

YOU are the Provider — PART 1

Your unit is dispatched to 125 Green Hills Drive for a 36-year-old man with a fever and chills. The time is 1325 hours, there is a fine mist falling, the temperature is 72°F (22.2°C), and the traffic is moderate. You and your partner respond; the scene is located approximately 10 minutes away.

1. What observations should you make when you arrive at the scene before making physical contact with the patient?

Determine the NOI. What signs and symptoms is the patient experiencing? Evaluation of the NOI for a medical patient will provide you with an index of suspicion for different types of serious and/or life-threatening underlying illnesses. The **index of suspicion** is your awareness and concern for potentially serious underlying and unseen injuries or illnesses. Finally, as always, initiate spinal stabilization if indicated.

Primary Assessment

As you approach a medical patient, you should develop a general impression of his or her condition. Perform a rapid examination of the patient to identify life threats. Visual clues include apparent unconsciousness, obvious severe bleeding, or extreme difficulty breathing.

Quickly determine the patient's level of consciousness using the AVPU scale. If the patient is alert on your approach, you can infer several things about his or her condition, but you must always complete the remainder of the primary assessment. If the patient is unconscious as you approach, try to see if you can get a response to verbal stimuli by speaking to the patient while using a gentle touch. If the patient does not respond to your verbal stimulation, pinch the patient's ear or use the trapezius squeeze test (a pinch on the muscle that runs along the side of the neck to the shoulders) to see whether the patient responds. If there is no response to verbal or painful stimuli, consider the patient unresponsive and quickly continue the assessment.

Words of Wisdom

Do not let a relatively normal impression lull you into complacency. The conditions of many medical patients may not appear serious at first.

In conscious patients, ensure the airway is open and they are breathing adequately. Check the respiratory rate, depth, and quality. Consider applying oxygen at this time if there is any indication that breathing has been affected. For unconscious patients, make sure to open the airway using the proper technique for their condition and take several seconds to evaluate their breathing. Apply oxygen to patients in shock, with difficulty breathing, and when low oxygen saturations are measured (Spo_2 less than 94%). Consider having your partner administer oxygen as you continue your assessment. Unconscious patients may need airway adjuncts and ventilatory assistance with a bag-valve mask (BVM).

YOU are the Provider — PART 2

You arrive at the residence and knock on the patient's door. His wife answers and escorts you to the bedroom where you find the patient in a semi-sitting position in his bed. He is conscious and alert, is covered with several blankets, and is shivering. Your primary assessment reveals the following information:

Recording Time: 0 Minutes	
Appearance	Flushed skin, shivering
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, rapid strong; skin, flushed and hot to the touch

The patient tells you that he began feeling ill the day before but then started running a fever last night. Other than chills and generalized weakness, he denies any other symptoms. He took 400 mg of ibuprofen approximately 30 minutes ago, and his wife took his temperature shortly before your arrival; it read 102.6°F (39.2°C).

2. On the basis of your general impression and primary assessment findings, does this patient require immediate transport?

3. How should you proceed with your care of the patient?

Figure 14-1 Skin color can provide an early and fast indication of several disease processes. Cyanosis presents as blue skin. This photo also shows nail clubbing, associated with chronic hypoxemia seen in various lung and heart diseases.

Quickly assess the circulation in a conscious patient by checking the radial pulse and observing the patient's skin color, temperature, and condition **Figure 14-1**. For unconscious patients, assess the circulation at the carotid artery because generally this is the site of the strongest pulse and it is relatively easy to palpate on a supine person. Also quickly glance around the patient to identify any life threats such as severe bleeding or injury to the chest that affects the breathing. If any life threats are found, address them immediately.

Once you have completed the primary assessment, you should have enough information to make a preliminary transport decision. The following patients should be considered in serious condition and in need of rapid transport: patients who are unconscious or who have an altered mental status, patients with airway or breathing problems, and patients with obvious circulation problems such as severe bleeding or signs of shock. Patients identified as needing rapid transportation still require additional assessment and care.

Words of Wisdom

Once the primary assessment has been completed, a preliminary transport decision should be made.

If the patient does not meet the criteria for rapid transport at this time, continue your assessment on scene and prepare for transport after you have completed the assessment and treatment. If you find that your patient's condition deteriorates during the primary assessment, prepare the patient for immediate transport and complete the assessment en route to the emergency department (ED).

History Taking

With a medical patient, history taking may be the only way to determine what the problem is or what may be causing the problem. It is imperative to gather a thorough history from the patient and/ or any family, friends, or bystanders who may have pertinent information. Family members may be the only people aware that an older patient sustained a head injury the previous week or that a patient has a history of drug abuse. Bystanders may have seen clues prior to the 9-1-1 call that will lead you and the hospital staff to identify the cause of a patient's condition. Investigate the NOI by inquiring about the chief complaint. Identifying signs and symptoms associated with the chief complaint will often help you determine the nature of the condition. Ask about the history of the present illness and ask follow-up questions such as, "Has anything like this ever happened before?" If the patient answers yes, then ask, "What was done at that time?" and "How does this episode compare with previous episodes?"

If a patient is unconscious, survey the scene for evidence of medication containers or medical devices the patient may have been using. Try to obtain as much of the patient's medical history as possible from family members, friends, and bystanders or from the scene itself. Family members or friends may know the patient's allergies, medications, or medical conditions. Ask whether the patient reported any symptoms before he or she lost consciousness. If possible, have a family member accompany you to the hospital to answer questions there as well.

As you continue to gather information, remember to obtain a SAMPLE history and to ask questions about the patient's chief complaint using the OPQRST mnemonic. Ask patients to identify all the symptoms they are experiencing. Make sure you record any allergies, medical conditions, and medications they take **Figure 14-2**. Ask about prescriptions, over-the-counter medications, and herbal medications.

Sometimes older patients will report taking numerous medications. In those situations, it is best to take the medications with you to the hospital, and list them in your report. Ask patients about their medical history to help determine the current problem and identify any other conditions that might cause complications. To obtain a complete history, ask about specific conditions such as heart problems, breathing problems, and blood sugar (glucose) problems. Determine if the patient is taking any medications for these conditions and whether he or she is compliant with the drug regimen. The purpose of these questions is to obtain the most complete medical history possible. In addition, look around the scene for clues, such as prescription pill bottles or home medical equipment, that may help you piece together the patient's medical history and better understand the circumstances surrounding the current medical emergency.

Figure 14-2 History taking is an important part of the patient assessment process.

Words of Wisdom

The mnemonic TACOS can be useful in the assessment process.

T Tobacco
A Alcohol
C Caffeine
O Over-the-counter medications/herbal supplements
S Sexual and street drugs

TACOS can help you understand the underlying conditions a patient may have that could be complicating the chief complaint. It also helps you understand why the medications administered may or may not work for a patient. For example, if you have a male medical patient reporting chest pain and you want to administer nitroglycerin, ask the patient whether he has taken medication to treat erectile dysfunction. The combination of these two medications may cause a dangerous drop in blood pressure. If the answer is yes, follow up by asking how much medication was taken and how often. In another example that involves a young woman who is showing signs of a stroke, you need to ask whether she smokes and takes birth control pills or herbal supplements (substances that increase the risk of clot formation and thus the risk of stroke). TACOS will help you remember to ask these important questions.

Secondary Assessment

In some cases in which the patient is critically ill or injured or the transport time is short, you may not have time to conduct a secondary assessment. In other cases, the secondary assessment may occur on scene or en route to the ED.

Conscious medical patients seldom need a secondary assessment of the entire body or a head-totoe examination, but all conscious patients should undergo a limited or detailed physical examination based on their chief complaint. For example, you should check for pulse, motion, and sensation in all of the patient’s extremities and check the patient’s pupillary reaction if you suspect a neurologic problem. Unconscious patients are unable to tell you what is wrong, so you should always perform a secondary assessment of the entire body or a head-to-toe examination. A full body assessment should help you obtain clues to assess the problem, but this assessment should be performed quickly so it does not delay transport to the hospital.

Words of Wisdom

Medical alert jewelry may provide you with valuable information about why the patient is unconscious.

If the patient's condition does warrant the secondary assessment, begin by carefully examining the head, scalp, and face. Look for evidence of possible trauma, and monitor the patient for any signs of pain with palpation throughout the assessment. Examine the head and face for symmetry, making sure to check the pupils for equality and reactivity to light. Look at the conjunctiva of the eyes for moisture and the ears and nose for any drainage. Look for nasal flaring, and examine the mouth for foreign bodies (including loose teeth or dentures) and pink, moist mucosa.

Examine the neck closely for any evidence of accessory muscle use with respirations. Check for jugular vein distention and tracheal deviation, which can be indicators of respiratory or cardiac problems. While you are examining the neck, make sure to move any clothing so that you can check for a tracheostomy or stoma.

Next, assess the chest and abdomen. At the chest, make sure to check breath sounds and ensure that the patient is breathing adequately with equal chest rise and fall on each side. Carefully inspect and palpate the chest and abdomen to identify any areas of tenderness or swelling. Look for medication patches on the chest or abdomen and any implanted medical devices, which usually can be palpated just under the skin. Check for rigidity and distention in the abdomen, and look for scars on the chest or abdomen that might indicate previous surgeries. Finally, check the pelvis and genital area, asking about pain and looking for signs of incontinence or bleeding.

Palpate the legs and arms for swelling and other abnormalities, making sure to check for distal motion, sensation, and circulation. Note any scars, or track marks, along the veins, which are indicators of intravenous (IV) drug use. Look for medical alert jewelry at the wrists as well. Finally, examine the patient's back to note any irregularities, pain, or scars. At this point, your full assessment of the patient should be complete, and treatment of non–life-threatening conditions should be instituted. Treatment will depend on the condition(s) and your local protocols.

Words of Wisdom

While the use of an automatic blood pressure cuff is convenient, you should always attempt to obtain at least one manual blood pressure reading to be sure it correlates with the automatic reading.

Obtaining a good set of vital signs is critical. Often your partner can begin this process while you are asking about the medical history. Assess the pulse for rate, quality, and regularity at the most appropriate site, either at the radial artery if the patient is conscious, or at the carotid artery if the patient is unconscious. Assess respirations as you assess the pulse to prevent the patient from modifying his or her respirations in response to your observation. Identify the rate, quality, and regularity of the respirations and any difficulties that may be apparent. Finally, obtain an initial blood pressure reading, measuring both systolic and diastolic pressures.

Consider using the automatic blood pressure cuff for future assessments at regular intervals. Depending on your local protocol, other important information to consider obtaining includes a blood glucose level and a pulse oximetry reading. End-tidal CO_2 ($ETCO_2$) monitoring should be considered if the patient complains of respiratory problems.

Reassessment

After completing the assessment and treatment, begin reassessment and continue throughout transport. During the reassessment, repeat the primary assessment and reassess the chief complaint. Look for any changes in the level of consciousness; reassess the airway, breathing, and circulation; and reexamine the transport decision. Consider the need for ALS backup. Obtain another full set of vital signs every 5 minutes for unstable patients or every 15 minutes for stable patients. Reassessment also includes repeating your physical examination to identify and treat changes in the patient's condition.

YOU are the Provider — PART 3

Your partner obtains the patient's vital signs. The patient agrees to transport and asks you to take him to a hospital that he has been to before, which is located 25 miles away. There is another hospital located only 10 miles away.

Recording Time: 5 Minutes	
Respiration	22 breaths/min; regular and adequate
Pulse	110 beats/min; strong and regular
Skin	Flushed; hot to the touch
Blood pressure	124/70 mm Hg
Oxygen saturation (Spo_2)	99%

4. Is it appropriate to transport the patient to the hospital he requested, or should you transport him to the closer facility?

Finally, the reassessment includes reviewing all treatments that have been performed. Reassess oxygen delivery, any bandages or splints applied, and any other treatment that has been performed.

Document any changes that have developed as a result of the treatments, and, if needed, adjust any of the treatments accordingly. Reassessment is an important step in patient assessment to modify care accordingly and so that you have the most current information on the patient's condition when you arrive at the hospital.

Management, Transport, and Destination

Most medical emergencies require a level of treatment beyond that available in the prehospital setting. Also, the treatments depend on an accurate diagnosis of the exact medical condition, which may require advanced testing available in a hospital. The primary prehospital treatments for medical emergencies address the symptoms more than the actual disease process.

Depending on local protocol, it may be beyond the scope of an EMT to administer medications to a patient. In a few limited circumstances, such as the administration of nitroglycerin to a patient with chest pain or to a patient for whom it has been prescribed, an exception may be made. Another exception may be granted to allow an EMT to assist a patient with a prescribed metered-dose inhaler when it is required because of respiratory difficulty.

Administration of medications that are stored in the ambulance is also limited for EMTs and is dependent on state and local protocols. A few of these protocols include administering aspirin for patients having chest pain, administering oral glucose to a patient with diabetes and a low blood glucose level, and possibly administering albuterol to a patient with respiratory difficulty. The administration of activated charcoal to a patient who has ingested a poison is also allowed when it may be beneficial. Each of these situations and any other administration of medication by an EMT require that direct permission be obtained from medical control. The process of obtaining permission includes completing a thorough assessment of the patient before calling medical control. After you give a report to the physician and obtain permission, the medication may be administered. Never administer any medication without first obtaining permission from medical control, and always follow your state and local protocols.

You may also use an automated external defibrillator (AED) on a patient who is pulseless and apneic. In some cases of cardiac arrest, immediate treatment with an AED may provide the best option to resuscitate the patient. The AED is discussed in more detail in Chapter 16, *Cardiovascular Emergencies*. Familiarize yourself with the equipment and medications carried on your ambulance and use them appropriately under a medical director's instruction.

Scene Time

In many cases, the time on scene may be longer for medical patients than for trauma patients. If the patient is not in critical condition, gather as much information as possible from the scene so that you can transmit that information to the physician at the ED. Check the patient's living conditions—heating, air conditioning, cleanliness of environment, adequate food, and so on. Critical patients include those with altered mental status, airway or breathing difficulties, or any sign of circulatory compromise. In addition, a patient who is very old or very young may be considered critical even if they appear to be relatively stable. Critical patients always need rapid transport. The time on scene should be limited to 10 minutes or less for these patients.

Type of Transport

Serious consideration should be given to how best to transport a medical patient. If a life-threatening condition exists, the transportation should include lights and sirens, but if the patient is not critical, consider nonemergency transport. Many patients experiencing a medical emergency do not have immediate life-threatening conditions; therefore, they can be transported without the use of lights and sirens. This is a much safer method of transport and will often result in arrival only a few minutes later than an emergency transport using lights and sirens.

Differentiating a high-priority transport from a low-priority transport is a skill developed with experience, but it is a skill that can be learned. A good rule of thumb for determining the priority of transport is to consider the results of the patient's primary assessment. Patients with an altered mental status, especially if it is still present at the completion of your assessment and treatment, should be considered a high-priority transport. Patients with circulatory compromise, including signs and symptoms of shock, should also be considered a high-priority transport. Most patients with circulatory problems cannot be stabilized in the prehospital setting and need to receive treatment at a hospital quickly but safely. Patients with difficulty breathing generally require high-priority transport. However, if the patient has responded well to your initial treatment, such as oxygen and albuterol administration, lights and sirens may not be necessary.

Modes of transport ultimately come in one of two categories: ground **Figure 14-3** or air **Figure 14-4**. Ground transportation EMS units are generally staffed by EMTs and paramedics. Air transportation EMS units or critical care transport units are generally staffed by critical care transport professionals such as critical care nurses and paramedics. While it is not as common to summon an air ambulance for a medical patient, there are instances where it is advisable. In rural areas with long ground transport times, patients who have possibly experienced a heart attack, a stroke, or a complication of pregnancy could benefit from air transport. Children with serious medical conditions can also benefit from air transport. When you are considering ALS support for a patient, compare the total time for a ground ALS unit to respond and transport to the time required for an ALS helicopter to respond and transport as well as the urgent resources needed by the patient. Follow local protocols and medical direction.

Figure 14-3 Ground transport.

Figure 14-4 Air transport.

LindaCharlton/iStock.

Destination Selection

It is generally appropriate to select the closest ED as your destination. However, there are times when the closest hospital is not necessarily the most appropriate choice. Patients with chest pain as the result of a heart attack may need a facility that is capable of performing heart catheterization, which may not necessarily be available at the closest hospital. If the patient is in cardiac arrest or experiences cardiac arrest during transport, immediately reroute to the closest hospital with emergency facilities. Stroke patients can also benefit from specialized hospital selection. Although most hospitals now have designated stroke teams, taking a possible stroke patient to a hospital without these resources may result in a delay in definitive treatment and may lead to a worse outcome for the patient.

Some medical patients may benefit from on-scene treatment provided by advanced EMS personnel such as paramedics. It is important to recognize early when paramedics can provide added value on a scene so that, if they are readily available, they can be called to respond in a timely manner.

Infectious Diseases

As discussed in Chapter 2, *Workforce Safety and Wellness*, you will be called on to treat and transport patients with a variety of infectious or communicable diseases. Chapter 2 discusses the routes of transmission and standard precautions that responders need to take to reduce risk and increase prevention. This chapter discusses the awareness, assessment, and management of a patient who may have a communicable or infectious disease. Chapter 37, *Transport Operations*, discusses decontamination techniques after transport.

General Assessment Principles

The assessment of a patient suspected to have an infectious disease should be approached much like any other medical patient. With most patients who have a potentially infectious disease in the prehospital setting, the next step after scene size-up and primary assessment is to gather patient history, using OPQRST to elaborate on the patient's chief complaint. Typical chief complaints include fever, nausea, rash, pleuritic chest pain, difficulty breathing, vomiting, and diarrhea. Obtain a SAMPLE history and a set of baseline vital signs, paying particular attention to medications the patient is currently taking and the events leading up to today's problem. Also ask whether the patient has recently traveled or has come in contact with someone who has traveled. Always show respect for the feelings of the patient, family members, and others at the scene.

General Management Principles

The general management of the patient with a suspected infectious disease first focuses on any life-threatening conditions that were identified in the primary assessment (airway management, oxygen and ventilatory assistance, bleeding control, and circulatory support). Remember to be empathetic. Because most of these patients will have a fever of unexplained origin or mild breathing problems, place the patient in the position of comfort on the stretcher and keep him or her warm. Remember to use standard precautions for your own safety. Always follow your agency's exposure control plan regarding cleaning equipment, properly discarding any disposable supplies, and washing linens.

Epidemic and Pandemic Considerations

An **epidemic** occurs when new cases of a disease in a human population substantially exceed the number expected based on recent experience. A **pandemic** is an outbreak that occurs on a global scale. A flu pandemic occurs when a new influenza virus for which people have little or no immunity emerges. The disease can spread easily from person to person, cause serious illness, and be found in multiple countries in a short time. Obviously, there would be no specific vaccine immediately available.

Words of Wisdom

An **infectious disease** is a medical condition caused by the growth and spread of small harmful organisms within the body. A **communicable disease** is a disease that can be spread from one person or species to another. Most of these diseases are much harder to be infected with than is commonly believed. In addition, there are many immunizations, protective techniques, and devices that can be used to minimize your risk of infection. When these protective measures are used, the risk of your contracting a serious infectious disease is negligible.

Common or Serious Communicable Diseases

Influenza

Influenza, commonly known as flu, is primarily an animal respiratory disease that has mutated to infect humans. It can affect all people, but those with chronic medical conditions, compromised immune systems, the very young, and the very old are particularly susceptible to complications of the disease. All strains of influenza are transmitted by direct contact with nasal secretions and aerosolized droplets from coughing and sneezing by infected people.

The H1N1 virus, which was initially identified as the swine flu in 2009, is a specific form of influenza. This virus has been present for years in animals. Many deaths have been caused by the H1N1 virus, although deaths caused by other influenza viruses have also occurred. The most positive effect of the outbreak of the H1N1 virus has been the general public's greater awareness of the routes of transmission of contagious diseases. This increased awareness could result in a reduction of all communicable diseases, not only H1N1.

Many potentially serious diseases can be passed by the respiratory route; therefore, you need to wear personal protective equipment (PPE), such as gloves, eye protection, and a high-efficiency particle absorbing (HEPA) respirator, at a minimum. Viruses can live for several days on surfaces, so frequent handwashing is also important. Maintain your vaccinations and stay up-to-date on the latest Centers for Disease Control and Prevention (CDC) recommendations. Place a surgical mask on patients with suspected or confirmed respiratory disease. Wear a HEPA respirator during any aerosol-generating procedures such as suctioning of airway secretions, performing cardiopulmonary resuscitation, or assisting with endotracheal intubation.

An annual influenza immunization is important, especially for EMS personnel, to protect providers and patients. The influenza virus is constantly changing. Experts adjust vaccines from year to year to provide protection against the strains most likely to affect the population. Vaccination effectively decreases transmission rates and limits (though does not eliminate) the disease incidence. Complications of the vaccine are far less common and severe than complications of the flu, which kills people every year. The theory that immunizations cause autism has been proven through research to be untrue.

Herpes Simplex

Herpes simplex is a common virus strain carried by humans. Eighty percent of people carrying the virus are asymptomatic, but symptomatic infections cause eruptions of tiny fluid-filled blisters called *vesicles* that often appear on the lips or genitals. Herpes simplex can cause more serious illnesses like pneumonia and meningitis in the very young, very old, and immuno-compromised patients. The primary mode of infection is through close personal contact, so standard precautions are generally sufficient to prevent spread to or from health care workers.

HIV Infection

Exposure to the virus that causes acquired immunodeficiency syndrome (AIDS) is a risk that EMTs face on a regular basis. It is this prospect that led to the development of standard precautions. There is no vaccine to protect against human immunodeficiency virus (HIV) infection, and despite great progress in drug treatments, AIDS can still be fatal. However, with treatment, patients can expect a near-normal lifespan. HIV attacks the body's immune system, making it difficult for the natural defenses to fight disease. If the HIV infection develops into AIDS, minor illnesses can become fatal to the patient. Fortunately, HIV is not easily transmitted in your work setting. For example, it is far less contagious than hepatitis B. HIV infection is a potential hazard only when deposited on mucous membranes or directly into the bloodstream.

This can occur via sexual contact or exposure to blood or body fluids, meaning your risk of infection is limited to exposure to an infected patient's blood and body fluids. Exposure can take place in the following ways:

- The patient's blood is splashed or sprayed into your eyes, nose, or mouth or into an open sore or cut, however tiny; even a microscopic opening in the skin is an invitation for infection with a virus.

Words of Wisdom

Causes of Infectious Disease

Organism	Description	Example
Bacteria	Grow and reproduce outside the human cell in the appropriate temperature and with the appropriate nutrients	*Salmonella*
Viruses	Smaller than bacteria; multiply only inside a host and die when exposed to the environment	Human immunodeficiency virus
Fungi	Similar to bacteria in that they require the appropriate nutrients and organic material to grow	Mold
Protozoa (parasites)	One-celled microscopic organisms, some of which cause disease	Amoebas
Helminths (parasites)	Invertebrates with long, flexible, rounded, or flattened bodies	Worms

- You have blood from the infected patient on your hands and then touch your own eyes, nose, mouth, or an open sore or cut.
- A needle used to inject the patient breaks your skin. The risk to you from a single injection, even with a hollow-bore needle, is small, probably less than 1 in 1,000. However, this is by far the most dangerous form of exposure.
- Broken glass at a motor vehicle crash or other incident penetrates your glove (and skin), which may have already been covered with blood from an infected patient.

Many patients who are infected with HIV do not show any symptoms. This is why health care workers should wear gloves any time they are likely to come into contact with secretions or blood from any patient. Always put on gloves before leaving the ambulance to care for a patient. Also, take great care in handling and properly disposing of needles and other sharp objects in a sharps container so that you and others are not inadvertently exposed to them. Finally, cover any open wounds that you have whenever you are on the job.

If you have any reason to think that a patient's blood or secretions may have entered your system, especially through contact with a patient's blood, seek medical advice as soon as possible and notify your infectious disease officer. If you know that the patient is infected with HIV, your physician may suggest immediate treatment to try to prevent you from becoming infected. However, if the patient is an unlikely candidate for HIV infection, your physician may recommend that you and the patient be tested before you undergo therapy. As scientists learn more about HIV infection, testing and treatment recommendations change. It is important that you immediately see your physician (or your program's designated physician) any time you have a significant exposure to a communicable or infectious disease. Know the policy for your system, and take time now to consider what you would do in the event of exposure.

Hepatitis

The term hepatitis refers to an inflammation (and often infection) of the liver. Hepatitis can be caused by a number of different viruses and toxins. Early signs of viral hepatitis include loss of appetite, vomiting, fever, fatigue, sore throat, cough, and muscle and joint pain. Several weeks later, jaundice (yellow eyes and skin) and right upper quadrant abdominal pain develop **Figure 14-5**. The severity of toxin-induced hepatitis depends on the amount of agent absorbed and the duration of exposure. Toxin-induced hepatitis is not contagious. There is no sure way to tell which patients with hepatitis have a contagious form of the disease and which do not. **Table 14-2** shows the characteristics of different types of hepatitis, from which you can assess your risk of exposure. Hepatitis A can be transmitted only from a patient who has an acute infection, whereas hepatitis B and hepatitis C can be transmitted from long-term carriers who have no signs of illness. A carrier is a person (or animal) in whom an infectious organism has taken up permanent residence and may or may not cause any active disease. Carriers may never know that they harbor the organism; however, they can infect other people.

Figure 14-5 Jaundice is a sign of a hepatitis infection.

YOU are the Provider PART 4

You place the patient onto the stretcher, load him into the ambulance, and begin transport to the hospital.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert
Respiration	22 breaths/min; regular and adequate
Pulse	104 beats/min; strong and regular
Skin	Flushed, warm, and moist
Blood pressure	122/68 mm Hg
Spo_2	98%

You set the automatic vital sign device to reassess his vital signs every 15 minutes. The patient tells you that he thinks his fever is breaking because he is sweating. En route, his vital signs and overall condition are reassessed and remain unchanged.

5. Should you set the vital sign device to reassess his vital signs at shorter intervals? Why or why not?

6. On the basis of the patient's chief complaint, what additional information can you obtain by using the OPQRST mnemonic?

Table 14-2 Characteristics of Hepatitis

Type	Route of Infection	Incubation Period	Chronic Infection	Vaccine and Treatment	Comments
		Viral Hepatitis			
Hepatitis A (infectious)	Fecal–oral, infected food or drink	2–6 wk	Chronic condition does not exist	Vaccine is available; no specific treatment is available; body will clear the infection on its own	Mild illness; approximately 2% of patients die; after acute infection, the patient has life-long immunity
Hepatitis B	Blood, sexual contact, saliva, urine, breast milk	4–12 wk	Chronic infection affects up to 10% of patients and up to 90% of newborns who have the disease	Vaccine is available; treatment is minimally effective	Up to 30% of patients may become chronic carriers; patients are asymptomatic and without signs of liver disease, but they may infect others; approximately 1% to 2% of patients die
Hepatitis C	Blood, sexual contact	2–10 wk	Chronic infection affects 90% of patients	No vaccine is available; treatment is costly but effective for many strains of hepatitis C.	Cirrhosis of the liver develops in 50% of patients with chronic hepatitis C; chronic infection increases the risk of cancer of the liver
Hepatitis D	Blood, sexual contact	4–12 wk	Chronic infection is common	No vaccine is available; no treatment is available	Occurs only in patients with active hepatitis B infection; fulminant disease may develop in 20% of patients
		Toxin-Induced Hepatitis			
Medications, drugs, and alcohol	Inhalation, skin or mucous membrane exposure, oral ingestion, or intravenous administration	Within hours to days following exposure	Some chemicals may initiate an inflammatory response that continues to cause liver damage long after the chemical is out of the body	No vaccine is available; treatment is to stop exposure; in patients with an overdose of acetaminophen, certain drugs may minimize liver injury if given early enough	This type of hepatitis is not contagious; patients with toxin-induced hepatitis may have liver damage and jaundice; not every exposure to a toxin will cause liver damage.

Hepatitis A is transmitted orally through oral or fecal contamination. This means that, generally, you must eat or drink something that is contaminated with the virus. Contamination is the presence of an infectious organism on or in an object. The organisms that cause hepatitis B and C are transmitted through vehicles other than food or water. For example, these organisms may enter the body through a transfusion or needlestick with infected blood, which puts health care workers at high risk for contracting hepatitis B, the more contagious and virulent form. **Virulence** is the strength or ability of a pathogen to produce disease. Hepatitis B is far more contagious than HIV. For this reason, vaccination with hepatitis B vaccine is highly recommended for EMTs. Unfortunately, not everyone who is vaccinated develops immediate immunity to the virus. Sometimes, but not always, an additional dose will provide immunity. You should be tested after vaccination to determine your immune status.

If you are stuck with a needle or injured in some other way while caring for a patient who might have hepatitis, see your physician immediately.

Words of Wisdom

Patients with track marks are at high risk for hepatitis B, hepatitis C, and HIV.

Meningitis

Meningitis is an inflammation of the meningeal coverings of the brain and spinal cord. Patients with meningitis will have signs and symptoms such as fever, headache, stiff neck, and altered mental status. It is an uncommon but very frightening infectious disease. Meningitis can be caused by viruses or bacteria, most of which are not contagious. However, one form, **meningococcal meningitis**, is highly contagious. The meningococcus bacterium colonizes the human nose and throat and only rarely causes an acute infection. When it does, it can be lethal. Patients with this kind of infection often have red blotches on their skin; however, many patients with forms of meningitis that are not contagious also have red blotches.

Only laboratory tests can sort out the different forms of meningitis; therefore, you should take standard precautions with any patient who is suspected of having meningitis. Wearing gloves and a mask will go a long way to prevent the patient's secretions from getting into your nose and mouth. Again, the risk of infection is small, even if the organism is transmitted. For this reason, vaccines, which are available for most types of meningococcus, are rarely used. Meningitis can be treated at the ED with antibiotics.

Words of Wisdom

Meningococcal meningitis is an inflammation of the meningeal coverings of the brain and spinal cord that can be highly contagious. The bacteria that cause meningococcal meningitis can be spread by the exchange of respiratory secretions through coughing and sneezing. The effects are lethal in some cases. Victims who survive can be left with brain damage, hearing loss, or learning disabilities. Patients may present with flulike symptoms, but high fever, severe headache, photophobia (light sensitivity), and a stiff neck in adults are symptoms unique to meningitis. Patients sometimes have an altered level of consciousness and can have red blotches on the skin. Use respiratory protection, provide rapid transportation, and provide early notification to the ED so they can make specific preparations for accepting a highly contagious patient.

After treating a patient with meningitis, contact your employer health representative. Many states consider meningitis reportable and will notify you that one of your patients was diagnosed with meningitis. Prophylactic treatment may be recommended for you.

Tuberculosis

Most patients who are infected with *Mycobacterium tuberculosis* (the tubercle bacillus) are well most of the time. If the disease involves the brain or kidneys, the patient is only slightly contagious. In the United States, however, **tuberculosis** is a chronic mycobacterial disease that usually strikes the lungs. Disease that occurs shortly after infection is called primary tuberculosis. Except in infants, this infection is not usually serious. After the primary infection, the tubercle bacillus is rendered dormant by the patient's immune system. However, even after decades of lying dormant, this germ can reactivate. Reactive tuberculosis is common and can be much more difficult to treat, especially because an increasing number of tuberculosis strains have grown resistant to most antibiotics.

Although tuberculosis is often hard to distinguish from other diseases, patients who pose the highest risk almost invariably have a cough. Therefore, for your safety, you should consider respiratory tuberculosis to be the only contagious form because it is the only one that is spread by airborne transmission. The droplets produced by coughing are not the real problem. The real problem is the droplet nuclei, which are the remnants of the droplets after the excess water has evaporated. These particles are tiny enough to be invisible and can remain suspended in the air for a long time. In fact, as long as these particles are shielded from ultraviolet light, they can remain alive for decades. Particles that are the size of droplet nuclei are not stopped by routine surgical masks. Inhaled, they are carried directly to the alveoli of the lungs, where the bacteria may begin to grow. N95 or HEPA masks are required to stop droplet nuclei **Figure 14-6**.

Why is tuberculosis not more common than it is? After all, absolute protection from infection with the tubercle bacillus does not exist. Everyone who breathes is at risk. According to the CDC, one-third of the world's population is infected with tuberculosis. The vaccine for tuberculosis, called BCG, is only rarely used in the United States. Under normal circumstances, however, the mechanism of transmission used by *Mycobacterium tuberculosis* is not very efficient. Infected air is easily diluted with uninfected air. *M tuberculosis* is one of those germs that typically cause no illness in a new host. In fact, many patients with tuberculosis do not even transmit the infection to family members. However, in crowded environments with poor ventilation, the disease spreads more easily.

Figure 14-6 Wear an N95 mask when treating a patient whom you suspect has tuberculosis.

Special Populations

The aging process can pose a threat to the body's natural defense mechanisms against invading microorganisms. As a person ages, his or her physical defenses weaken or are eliminated. The skin's thinning and loss of supportive collagen, along with a reduction in the number of blood vessels, allow bacteria or viruses to enter the body with less resistance. The respiratory system cannot trap and eliminate bacteria and viruses in the airways as efficiently as it once did. Additionally, the gastrointestinal system allows easier entry for bacteria or viruses through the intestines. As the body ages, physical barriers to entry weaken, the immune system deteriorates, and invading organisms are not as easily identified as abnormal. Infectious agents can take hold in older people much more easily because of reduced defenses.

When transporting an older patient, protect the patient from the environment because extremes in heat or cold can further reduce the body's defenses. If the patient has a cold or the flu, protect yourself. However, remember that your defense system is probably much stronger than that of the patient.

People who are immunosuppressed from chronic illnesses, cancer treatment, or organ transplants may also lack the ability to fight certain infections. Ensure that these patients are not exposed to any additional conditions that could lead to an infection.

If you are exposed to a patient who is found to have pulmonary tuberculosis, you will be given a tuberculin skin test. This simple skin test determines whether a person has been infected with *M tuberculosis*. A positive result means that exposure has occurred; it does not mean that the person has active tuberculosis. It takes at least 6 weeks for the bacteria to show up in the laboratory test. So if you are tested for the disease within a few weeks of the exposure and your results are positive, this means that you were exposed to tuberculosis at an earlier time from somebody else. You will probably never identify the source. Most transmissions occur silently, so it is necessary that you have tuberculin skin tests regularly. If the infection is found before you become ill, preventive therapy is almost 100% effective. Usually, a daily dose of the medication isoniazid will prevent the development of active infection.

Whooping Cough

Whooping cough, also called pertussis, is an airborne disease caused by bacteria that mostly affects children younger than 6 years. Signs and symptoms include fever and a "whoop" sound that occurs when the patient tries to inhale after a coughing attack.

The best way to prevent infection from whooping cough is to be vaccinated with a diphtheria, tetanus, and pertussis vaccine (DTaP). Providers who have previously had this vaccine should make sure they are up-to-date with a booster. For added protection, place a mask on the patient and on yourself.

Methicillin-Resistant Staphylococcus Aureus

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium that causes infections and is resistant to many antibiotics. In health care settings, MRSA is believed to be transmitted from patient to patient via unwashed hands of health care providers. Studies have shown that 5% to 15% of health care providers carry MRSA in their nares. The pathogen can subsequently be transferred to skin and other areas of the body through a break in the skin. Surfaces contaminated with MRSA do not seem to be important in transmission. Factors that increase the risk for developing MRSA include antibiotic therapy, prolonged hospital stays, a stay in an intensive care or burn unit, and exposure to an infected patient.

The incubation period for MRSA appears to be between 5 and 45 days. The communicable period varies, as patients who have active infection may carry MRSA for months. MRSA results in soft-tissue infections. Its signs and symptoms may involve localized skin abscesses, and sepsis may be found in older patients with the infection.

Global Health Issues

MERS-CoV

Middle East respiratory syndrome coronavirus (MERS-CoV) is a virus most commonly found in bats and camels living in the Middle East. The first human case of MERS-CoV was discovered in 2012 in Saudi Arabia. While most clusters of human infections are found in the Middle East, reported cases of MERS-CoV have been found in Europe and the United States. Common patient symptoms include high fever, cough, muscle aches, vomiting, and diarrhea. In some cases, renal failure, respiratory failure, and death have been reported. There is presently no cure or vaccine for this virus. If you suspect your patient might have MERS-CoV, place a surgical mask on him or her and notify the receiving facility.

Ebola

In 2014, an outbreak of the Ebola virus in West Africa caused international concern. Several infected people with the virus traveled to other countries, including the United States, motivating EMS and health care facilities to prepare for further outbreaks. The incubation period is approximately 6 to 12 days after exposure; however, symptoms may not begin to appear for as long as 21 days after infection. Symptoms include watery diarrhea, vomiting, fever, body aches, and bleeding. The fatality rate can be as high as 70% if effective supportive treatment in an intensive care unit is not initiated promptly. If you suspect your patient may have this condition, place a surgical mask on him or her and follow PPE precautions as outlined by local protocols and the CDC. Immediately notify the receiving facility that your patient may have or may have been exposed to the Ebola virus.

Travel Medicine

Every day, thousands of people travel to various countries. While humans share many common germs, some are confined to certain areas of the world. As an EMS provider, you must be aware of this when assessing a patient who recently traveled outside the United States.

Patients who acquire an illness from another country can present with a variety of symptoms depending on the illness. They may have a fever, cough, vomiting, bloody diarrhea, body aches, and rashes. In many cases, the patient experiences mild symptoms and does not require EMS. However, some patients become extremely ill, requiring urgent evaluation and treatment. When you encounter an ill patient with a recent travel history, place a mask on the patient and gather as much information as possible. Important questions to ask the patient include:

- Where did you recently travel?
- Did you receive any vaccinations before your trip?
- Were you exposed to any infectious diseases?
- Is there anyone else in your travel party who is sick?
- What types of food did you eat?
- What was your source of drinking water?

Words of Wisdom

The ability of your EMS system to support you in the event of exposure to a communicable disease depends on your understanding of how an exposure to potentially infectious materials can occur and your immediate reporting of the exposure. Make notes right away to ensure that you remember all pertinent information, and report the possible exposure immediately after the response, following your service's guidelines.

If you suspect the patient has a communicable illness, follow appropriate PPE precautions and notify the receiving facility. While treatment for many travel-related illnesses is primarily supportive in the prehospital environment, always be prepared to manage life-threatening conditions should the patient become unstable.

Conclusion

Although trauma patients often present with dramatic signs and symptoms, the assessment and treatment you provide for them are fairly straightforward. The assessment and treatment of medical patients on the other hand can be very challenging and interesting because of the nature of medical conditions. The condition of a medical patient may not be as apparent as in a trauma patient and, therefore, treatment may not be as straightforward. You must remember that delays of any kind in an attempt to diagnose a condition can be harmful to the patient and thus are not recommended. Your best approach is to keep calm, use your patient assessment skills, treat the patient's symptoms, report to medical control, and transport the patient safely to the emergency department. Finally, keep in mind that patients sometimes have more than one problem, so you must be prepared to handle any combination of conditions, including conditions of medical patients who have been involved in traumatic situations.

YOU are the Provider — PART 5

With an estimated time of arrival at the hospital of 5 minutes, you reassess the patient and call in your radio report. The hospital acknowledges your report and is awaiting your arrival. The patient tells you that he feels better, but is very thirsty.

Recording Time: 21 Minutes	
Level of consciousness	Conscious and alert
Respiration	18 breaths/min; regular and adequate
Pulse	90 beats/min; strong and regular
Skin	Warm and moist; less flushed
Blood pressure	128/72 mm Hg
Spo_2	98%

The patient is delivered to the hospital without incident, and you give your verbal report to a staff nurse, who assumes care of the patient. The receiving nurse reassesses the patient's temperature and notes a reading of 99.8°F (37.7°C). After cleaning the ambulance, you return to service.

7. How and why do the patient's vital signs differ from your initial readings?

YOU are the Provider — SUMMARY

1. What observations should you make when you arrive at the scene before making physical contact with the patient?

When arriving at any scene, your first priority is to assess for any actual or potential hazards that could pose a risk to your safety and your partner's. Remember to use standard precautions before making contact with the patient! Next, assess the environment in which the patient is found. As you approach the patient, form a general impression that will help you rapidly recognize life-threatening conditions before making physical contact with the patient. Apparent unconsciousness, obvious external bleeding, and severe difficulty breathing are but a few of the visual clues that you may recognize during the initial general impression. After visually assessing the scene, the patient's environment, and the patient, proceed with the primary assessment.

2. On the basis of your general impression and primary assessment findings, does this patient require immediate transport?

Your patient is clearly sick; he has a high fever and reports weakness. However, he is conscious and alert and does not have any airway, breathing, or circulation problems. His heart rate and respiratory rate are both increased; however, his heart rate is strong and palpable at the radial artery, and his breathing is producing adequate tidal volume. Tachypnea and tachycardia are common physiologic responses to fever. At the present time, there are no signs indicating the need for immediate transport.

3. How should you proceed with your care of the patient?

You have already determined the patient's chief complaint and have begun initial treatment. Because his condition is stable, immediate transport is not indicated; therefore, proceed by inquiring about the history of his present illness, taking his vital signs, obtaining a SAMPLE history, and performing a secondary assessment. The secondary assessment of a medical patient should primarily focus on his or her chief complaint and presenting signs and symptoms. A baseline set of vital signs—including pulse oximetry, and if indicated, a blood glucose level—are often obtained by your partner while you are assessing the patient. The baseline vital signs can then be compared with future readings (trending) to determine if the patient's condition is unchanged, has improved, or has worsened.

4. Is it appropriate to transport the patient to the hospital he requested, or should you transport him to the closer facility?

Generally speaking, patients should be transported to the hospital of their choice when at all possible. Ultimately, however, the destination facility should be dictated by the patient's condition as well as local protocols and medical direction. Your patient is in stable condition—that is, he has no airway, breathing, or circulation problems. Therefore, it is not unreasonable to comply with his request and transport him to the hospital of his choice. However, you should inform him that if his condition worsens, it may be necessary to divert to a closer facility. If his wife will be following you in her personal vehicle, ask for her mobile phone number, if she has one, so you can contact her should diversion to a closer facility become necessary.

5. Should you set the vital sign device to reassess his vital signs at shorter intervals? Why or why not?

On the basis of your patient's stable condition, reassessing his vital signs every 15 minutes is appropriate at this time. If his condition worsens, you can always set the machine to record his vital signs at shorter intervals. Vital signs are only one component of reassessment. You should also monitor the patient's level of consciousness and other parameters (eg, skin condition and temperature, breathing status, pulse regularity and strength) en route. In many cases, these parameters change when a patient's condition is deteriorating before the vital signs change.

6. On the basis of the patient's chief complaint, what additional information can you obtain by using the OPQRST mnemonic?

Not every component of the OPQRST mnemonic will apply to every patient; however, there are some components that will. Your patient's chief complaint was fever, chills, and weakness. An acute onset of fever versus fever that developed slowly is important to note and can aid the ED physician in his or her diagnosis. The presence of provoking or palliating factors can also be established. In a patient with a fever, ask him or her if any antipyretics (fever-reducing medications), such as ibuprofen or acetaminophen, were taken and if they seemed to help, and if there is a particular position that improves or worsens his symptoms. Because the patient is not reporting pain or discomfort, there is no "quality" to determine; however, if the patient begins to report pain or discomfort, ask him to describe it. Radiating or referred pain cannot be established in this patient because he is not experiencing pain, but if pain is involved, ask the patient to assign it a number initially and then ask again at regular intervals. When establishing the time of onset, you are asking for a specific time that the symptoms began (eg, yesterday around 1500 hours.

7. How and why do the patient's vital signs differ from your initial readings?

The patient's blood pressure has remained consistent throughout your encounter with him. However, his heart rate, respiratory rate, and skin condition are different from previous readings.

His chief complaint was fever, chills, and weakness. Fever usually causes chills, which cause the patient to expend a lot of energy and can make him or her feel weak. Fever also increases a person's metabolic rate, resulting in the production of more heat energy. Physiologically, the body responds to an increased metabolic rate by increasing its vital functions—namely, respirations and heart rate. Thus, when the patient's temperature was 102.6°F (39.2°C), his body was responding with tachypnea and tachycardia. However, as his temperature reduced to 99.8°F (37.7°C), so did his metabolic rate and, thus, his respiratory rate and heart rate.

When a person is actively "running a fever," the skin is typically flushed (red), abnormally warm or hot, and dry. However, as the fever begins to subside, sweating occurs, which is the body's way of removing heat through evaporation.

EMS Patient Care Report (PCR)

Date: 7-29-16	**Incident No.:** 011109	**Nature of Call:** Sick person		**Location:** 125 Green Hills Dr	
Dispatched: 1325	**En Route:** 1325	**At Scene:** 1335	**Transport:** 1348	**At Hospital:** 1402	**In Service:** 1413

Patient Information

Age: 36 **Sex:** M **Weight (in kg [lb]):** 79 kg (175 lb)	**Allergies:** No known allergies **Medications:** Ibuprofen **Past Medical History:** None **Chief Complaint:** Fever, chills, and weakness

Vital Signs

Time: 1340	**BP:** 124/70	**Pulse:** 110	**Respirations:** 22	**Spo_2:** 99%
Time: 1347	**BP:** 122/68	**Pulse:** 104	**Respirations:** 22	**Spo_2:** 98%
Time: 1356	**BP:** 128/72	**Pulse:** 90	**Respirations:** 18	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Position of comfort

Narrative

9-1-1 dispatch for a 36-year-old man with fever and chills. On arrival at the scene, found the patient in a semi-sitting position in his bed. He was conscious and alert, his airway was patent, and his breathing was adequate. Patient stated that he began feeling bad the day before and began running a fever last night. He also reported chills and weakness, but denied any other symptoms. Approximately 30 minutes prior to EMS arrival, patient took 400 mg of ibuprofen. His wife took his temperature just prior to EMS arrival and noted a reading of 102.6°F (39.2°C). Obtained vital signs and performed additional assessment. Patient's skin was noted to be flushed, hot, and dry. His breath sounds were clear to auscultation bilaterally and he denied a cough. He further denied any significant past medical history and stated no allergies to medications. Completed assessment and treatment at the scene and began transport to the hospital with the patient in position of comfort. En route, continued to monitor patient's condition and vital signs as indicated. He remained conscious and alert, and his vital signs improved; he was less tachypneic and tachycardic. Patient stated that he felt better but was very thirsty. At this point, it was also noticed that patient began to sweat and his skin was less flushed. Remainder of transport was uneventful. Reassessed vital signs shortly before arrival at the hospital. Delivered patient to emergency department without incident and gave verbal report to staff nurse. Upon arrival, receiving nurse reassessed his temperature; a reading of 99.8°F (37.7°C) was noted. Medic 14 returned to service at 1413.**End of report**

Prep Kit

Ready for Review

- Trauma emergencies are injuries that are the result of physical forces applied to the body. Medical emergencies require EMS attention because of illnesses or conditions not caused by an outside force.
- The assessment of a medical patient is similar to the assessment of a trauma patient but with a different focus. Whereas a trauma assessment focuses on physical injuries, most of which are visible through a physical examination, medical patient assessment is usually more focused on symptoms and depends more on establishing an accurate medical history.
- Many medical patients may not appear to be seriously ill at first glance.
- For conscious medical patients, obtaining a thorough patient history can be one of the most beneficial aspects of the patient assessment. Try to determine the nature of the illness by asking questions about the patient's chief complaint.
- Conscious medical patients seldom need a secondary assessment of the entire body, but all should get a detailed physical examination based on their chief complaint. On the other hand, you should always perform a secondary assessment of the entire body on unconscious patients; this head-to-toe assessment may give you clues to help identify the problem. Your secondary assessment of an unconscious or unstable patient should never delay transport.
- Most medical emergencies require a level of treatment beyond what is available in the prehospital setting. Also, the treatments depend on an accurate diagnosis of the exact medical condition; therefore, advanced testing in the hospital may be required.
- If the patient is not in critical condition, you should gather as much important information as possible from the scene so that you can transmit that information to the physician at the ED.
- Many medical emergency patients do not have immediate life-threatening conditions. If a life-threatening condition exists, transportation should include the use of lights and sirens, but if that is not the case, careful consideration should be given to nonemergency transport.
- Modes of transport ultimately come in one of two categories: ground or air.
- Many medical patients will benefit from being transported to a specific hospital capable of handling their particular condition.
- Because it is often impossible to tell which patients have infectious diseases, you should avoid direct contact with the blood and body fluids of all patients.
- If you think you may have been exposed to an infectious disease, see your physician (or your employer's designated physician) immediately.
- Seven infectious diseases of special concern are:
  - Influenza
  - HIV infection
  - Hepatitis
  - Meningitis
  - Tuberculosis
  - MERS-CoV
  - Ebola
- Infection control should be an important part of your daily routine. Be sure to follow the proper steps when dealing with potential exposure situations.
- Patients who recently traveled outside of the United States should be screened for possible infectious illnesses. If you suspect the patient has a travel-related illness, place a mask on him or her, follow appropriate PPE, and gather as much information as possible.

Vital Vocabulary

communicable disease A disease that can be spread from one person or species to another.

epidemic Occurs when new cases of a disease in a human population substantially exceed the number expected based on recent experience.

herpes simplex A common virus that is asymptomatic in 80% of people carrying it, but characterized by small blisters on the lips or genitals in symptomatic infections.

index of suspicion Awareness that unseen life-threatening injuries or illness may exist.

infectious disease A medical condition caused by the growth and spread of small, harmful organisms within the body.

influenza A virus that has crossed the animal/ human barrier and infected humans and that kills thousands of people every year.

medical emergencies Emergencies that are not caused by an outside force; illnesses or conditions.

meningitis An inflammation of the meningeal coverings of the brain and spinal cord; it is usually caused by a virus or a bacterium.

meningococcal meningitis An inflammation of the meningeal coverings of the brain and spinal cord; can be highly contagious.

methicillin-resistant *Staphylococcus aureus* (MRSA) A bacterium that can cause infections in different parts of the body and is often resistant to commonly used antibiotics; it is transmitted by different routes, including the respiratory route, and can be found on the skin, in surgical wounds, in the bloodstream, lungs, and urinary tract.

nature of illness (NOI) The general type of illness a patient is experiencing.

pandemic An outbreak that occurs on a global scale.

trauma emergencies Emergencies that are the result of physical forces applied to the body; injuries.

tuberculosis A chronic bacterial disease, caused by Mycobacterium tuberculosis, that usually affects the lungs but can also affect other organs such as the brain and kidneys; it is spread by cough and can lie dormant in a person's lungs for decades and then reactivate.

virulence The strength or ability of a pathogen to produce disease.

Assessment *in Action*

You are dispatched to a local residence for a 70-year-old man reporting difficulty breathing. On arrival, you find the patient sitting in the living room on home oxygen. As you approach the patient, you notice he appears to be in respiratory distress and is using accessory muscles to help with breathing. He is unable to speak due to his difficulty breathing. His wife informs you that the patient has been ill for the past 2 days with a cough and increasing shortness of breath. He has a past medical history of chronic obstructive pulmonary disease (COPD), hypertension, and diabetes.

1. What is the first step in the assessment process for this patient?

   A. Manage the airway
   B. Obtain vital signs
   C. Determine scene safety
   D. Perform a secondary assessment

2. What is the general impression of this patient?

   A. The patient is experiencing mild dyspnea.
   B. The patient appears stable.
   C. The patient appears well.
   D. The patient needs immediate intervention.

3. Your transport decision should be based on the:

   A. secondary assessment.
   B. past medical history.
   C. physical examination.
   D. primary assessment.

4. What mnemonic is used to gather a patient's health information?

   A. AVPU
   B. SAMPLE
   C. OPQRST
   D. DUMBELS

5. After you assess the ABCs, what should be done for this patient?

   A. Transport
   B. Secondary assessment
   C. Vital signs
   D. Reassessment

6. What standard precautions should be taken with this patient?

   A. Gloves only
   B. Gloves and mask
   C. Gloves, mask, and eye protection
   D. Mask only

7. Which of the following best describes a communicable disease?

   A. The growth and spread of small harmful organisms within the body
   B. A disease that can be spread from one person or species to another
   C. A disease that cannot be transmitted from one person to another
   D. Presence of infectious organisms on or in objects

8. If this patient recently traveled outside of the country, what questions would you ask him?

9. List the seven infectious diseases of concern for EMS personnel.

10. The acronym TACOS can be helpful in determining factors that may be contributing to the chief complaint. What does each letter of this acronym represent?

CHAPTER 15

Respiratory Emergencies

EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Respiratory

Anatomy, signs, symptoms, and management of respiratory emergencies including those that affect the

› Upper airway (pp 585–593, 609–615)
› Lower airway (pp 585–593, 609–615)

Anatomy, physiology, pathophysiology, assessment, and management of

› Epiglottitis (pp 591, 602–609, 615)
› Spontaneous pneumothorax (pp 599, 602–609, 616–617)
› Pulmonary edema (pp 593–594, 602–609, 615–616)
› Asthma (pp 595, 597, 602–609, 616)
› Chronic obstructive pulmonary disease (pp 594–596, 602–609, 616)
› Environmental/industrial exposure (pp 601–609, 617)
› Toxic gas (pp 601–609, 617)
› Pertussis (pp 592–593, 602–609, 615)
› Cystic fibrosis (pp 602–609, 618–619)
› Pulmonary embolism (pp 600–609, 617)
› Pneumonia (pp 592, 602–609, 615)
› Viral respiratory infections (pp 590–593, 602–609, 615)

Knowledge Objectives

1. List the structures and functions of the upper and lower airways, lungs, and accessory structures of the respiratory

system. (p 585)
2. Explain the physiology of respiration; include the signs of normal breathing. (pp 586–587)
3. Discuss the pathophysiology of respiration, including examples of the common signs and symptoms a patient with inadequate breathing may present with in an emergency situation. (pp 587–588)
4. Explain the special patient assessment and care considerations that are required for geriatric patients who are experiencing respiratory distress. (pp 589, 592–593, 618–619)
5. Describe different respiratory conditions that cause dyspnea, including their causes, assessment findings and symptoms, complications, and specific prehospital management and transport decisions. (pp 589–590, 609–619)
6. List the characteristics of infectious diseases that are frequently associated with dyspnea. (pp 590–593)
7. Discuss some pandemic considerations related to the spread of influenza type A and strategies EMTs should employ to protect themselves from infection during a possible crisis situation. (pp 590, 593)
8. Explain the special patient assessment and care considerations that are required for pediatric patients who are experiencing respiratory distress. (pp 590–593, 597, 615–619)
9. Describe the assessment of a patient who is in respiratory distress and the relationship of the assessment findings to patient management and transport decisions. (pp 602–609)
10. Describe the primary emergency medical care of a person who is in respiratory distress. (pp 602–605, 609–615)
11. List five different types of adventitious breath sounds, their signs and symptoms, and the disease process associated with each one. (p 605)
12. State the generic name, medication forms, dose, administration, indications, actions, and contraindications for medications that are administered via metered-dose inhalers (MDI) and small-volume nebulizers. (pp 610–615)

Skills Objectives

1. Demonstrate the process of history taking to obtain more information related to a patient's chief complaint based on a case scenario. (pp 605–607)
2. Demonstrate how to use the OPQRST assessment to obtain more specific information about a patient's breathing problem. (p 606)
3. Demonstrate how to use the PASTE assessment to obtain more specific information about a patient's breathing problem. (p 607)
4. Demonstrate how to assist a patient with the administration of a metered-dose inhaler. (pp 612–613, Skill Drill 15-1)
5. Demonstrate how to assist a patient with the administration of a small-volume nebulizer. (pp 613–615, Skill Drill 15-2)

Introduction

As an EMT, you will often encounter the patient complaint of **dyspnea**, when a patient reports shortness of breath or has difficulty breathing. It is a symptom of many different conditions, from the common cold or asthma to heart failure and pulmonary embolism. You may not be able to determine what is causing dyspnea in a particular patient; this can be difficult even for physicians. Also, several different problems may be contributing to a patient's dyspnea at the same time, including some that are life threatening. Even without making a definitive diagnosis, you will often be able to improve the patient's symptoms or save the patient's life.

This chapter begins with a basic review of respiratory anatomy and physiology as defined more thoroughly in Chapter 10, *Airway Management*. It then looks at common medical problems that can impair normal respiratory functioning and cause dyspnea. This chapter then goes on to explain specific strategies you can use to assess a patient who has difficulty breathing, using the patient assessment template and organized approach established in Chapter 9, *Patient Assessment*. You will learn the signs and symptoms of each condition, and topics such as foreign body and anatomic airway obstruction, lung infections, and chronic airway disease. You should keep all these medical possibilities in mind as you obtain the patient's history and perform a physical assessment; these processes will be described in detail in this chapter. The information you collect will help you to decide on the proper treatment, which can differ according to the probable cause of the dyspnea.

Remember, the sensation of not getting enough air can be terrifying, regardless of its cause. As an EMT, you should be prepared to fully treat your patient, addressing not just the symptom and the underlying problem, but also the anxiety it produces.

Anatomy of the Respiratory System

The respiratory system consists of the structures of the body that contribute to the breathing process **Figure 15-1**. These structures include the diaphragm, the muscles of the chest wall, the accessory muscles of breathing, and the nerves from the brain and spinal cord to those muscles.

The upper airway consists of all anatomic airway structures above the level of the vocal cords. These include the nose, mouth, jaw, oral cavity, pharynx, and larynx. Air enters the upper airway through the nose and mouth, and it is here that the air is filtered, warmed, and humidified. The upper airway ends at the larynx, which is protected by the epiglottis. This leaf-shaped valve folds over the larynx during swallowing and diverts food and fluid into the esophagus. During normal breathing, the epiglottis returns to an upright position, allowing air to flow freely between the vocal cords into and out of the trachea. Air moves through the trachea into and out of the lungs.

The principal function of the lungs is **respiration**, which is the exchange of oxygen and carbon dioxide. To reach the lower airways, air travels through the trachea into each lung, first passing through the left and right mainstem bronchus (larger airways), then on to the bronchioles (smaller airways), and finally into the alveoli. The alveoli are microscopic, thin-walled air sacs where the actual exchange of oxygen and carbon dioxide occurs.

YOU are the Provider — PART 1

It is 0430 hours when the alert tones sound, “Medic 81, respond to 109 East Lawler for a 72-year-old woman with shortness of breath.” You recognize the address as one to which you have responded on numerous occasions. The woman lives alone; has emphysema, hypertension, and gout; and routinely refuses EMS transport. You and your partner proceed to the scene. The weather is clear, and the temperature is 65°F (18.3°C).

1. What is emphysema? What is the typical cause?
2. Why is it especially significant that *this* patient called 9-1-1?

Physiology of Respiration

As discussed in Chapter 10, *Airway Management*, the two processes that occur during respiration are inspiration, the act of breathing in (inhaling), and expiration, the act of breathing out (exhaling). During respiration, oxygen is provided to the blood, and carbon dioxide is removed from it. In healthy lungs, this exchange of gases takes place rapidly at the level of the alveoli **Figure 15-2**. The alveoli lie against the pulmonary capillary vessels, and as oxygen enters the alveoli from inhalation, it passes freely through tiny passages in the alveolar wall into these capillaries through the process of diffusion. The oxygen is then carried to the heart, which then pumps the oxygen around the body. Carbon dioxide produced by the body’s cells returns to the lungs in the blood that circulates through and around the alveolar air spaces. The carbon dioxide diffuses back into the alveoli and travels back up the bronchial tree and out through the upper airways during exhalation **Figure 15-3**. Again, carbon dioxide is “exchanged” for oxygen, which travels in exactly the opposite direction (during inhalation).

Through this whole process of respiration, the brain stem constantly senses the level of carbon dioxide in the arterial blood. The level of carbon dioxide bathing the brain stem stimulates a healthy person to breathe. If the level of carbon dioxide drops too low, the person automatically breathes at a slower rate and less deeply. As a result, less carbon dioxide is expired, allowing carbon dioxide levels in the blood to return to normal. Although considered a waste gas, some level of carbon dioxide in the blood is actually necessary and, in addition to stimulating breathing, helps balance pH. If the level of carbon dioxide in the arterial blood rises above normal, the person breathes more rapidly and more deeply. When more fresh air is brought into the alveoli, more carbon dioxide diffuses out of the bloodstream, thereby lowering the level of carbon dioxide in the blood.

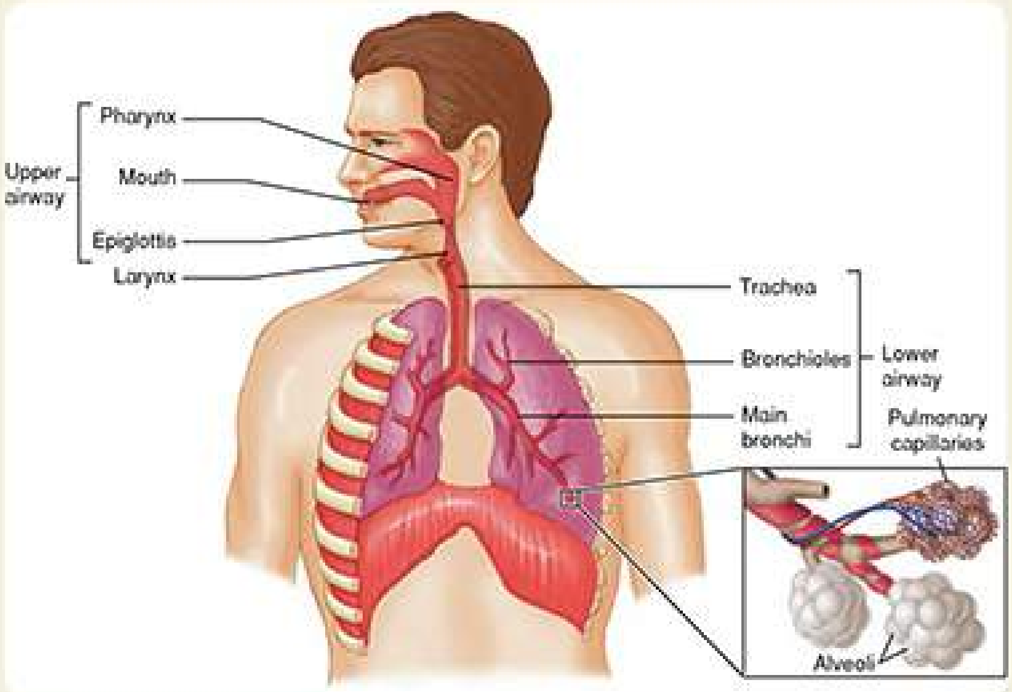


Figure 15-1 The upper airway includes the nose, mouth, jaw, oral cavity, pharynx, and larynx. The lower airway includes the trachea, bronchi, bronchioles, and alveoli surrounded by the pulmonary capillaries.

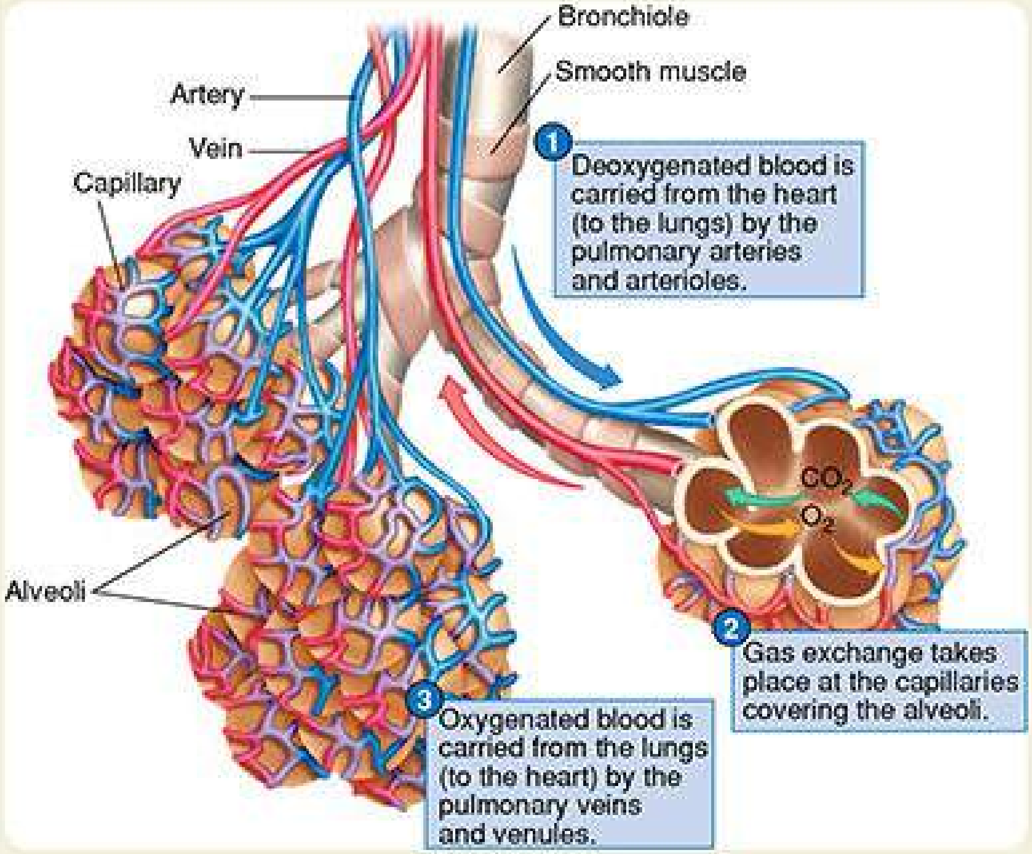
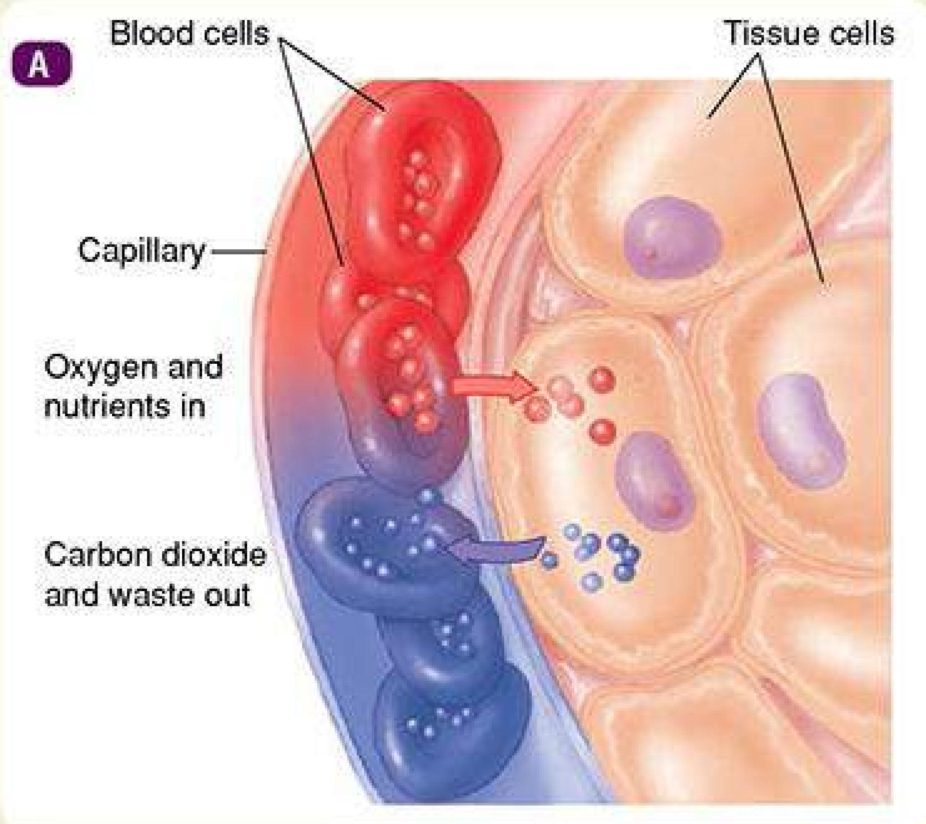


Figure 15-2 An enlarged view of a single alveolus (air sac) showing where the exchange of oxygen and carbon dioxide between air in the sac and blood in the pulmonary capillaries takes place.



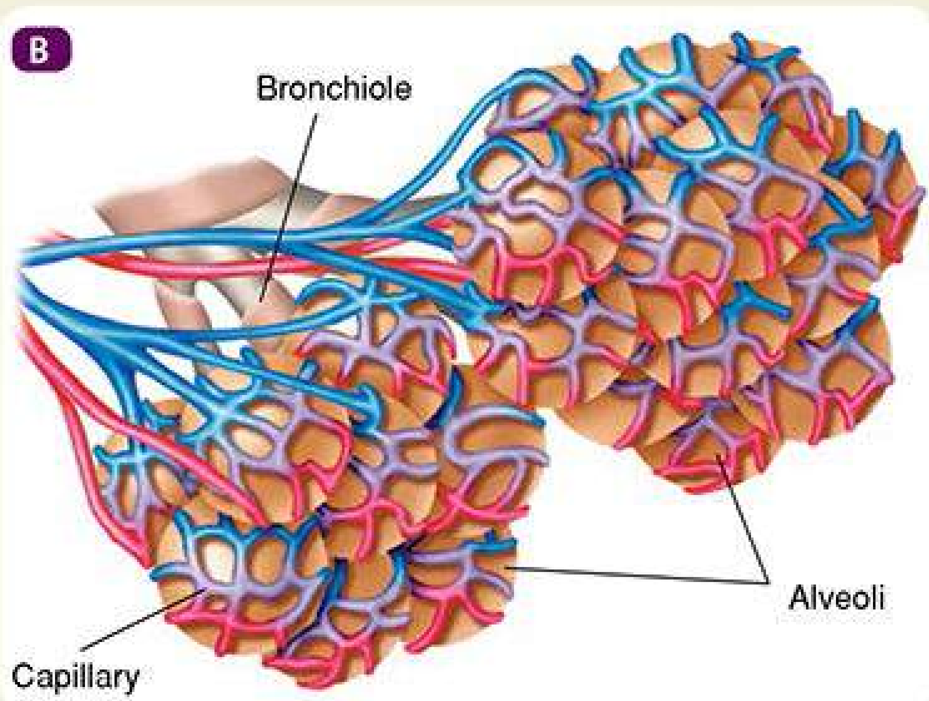


Figure 15-3 The exchange of oxygen and carbon dioxide in respiration. **A.** Oxygen passes from the blood through capillaries to tissue cells. Carbon dioxide passes from tissue cells through capillaries to the blood. **B.** In the lungs, oxygen is picked up by the blood, and carbon dioxide is given off.

Pathophysiology

The pathophysiology of respiration refers to conditions under which body processes are not working as they should and, as a result, interfere with normal respiration. Abnormal or pathologic conditions in the anatomy of the airway, disease processes, and traumatic conditions can prevent the proper exchange of oxygen and carbon dioxide. In addition, the pulmonary blood vessels themselves may have abnormalities that interfere with blood flow and thus with the transfer of gases.

Regardless of the reason for breathing difficulty, it is important that you are able to immediately recognize the signs and symptoms of inadequate breathing and know what to do about it. Table 15-1 gives the signs of normal (adequate) breathing, which is measured by rate, rhythm, and quality.

Table 15-2 lists the clues that will help you determine if your patient is having difficulty breathing.

Table 15-3 provides key signs and symptoms to help you recognize and differentiate between various respiratory-related complaints.

Carbon Dioxide Retention and Hypoxic Drive

You will sometimes encounter patients who have an elevated level of carbon dioxide in their arterial blood. The level can rise for a number of reasons. The exhalation process may be impaired by various types of lung disease. The body may also produce too much carbon dioxide, either temporarily or chronically, depending on the disease or abnormality. If, for a period of years, arterial carbon dioxide levels rise to an abnormally high level and remain there, the respiratory centers in the brain, which sense the carbon dioxide level and control breathing, may work less efficiently.

The failure of these centers to respond normally to a rise in arterial levels of carbon dioxide is due to chronic **carbon dioxide retention**. Recall from Chapter 10, *Airway Management,* that normally, the brain senses the levels of carbon dioxide (based on the pH) in the blood and cerebrospinal fluid. When carbon dioxide levels become elevated, the respiratory centers in the brain adjust the rate and depth of **ventilation** accordingly. However, patients with chronic lung diseases have difficulty eliminating carbon dioxide through exhalation; thus, they always have higher levels of carbon dioxide. This condition potentially alters their drive for breathing. The theory is that the brain gradually accommodates high levels of carbon dioxide and then uses a "backup system" to control breathing based on low levels of oxygen, rather than high levels of carbon dioxide. This condition is called **hypoxic drive**.

Table 15-1 Signs of Normal Breathing

- A normal rate (adult: 12 to 20 breaths/min; child: 15 to 30 breaths/min; infant: 25 to 50 breaths/min)
- A regular pattern of inhalation and exhalation
- Clear and equal breath sounds on both sides of the chest
- Regular and equal chest rise (chest expansion) and fall
- Adequate depth (tidal volume)
- Unlabored; without adventitious (abnormal) breath sounds (wheezing, stridor)

Note: Respiratory ranges are per the NHTSA 2009 EMT National EMS Education Standards. Ranges presented in other sources may vary.

Table 15-2 Signs and Symptoms of Inadequate Breathing

- The patient reports difficulty breathing or shortness of breath.
- The patient has an altered mental status associated with shallow or slow breathing.
- The adult patient appears anxious or restless; the pediatric patient appears sleepy or listless.
- The respiratory rate is too fast or too slow (see Table 15-1).
- The breathing rhythm is irregular.
- The skin is pale, cool, clammy, or cyanotic.
- Adventitious breath sounds are heard, including wheezing, gurgling, snoring, crowing, or stridor (harsh, high-pitched, barking sounds).
- Decreased or noisy breath sounds are heard on one or both sides of the chest.
- The patient cannot speak more than few words between breaths. Ask the patient "How are you doing?" If the patient cannot speak at all, he or she most likely has a respiratory emergency.
- You observe accessory muscle use, retractions, or labored breathing.
- The patient has unequal or inadequate chest expansion.
- The patient is coughing excessively.
- The patient is sitting up, leaning forward with his or her palms flat on the bed or the arms of the chair. This is called the tripod position because the patient's back and both arms are working together to support the upper body.
- The patient has pursed lips (pursed lip breathing) or nasal flaring.

Table 15-3 Signs and Symptoms Seen in Various Respiratory Conditions

Condition	Signs and Symptoms
Asthma	▪ Wheezing on inspiration/expiration ▪ Bronchospasm
Anaphylaxis	▪ Flushed skin or hives (urticaria) ▪ Generalized edema ▪ Decreased blood pressure (hypotension) ▪ Laryngeal edema with dyspnea ▪ Wheezing or stridor
Bronchiolitis	▪ Shortness of breath ▪ Wheezing ▪ Coughing ▪ Fever ▪ Dehydration ▪ Tachypnea ▪ Tachycardia
Bronchitis	▪ Chronic cough (with sputum production) ▪ Wheezing ▪ Cyanosis ▪ Tachypnea (increased breathing rate)
Congestive heart failure	▪ Dependent edema ▪ Crackles (pulmonary edema) ▪ Orthopnea ▪ Paroxysmal nocturnal dyspnea
Common cold	▪ Cough ▪ Runny or stuffy nose ▪ Sore throat
Croup	▪ Fever ▪ Barking cough ▪ Stridor ▪ Mostly seen in pediatric patients
Diphtheria	▪ Difficulty breathing and swallowing ▪ Sore throat ▪ Thick, gray buildup in throat or nose ▪ Fever
Emphysema	▪ Barrel chest ▪ Pursed lip breathing ▪ Dyspnea on exertion ▪ Cyanosis ▪ Wheezing/decreased breath sounds
Epiglottitis	▪ Dyspnea ▪ High fever ▪ Stridor ▪ Drooling ▪ Difficulty swallowing ▪ Severe sore throat ▪ Tripod or sniffing position

Influenza type A (flu)	▪ Cough ▪ Fever ▪ Sore throat ▪ Fatigue
Pertussis (whooping cough)	▪ Coughing spells ▪ "Whooping" sound ▪ Fever
Pneumonia	▪ Dyspnea ▪ Chills, fever ▪ Cough ▪ Green, red, or rust-colored sputum ▪ Localized wheezing or crackles
Pneumothorax	▪ Sudden chest pain with dyspnea ▪ Decreased breath sounds (affected side) ▪ Subcutaneous emphysema
Pulmonary embolus	▪ Sharp chest pain ▪ Sudden onset ▪ Dyspnea ▪ Tachycardia ▪ Clear breath sounds initially
Tension pneumothorax	▪ Severe shortness of breath ▪ Decreased/altered level of consciousness ▪ Neck vein distention ▪ Tracheal deviation (late sign) ▪ Hypotension; signs of shock (late sign)
Respiratory syncytial virus (RSV)	▪ Cough ▪ Wheezing ▪ Fever ▪ Dehydration
Tuberculosis (TB)	▪ Cough ▪ Fever ▪ Fatigue ▪ Productive/bloody sputum

Hypoxic drive is frequently found in end-stage chronic obstructive pulmonary disease (COPD). Some experts advocate for withholding high concentrations of oxygen from patients with chronic lung diseases for fear that the increased oxygen level in the blood could depress, or completely stop, the patient's respiratory drive. Regardless of the current research, use caution when providing high concentrations of oxygen on a long-term basis to patients with chronic lung disease, but *never* withhold oxygen therapy from a patient who needs it. Closely monitor patients who are experiencing respiratory distress, and be prepared to assist with ventilations if needed.

Special Populations

As a result of the normal aging process, geriatric patients have greater difficulties with the exchange of carbon dioxide and oxygen. In respiratory emergencies, begin oxygen therapy early in the assessment and treatment process.

Words of Wisdom

It is important for you to properly ventilate a patient; both underventilation and overventilation can cause harmful alterations in the level of carbon dioxide in the blood. Avoid hyperventilation when performing bag-valve mask (BVM) ventilation during CPR. This is a common pitfall that detracts from the overall quality of CPR and can cause serious alterations in pH, increased intrathoracic pressure, impaired venous return, and hypotension.

Causes of Dyspnea

Many medical problems may cause dyspnea. Be aware that if the patient's problem is severe and the brain is deprived of oxygen, he or she may not be alert enough to report shortness of breath. Altered mental status may be a sign that the brain is dysfunctional because of severe **hypoxia**, a condition in which the body's cells and tissues do not get enough oxygen.

In addition to the conditions discussed in Table 15-3, patients often have breathing difficulty and/or hypoxia with the following medical conditions:

- Pulmonary edema
- Hay fever
- Pleural effusion

- Obstruction of the airway
- Hyperventilation syndrome
- Environmental/industrial exposure
- Carbon monoxide poisoning
- Drug overdose

As you treat patients with disorders of the lung, be aware that one or more of the following situations most likely exists:

- Gas exchange between the alveoli and pulmonary circulation is obstructed by fluid in the lung, infection, or collapsed alveoli (**atelectasis**).
- The alveoli are damaged and cannot transport gases properly across their own walls.
- The air passages are obstructed by muscle spasm, mucus, or weakened airway walls.
- Blood flow to the lungs is obstructed by blood clots.
- The pleural space is filled with air or excess fluid, so the lungs cannot properly expand.

All of these conditions prevent the proper exchange of oxygen and carbon dioxide. In addition, the pulmonary blood vessels themselves may have abnormalities that interfere with blood flow and thus with the transfer of gases.

Besides shortness of breath, a patient with dyspnea may also report the sensation of chest tightness and air hunger. Air hunger is when a person reports the feeling of "not getting enough air" and has a strong need to breathe. Chest tightness is described as an uncomfortable feeling in the chest, and it is commonly reported by patients with asthma.

Dyspnea is also a common complaint in patients with cardiopulmonary diseases. In some cases, it may be caused by physical exertion that has been made difficult because the patient's heart is damaged. Congestive heart failure is a troublesome cause of breathlessness because the heart is not pumping efficiently and, therefore, the body does not have adequate oxygen. Another condition commonly associated with congestive heart failure is pulmonary edema, in which the alveoli are filled with fluid.

Severe pain can cause a patient to experience rapid, shallow breathing without the presence of a primary pulmonary dysfunction. In some patients, breathing deeply causes pain because it causes expansion of the chest wall.

When you assess your patient for complaints of dyspnea, ask about chest pain; conversely, when you are evaluating your patient for chest pain, ask about dyspnea.

Upper or Lower Airway Infection

Infectious diseases causing dyspnea may affect all parts of the airway. Some cause mild discomfort; others require aggressive respiratory support. Infections that impair airflow through the airways are problems of respiration. Inadequate oxygen delivery to the tissues is a problem of **oxygenation**. Infections may cause dyspnea by obstructing airflow in the larger airways due to production of mucus and secretions (colds, diphtheria) or by causing swelling of soft tissues located in the larger, upper airways (epiglottitis, croup). Infections may also impair exchange of gases between the alveoli and the capillaries (pneumonia). In patients with infectious diseases, you will be in close contact, so be diligent about your personal use of appropriate personal protective equipment (PPE). Recall from Chapter 2, *Workforce Safety and Wellness*, that immunizations, protective techniques, and handwashing can dramatically minimize your risk of contracting an infectious disease. Follow your local protocols, and stay up to date on the latest Centers for Disease Control and Prevention (CDC) recommendations. A minimum of gloves, eye protection, and a surgical mask or a high-efficiency air particulate (N-95) respirator should be mandatory. Gowns can be considered in some situations. Place a surgical mask on patients with suspected or confirmed respiratory disease. Remember to completely disinfect your unit prior to returning to service.

The following section discusses some of the infectious diseases that may be associated with complaints of dyspnea.

Croup

Croup is caused by inflammation and swelling of the pharynx, larynx, and trachea **Figure 15-4**. This disease is often secondary to an acute viral infection of the upper respiratory tract and is typically seen in children between ages 6 months and 3 years. It is easily passed between children. Peak seasonal outbreaks of this disease occur in the late fall and during the winter.

The disease starts with a cold, cough, and a low-grade fever that develops over 2 days. The hallmark signs of croup are stridor and a seal-bark cough, which signal a narrowing of the air passage of the trachea that may progress to significant obstruction.

Croup is rarely seen in adults because their breathing passages are larger and can accommodate the inflammation and mucus production without producing symptoms. The airways of adults are wider, and the supporting tissue is firmer than in children.

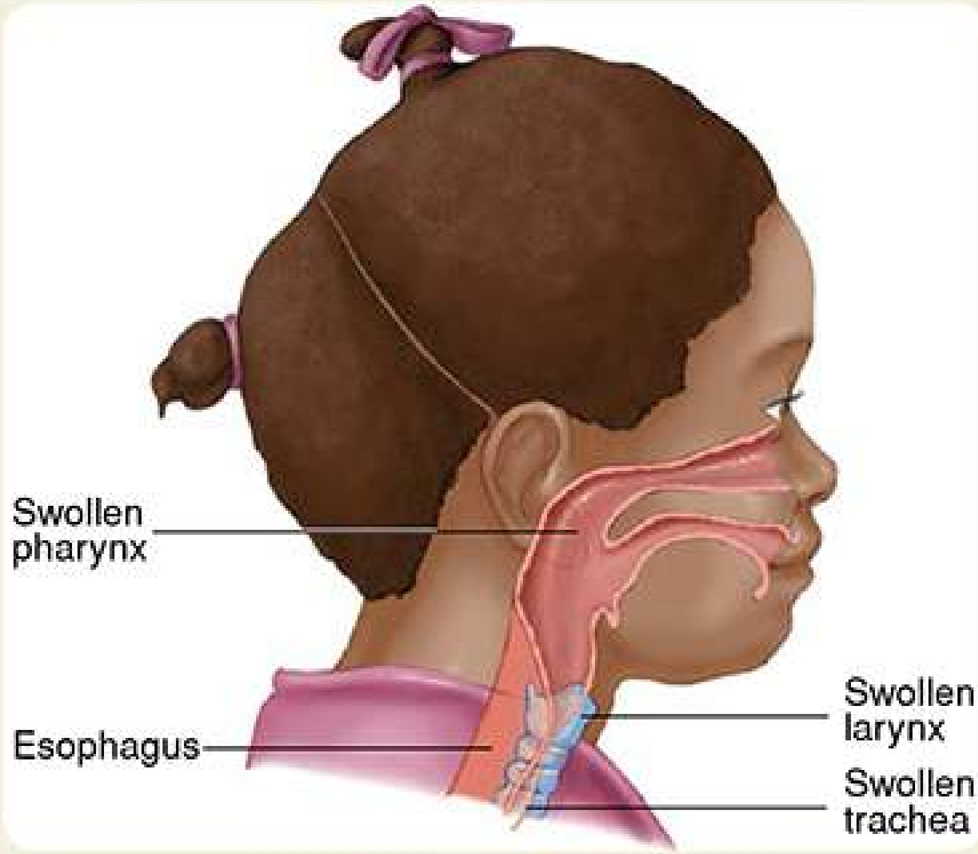


Figure 15-4 Croup results in swelling of the whole airway: pharynx, larynx, and trachea.

Croup often responds well to the administration of humidified oxygen. Note that bronchodilators are not indicated for croup and can worsen a patient's symptoms.

Epiglottitis

Epiglottitis is a life-threatening inflammatory disease of the epiglottis, the small flap of tissue at the back of the throat that protects the larynx and trachea during swallowing. Bacterial infection is the most common cause **Figure 15-5**. In the past, epiglottitis was most often seen in infants and children. In some cases, it occurs in adults. The development of a childhood vaccine against *Haemophilus influenzae* has dramatically decreased the incidence of this disease.

In preschool and school-aged children especially, the epiglottis can swell to two to three times its normal size. This puts the airway at risk of complete obstruction. The condition usually develops in otherwise healthy children, and symptoms are sudden in onset. Children with this infection look ill, report a very sore throat, and have a high fever. They will often be found in the tripod position and drooling. Stridor is a late sign in the development of airway obstruction.

Treat children with suspected epiglottitis gently and try not to do anything that will cause them to cry. Keep them in a position of comfort, and give them high-flow oxygen. *Do not* put anything in their mouths, as this could trigger a complete airway obstruction.

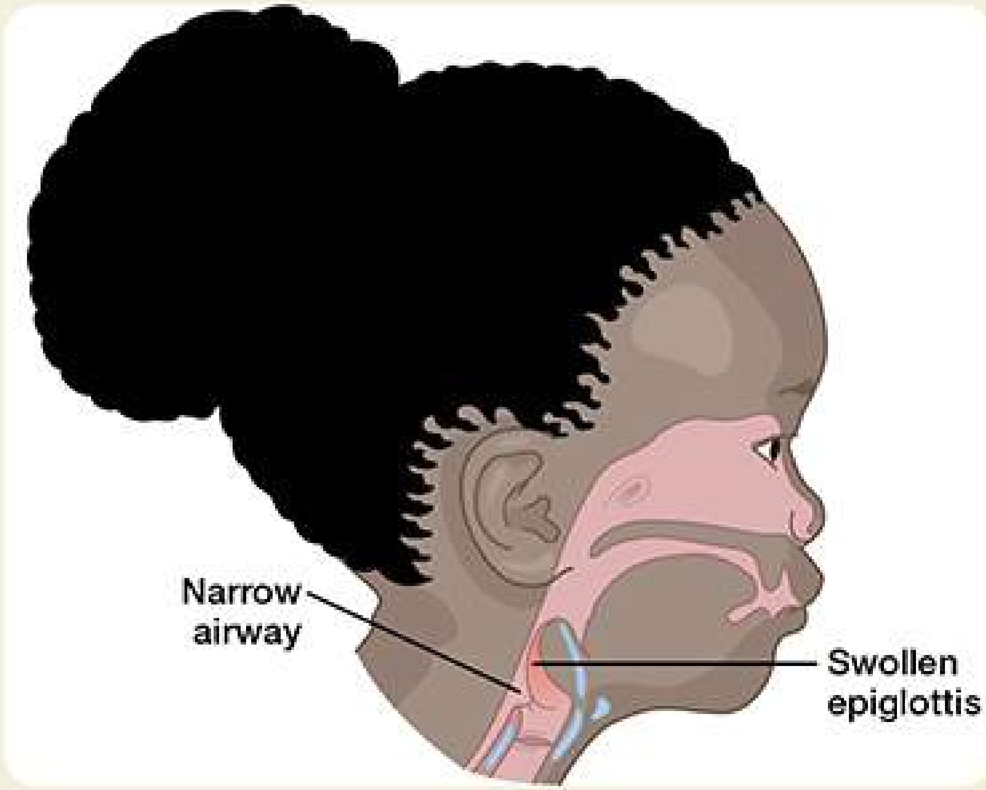


Figure 15-5 Acute epiglottitis is caused by a bacterial infection that results in severe swelling of the epiglottis, which could obstruct the airway.

Deterioration can occur quickly in adults with acute epiglottitis. You should be concerned if your adult patient presents with stridor or any other sign of airway obstruction without an obvious mechanical cause. Focus your patient management on maintaining a patent (adequate) airway, and provide prompt transport to the emergency department (ED).

Respiratory Syncytial Virus

Respiratory syncytial virus (RSV) is a common cause of illness in young children. It causes an infection in the lungs and breathing passages, and can lead to other serious illnesses such as bronchiolitis and pneumonia, as well as serious heart and lung problems in premature infants and in children who have depressed immune systems.

RSV is highly contagious and can be spread through droplets when the patient coughs or sneezes. The virus can also survive on surfaces, including hands and clothing. Therefore, the infection tends to spread rapidly through schools and child care centers.

When you assess a child with suspected RSV, look for signs of dehydration. Infants with RSV often refuse liquids. Treat airway and breathing problems as appropriate. Humidified oxygen is helpful if available.

Bronchiolitis

Bronchiolitis is a respiratory illness that often occurs due to respiratory syncytial virus (RSV) infection and results in severe inflammation of the bronchioles. Bronchioles, the tiny airways that lead from the larger airways (bronchi) to the alveoli in the lungs, become inflamed, swell, and fill with mucus. It occurs most frequently in newborns and toddlers, especially boys, whose airways can easily become blocked. Infections are common during the winter and spring. Young children who require hospitalization for bronchiolitis are at increased risk for developing childhood asthma.

The treatment for a child suffering from bronchiolitis is mainly supportive. While many of these patients do well, there is still a risk for significant respiratory compromise. You should provide appropriate oxygen therapy and allow the patient to remain in a position of comfort. Reassess frequently for signs of worsening respiratory distress. Be prepared to provide airway management and positive-pressure ventilation should the patient develop respiratory failure.

Pneumonia

According to the World Health Organization, pneumonia is a significant cause of morbidity worldwide. **Pneumonia** is a general term that refers to an infection of the lungs. The infection collects in the surrounding normal lung tissues, impairing the lung's ability to exchange oxygen and carbon dioxide.

Pneumonia is often a secondary infection, meaning it begins after an upper respiratory tract infection such as a cold or sore throat. It can be caused by a virus or bacterium, or by a chemical injury after an accidental ingestion or a direct lung injury from a submersion incident. Interventions such as intubation and tracheostomy can increase the risk of developing pneumonia. Pneumonia commonly affects people who are chronically and terminally ill. The factors that predispose patients to pneumonia include:

- Institutional residence (nursing home or long-term care facilities)
- Recent hospitalization
- Chronic disease processes (such as renal failure requiring dialysis)
- Immune system compromise (patient receiving chemotherapy or diseases such as HIV)
- History of COPD

Symptoms of pneumonia vary, depending on the age of the person and the cause of the illness. Children often present with unusually rapid or labored breathing or breathing characterized by grunting or wheezing sounds. In severe cases where oxygen exchange at the alveoli is markedly impaired, the lips and fingernails may be blue or gray. If the pneumonia is in the lower part of the lungs near the abdomen, there may be fever, abdominal pain, and vomiting rather than dyspnea.

Bacterial pneumonia results in severe symptoms more quickly including high fevers, which put the child at risk for febrile seizures. A viral pneumonia presents more gradually and is less severe.

Other signs and symptoms include dry skin, decreased skin turgor, exertional dyspnea, a productive cough, chest discomfort and pain that vary with inspiration and expiration, headache, nausea and vomiting, musculoskeletal pain, weight loss, and confusion. The patient may be febrile, tachycardic, or even hypotensive. Assessment of the lungs may reveal diminished breath sounds with sounds of wheezing, crackles, or rhonchi. You will need to evaluate the patient's history for possible risk factors. If possible, assess temperature to determine the presence of fever. Pulse oximetry readings, if available, may be low.

Regardless of the cause, treatment includes airway support and providing supplemental oxygen. Use oxygen with appropriate adjuncts, and provide supportive measures if needed. Evaluate patient treatment through reassessment and prepare for possible deterioration in the patient's condition.

Pertussis

Pertussis (whooping cough) is an airborne bacterial infection that primarily affects children younger than 6 years. It is highly contagious and is passed through droplet infection.

A patient with pertussis will be feverish and exhibit a "whoop" sound on inspiration after a coughing attack. Symptoms are generally similar to colds, but coughing spells can last for more than a minute during which the child may turn red or purple. This may frighten the parents or caregivers into calling 9-1-1.

Some infants and younger children with pertussis should be treated in a hospital because they are at greater risk for complications like pneumonia, which occurs mostly in children younger than 1 year. In infants younger than 6 months, pertussis can be life threatening.

Children with pertussis may vomit or not want to eat or drink. Watch for signs of dehydration. You may have to suction thick secretions to clear the airway. Give oxygen by the most appropriate means.

Pertussis in adults does not cause the typical whooping illness that it does in infants and toddlers. However, it can cause a severe upper respiratory infection, which can lead to pneumonia in geriatric patients or people with compromised immune systems. The infection can cause coughing spells that last for weeks and can be so severe that patients find it hard to breathe, eat, or sleep. In the worst cases of infection in geriatric patients, coughing can lead to cracked ribs. For patients who are already weak from other chronic conditions, pertussis can lead to hospitalization. According to the CDC, the disease has become a serious issue and physicians are becoming more aggressive about immunizing adults with the pertussis vaccine.

Influenza Type A

Influenza type A is an animal respiratory disease that has mutated to infect humans. In 2009, the H1N1 strain of influenza type A became **pandemic** (an outbreak that occurred on a global scale). Like seasonal flu, it may make chronic medical conditions worse. All strains of influenza type A are transmitted by direct contact with nasal secretions and aerosolized droplets from coughing and sneezing by infected people. Influenza type A viruses cause fever, cough, sore throat, muscle aches, headache, and fatigue and may lead to pneumonia or dehydration.

Tuberculosis

Tuberculosis (TB) is a bacterial infection caused by *Mycobacterium tuberculosis*. TB spreads by cough and is dangerous because many strains are resistant to antibiotics. TB most commonly affects the lungs but can also be found in almost any organ of the body, particularly the kidneys, spine, and lining of the brain and spinal cord (meninges). In some cases, TB can remain dormant (inactive) for years without causing symptoms or being infectious to other people. However, when the person is in a state of weakened immunity, TB can become active again. The patient may not even be aware he or she has the disease.

Patients with active TB involving the lungs will report fever, coughing, fatigue, night sweats, and weight loss. If the lung infection becomes severe, the patient will experience shortness of breath, coughing, productive sputum, bloody sputum, and chest pain.

TB has a higher prevalence among people who live in close contact, such as prison inmates, nursing home residents, and people in homeless shelters. TB is also found in people who abuse intravenous drugs or alcohol and people whose immune systems are compromised by an infection such as HIV. Anyone who comes into close contact with people who have active TB, or is in contact with people from countries that have a high prevalence of TB, is at risk for contracting the disease. As an EMT, you are also at risk.

If you suspect your patient may have active TB, you need to wear (at a minimum) your gloves, eye protection, and an N-95 respirator. These respirators are fit-tested to the individual to ensure no contaminated air can pass through.

Acute Pulmonary Edema

Sometimes, the heart muscle is so injured after a heart attack or other illness that it cannot circulate blood properly. In these cases, the left side of the heart cannot remove blood from the lung as fast as the right side delivers it. As a result, fluid builds up within the alveoli and in the lung tissue between the alveoli and the pulmonary capillaries. This accumulation of fluid is referred to as **pulmonary edema**, and it is usually a result of congestive heart failure. By physically separating the alveoli from the pulmonary capillary vessels, the edema interferes with the exchange of carbon dioxide and oxygen **Figure 15-6**. Not enough space is left in the lung to allow for slow, deep breaths. High blood pressure and low cardiac output often trigger this "flash" (sudden) pulmonary edema. These patients are among the most sick, frightened, and worrisome patients you will encounter. They are literally drowning in their own fluid. The patient usually experiences dyspnea with rapid, shallow respirations. In the most severe cases, you will see frothy pink sputum at the nose and mouth.

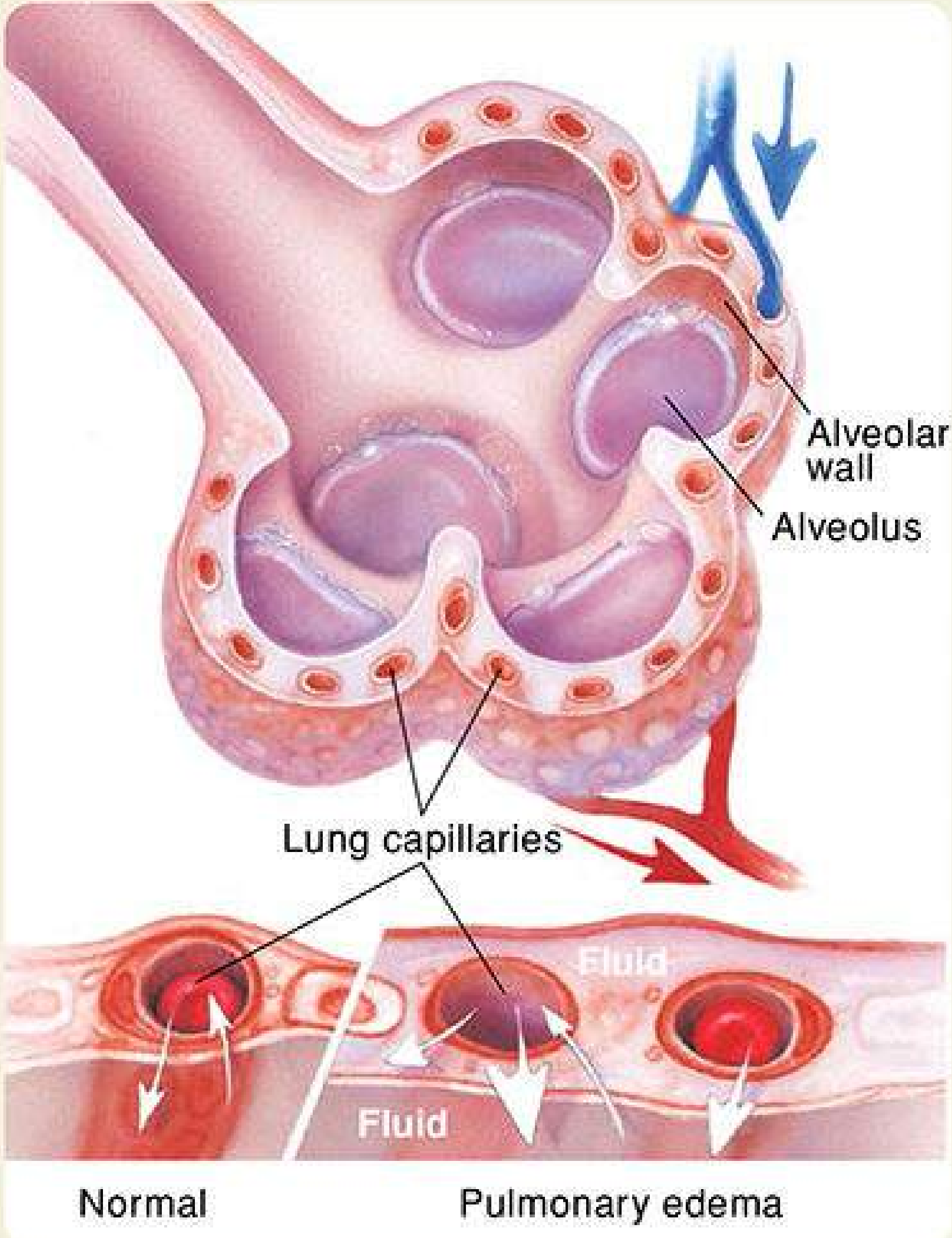


Figure 15-6 In pulmonary edema, fluid fills the alveoli and separates the capillaries from the alveolar wall, interfering with the exchange of oxygen and carbon dioxide.

Patient risk factors for congestive heart failure include hypertension and a history of coronary artery disease and/or atrial fibrillation, a condition in which the atria no longer contract, but instead quiver.

According to the Agency for Healthcare Research and Quality, congestive heart failure (which can lead to pulmonary edema) is one of the most common causes of hospital admission in the United States. It is not uncommon for a patient to have repeated bouts. In most cases, patients have a long-standing history of chronic congestive heart failure that can be kept under control with medication. However, an acute onset may occur if the patient stops taking the medication, eats food that is too salty, or has a stressful illness, a new heart attack, or an abnormal heart rhythm.

However, not all patients with pulmonary edema have heart disease. Poisonings from inhaling large amounts of smoke or toxic chemical fumes can produce pulmonary edema, as can traumatic injuries of the chest and exposure to high altitudes. In these cases, fluid collects in the alveoli and lung tissue in response to damage of the tissues of the lung or the bronchi.

Signs and symptoms of congestive heart failure include difficulty breathing with exertion because the heart cannot keep up with the body's need for oxygen. Patients may also report a sudden attack of respiratory distress that wakes them at night when they are in a reclining position. This is caused by fluid accumulation in the lungs. Patients also report coughing, feeling suffocated, cold sweats, and tachycardia.

In your primary assessment, you might find the patient has cool, diaphoretic, cyanotic skin and you will hear adventitious breath sounds like crackles or wheezing. The patient's pulse will be tachycardic. The patient may have hypertension early, followed by deterioration to hypotension as a late finding.

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) is a slow process of dilation and disruption of the airways and alveoli caused by chronic bronchial obstruction. According to the US Department of Health and Human Services, an estimated 12 million people are diagnosed with COPD, and an additional 12 million people may have COPD and not know it. According to the CDC, it is the third leading cause of death in the United States. COPD is an umbrella term used to describe a few lung diseases including emphysema and **chronic bronchitis**, an ongoing irritation of the trachea and bronchi.

COPD may be a result of direct lung and airway damage from repeated infections or inhalation of toxic gases and particles, but most often it results from cigarette smoking. Although it is well known that cigarettes are a direct cause of lung cancer, their role in the development of COPD is far more significant and less publicized.

Tobacco smoke is a bronchial irritant and can create chronic bronchitis. With bronchitis, excess mucus is constantly produced, obstructing small airways and alveoli. Protective cells and lung mechanisms that remove foreign particles are destroyed, further weakening the airways. Chronic oxygenation problems can also lead to right-sided heart failure and fluid retention, such as edema in the legs.

Pneumonia develops easily when the air passages are persistently obstructed. Ultimately, repeated episodes of irritation and pneumonia cause scarring in the lungs and some dilation of the obstructed alveoli, leading to COPD **Figure 15-7**.

The most common form of COPD is **emphysema**. Emphysema is a loss of the elastic material in the lungs that occurs when the alveolar air spaces are chronically stretched due to inflamed airways and obstruction of airflow out of the lungs. Smoking can also directly destroy the elasticity of the lung tissue. Normally, the lungs act like spongy balloons that are inflated; once they are inflated, they will naturally recoil because of their elastic nature, expelling gas rapidly. However, when they are constantly obstructed or when the elasticity is diminished, air is no longer expelled rapidly, and the walls of the alveoli eventually fall apart, leaving large "holes" in the lung that resemble large air pockets or cavities.

Most patients with COPD have elements of both chronic bronchitis and emphysema. Some patients will have more elements of one condition than the other; few patients will have only emphysema or bronchitis. Therefore, most patients with COPD will chronically produce sputum, have a chronic cough, and have difficulty expelling air from their lungs, with long expiration phases and wheezing. Patients may present with adventitious breath sounds such as crackles, rhonchi, and wheezes, or may have severely diminished breath sounds due to poor air movement.

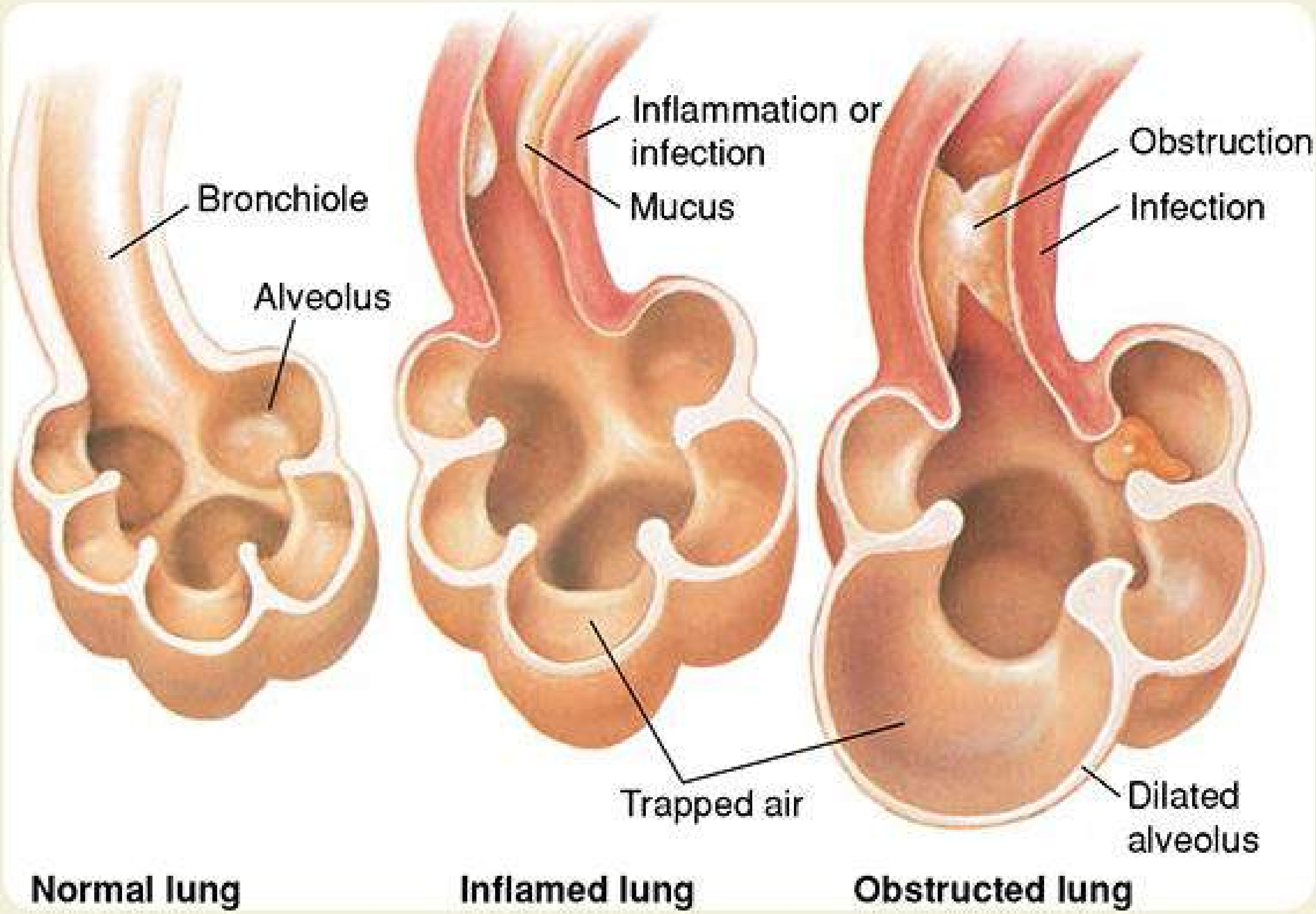


Figure 15-7 Repeated episodes of irritation and inflammation in the alveoli result in the obstruction, scarring, and some dilation of the alveolar sac characteristic of COPD.

Wet Lungs Versus Dry Lungs and "Cardiac Asthma"

Be aware that the signs and symptoms of COPD and congestive heart failure significantly overlap. Many patients suffer from both diseases, and it is often difficult to determine which disease is causing the patient's shortness of breath; often these patients are treated for both diseases after arrival to the hospital. Lung sounds (discussed later in the chapter) are one way to help you tell the difference. Patients with pulmonary edema caused most often by congestive heart failure will often have "wet" lung sounds (rhonchi, crackles), and patients with COPD will often have "dry" lung sounds (wheezes). However, do not assume *all* COPD patients have wheezes and *all* congestive heart failure patients have crackles. Table 15-4 compares COPD and congestive heart failure.

Suppose you are called to assist an 80-year-old man who has had shortness of breath for 45 minutes. Physical examination reveals that his pulse and respirations are elevated, and you observe pedal edema (swollen legs and feet) and jugular vein distention. His lung sound check reveals wheezing. He has a history of hypertension, congestive heart failure, and myocardial infarction; however, he has no history of smoking, asthma, or COPD. What is your initial general impression?

This patient's elevated blood pressure, pedal edema, jugular vein distention, and history of congestive heart failure should lead you in the direction of congestive heart failure. Unlike a typical patient with COPD, he has no history of smoking and takes diuretics and medication for hypertension. In this case, the alveoli are so full of fluid that bubbles (the condition that gives the sound of crackles) cannot form. The bronchi also become constricted, which produces wheezing. The wheezing this patient is experiencing is called cardiac asthma, which is not a form of asthma, but rather a type of coughing or wheezing that occurs with left-sided heart failure.

Patients with COPD wheeze because of bronchial constriction and present with shortness of breath. Their breathing gets progressively worse, and they have the most trouble breathing on exertion. Patients with COPD have chronic coughing and thick sputum. They are usually long-term smokers with a thin, barrel chest appearance. Their medications would include home oxygen, bronchodilators, and corticosteroids.

Patients with COPD often have a slower onset of symptoms because their disease is worsened by infection and other stressors. Patients with congestive heart failure experience a fluid overload in the lung, which may develop quickly from a failing pump.

As you try to discern between COPD and congestive heart failure, keep an open mind so that you do not miss important differences. The best advice is to treat the patient, not the lung sounds.

Asthma, Hay Fever, and Anaphylaxis

Asthma, hay fever, and anaphylaxis are the result of an allergic reaction to an inhaled, ingested, or injected substance. The substance itself (**allergen**) is not the cause of the allergic reaction; rather, it is an exaggerated response of the body's immune system to that substance that causes it. In some cases, however, there is no identifiable allergen that triggers the body's immune system.

Asthma

Asthma is an acute spasm of the bronchioles associated with excessive mucus production and with swelling of the mucous lining of the respiratory passages **Figure 15-8**. According to the CDC, approximately 25 million Americans have asthma. Asthma affects people of all ages, but the highest prevalence rate is seen in children 5 to 17 years of age.

Table 15-4 Comparison of COPD and Congestive Heart Failure

	COPD	Congestive Heart Failure
Description	▪ A slow process of dilation and disruption of the airways and alveoli caused by chronic bronchial obstruction. ▪ Usually in long-term smokers	▪ A disease of the heart characterized by shortness of breath, edema, and weakness ▪ Patient may or may not smoke
Pathophysiology	Emphysema: ▪ Destruction of the airways distal to the bronchiole ▪ Destruction of the pulmonary capillary bed ▪ Decreased ability to oxygenate the blood ▪ Lower cardiac output and hyperventilation ▪ Development of muscle wasting and weight loss Chronic bronchitis: ▪ Excessive mucus production with airway obstruction ▪ Pulmonary capillary bed undamaged ▪ Compensation by decreasing ventilation and increasing cardiac output ▪ Poorly ventilated lungs, leading to hypoxemia ▪ Increased carbon dioxide retention	▪ Damaged ventricles and failure of heart as a pump ▪ Attempt by heart to compensate with increased rate ▪ Enlarged left ventricle ▪ Backup of fluid into the body as the heart fails to pump adequately
Signs/symptoms	▪ Use of accessory muscles Emphysema: ▪ Thin appearance with barrel chest ▪ "Puffing" (pursed lip) style of breathing ▪ Tripod position Chronic bronchitis: ▪ May be obese ▪ Difficulty with expiration	▪ Abdominal distention ▪ Dependent edema (sacral or pedal) ▪ Tachycardia ▪ Increased respiratory rate ▪ Anxiety ▪ Inability to lie flat ▪ Ashen or cyanotic
Level of consciousness	Normal or altered	Confusion
Neck veins	▪ Flat ▪ Distended when heart failure also present	Distended
Skin color	▪ In emphysema, pink ▪ In chronic bronchitis, blue, often cyanotic	Blue
Lung condition	▪ In emphysema, dry ▪ In chronic bronchitis, wet when heart failure also present	Wet
Breathing	▪ Shortness of breath (mostly on exertion) ▪ Breathing worsens over time (progressive)	▪ Shortness of breath all the time ▪ Sudden onset of shortness of breath
Breath sounds	Rhonchi, wheezing	Crackles, wheezing
Circulation	No dependent edema	Dependent edema
Cough	▪ In emphysema, little or none ▪ In chronic bronchitis, frequent or chronic cough	Coughing may be present; increases when supine
Sputum	▪ In emphysema, no mucus ▪ In chronic bronchitis, excessive, thick mucus	Pink, frothy sputum
Medications	Home oxygen, bronchodilators, and steroids help open the airways	Diuretics and antihypertensives help promote cardiac function and reduce fluid loads on the heart

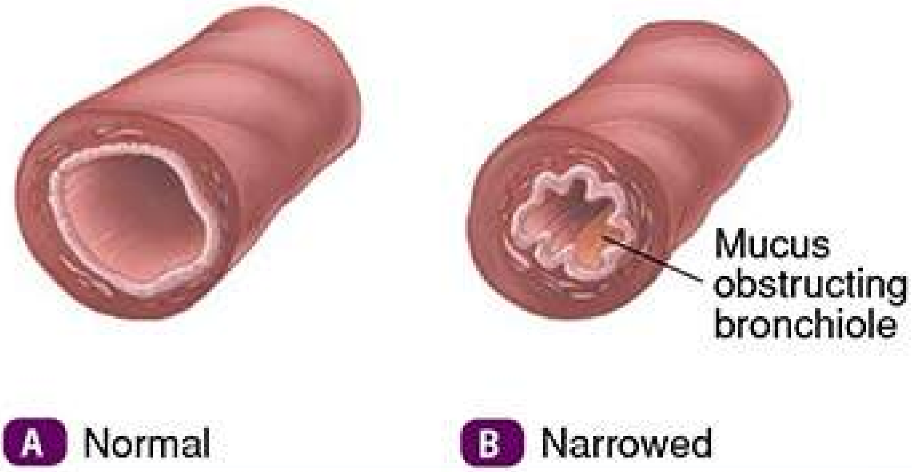


Figure 15-8 Asthma is an inflammation of the lungs associated with excessive mucus production and swelling of the bronchioles. **A.** Cross section of a normal bronchiole. **B.** The bronchiole in spasm; a mucous plug has formed and partially obstructed the bronchiole.

Asthma produces a characteristic wheezing as the patient attempts to exhale through partially obstructed air passages; wheezing is indicative of a partial lower airway obstruction. These same air passages open easily during inspiration. The wheezing may be so loud that you can hear it without a stethoscope. In other cases, the airways are so blocked that no air movement is heard. In severe cases, the actual work of exhaling is tiring, and cyanosis and/or respiratory arrest may quickly develop. Cyanosis is the body's attempt to divert blood to the core to help keep the vital organs functioning. It can be seen first in the lips and mucous membranes.

An acute asthma attack may be caused by an allergic response to specific foods or some other allergen. Between attacks, patients may breathe normally. Asthma attacks may also be triggered by severe emotional stress, exercise, and respiratory infections. In its most severe form, an allergic reaction can produce anaphylaxis. This, in turn, may cause respiratory distress that is severe enough to result in coma and death.

Most patients with asthma are familiar with their symptoms and know when an attack is imminent. Typically, they will have appropriate medication with them. Depending on your local protocols, you may be allowed to assist an asthma patient with an inhaler or nebulizer. Listen carefully to what a patient with asthma tells you; they often know exactly what they need.

YOU are the Provider — PART 2

After arriving at the scene and entering the patient's house, you smell cigarette smoke. There are numerous full ashtrays in the living room. The patient is sitting on the edge of her couch; she is wearing a nasal cannula attached to home oxygen, is smoking a cigarette, and is experiencing obvious breathing difficulty. She tells you, in two-word sentences, that her shortness of breath has worsened. You perform a primary assessment as your partner prepares to begin treatment.

Recording Time: 0 Minutes	
Appearance	Obvious breathing difficulty; breathing through pursed lips
Level of consciousness	Conscious and alert

Airway	Open; no secretions or foreign bodies
Breathing	Rapid and labored
Circulation	Radial pulse, rapid and weak; skin pink, warm, and dry

3. What should be your *most* immediate action?
4. How does emphysema differ from chronic bronchitis?

Hay Fever (Allergic Rhinitis)

Hay fever, or allergic rhinitis, causes coldlike symptoms, including a runny nose, sneezing, congestion, and sinus pressure. The symptoms are caused by an allergic response, usually to outdoor airborne allergens such as pollen or sometimes indoor allergens such as dust mites and pet dander. For many people, hay fever is at its worst in the spring and summer, but others may have hay fever symptoms year-round. People do not generally call 9-1-1 or request an ambulance for simple hay fever symptoms, but hay fever is included in this discussion of allergic conditions because it affects so many people. People with hay fever tend to be atopic, meaning that they are more likely to have other allergies, and they may also have a higher incidence of severe reactions, including anaphylaxis.

Anaphylactic Reactions

Anaphylaxis (anaphylactic shock) is a severe allergic reaction characterized by airway swelling and dilation of blood vessels all over the body, which may significantly lower blood pressure **Figure 15-9**. Anaphylaxis may be associated with widespread hives (urticaria), itching, signs of shock, and signs and symptoms similar to asthma. The airway may swell so much that breathing problems can progress to total airway obstruction in a matter of minutes. Most anaphylactic reactions occur within 30 minutes of exposure to the allergen, which can be anything from food (such as peanuts) to medication (such as penicillin). For some patients, the episode of anaphylaxis may be their first; therefore, they may not know what caused the reaction. In other cases, the patient may be aware of what substance he or she is sensitive to but is unaware that an exposure has occurred, such as eating food that was not supposed to contain nuts. In most cases, epinephrine (adrenalin) is the treatment of choice. Patients may have their own prescribed automatic epinephrine injector, or EpiPen. Oxygen and antihistamines are also useful. As always, medical direction should guide appropriate therapy. For more information about anaphylaxis and the EpiPen, see Chapter 20, *Immunologic Emergencies*.

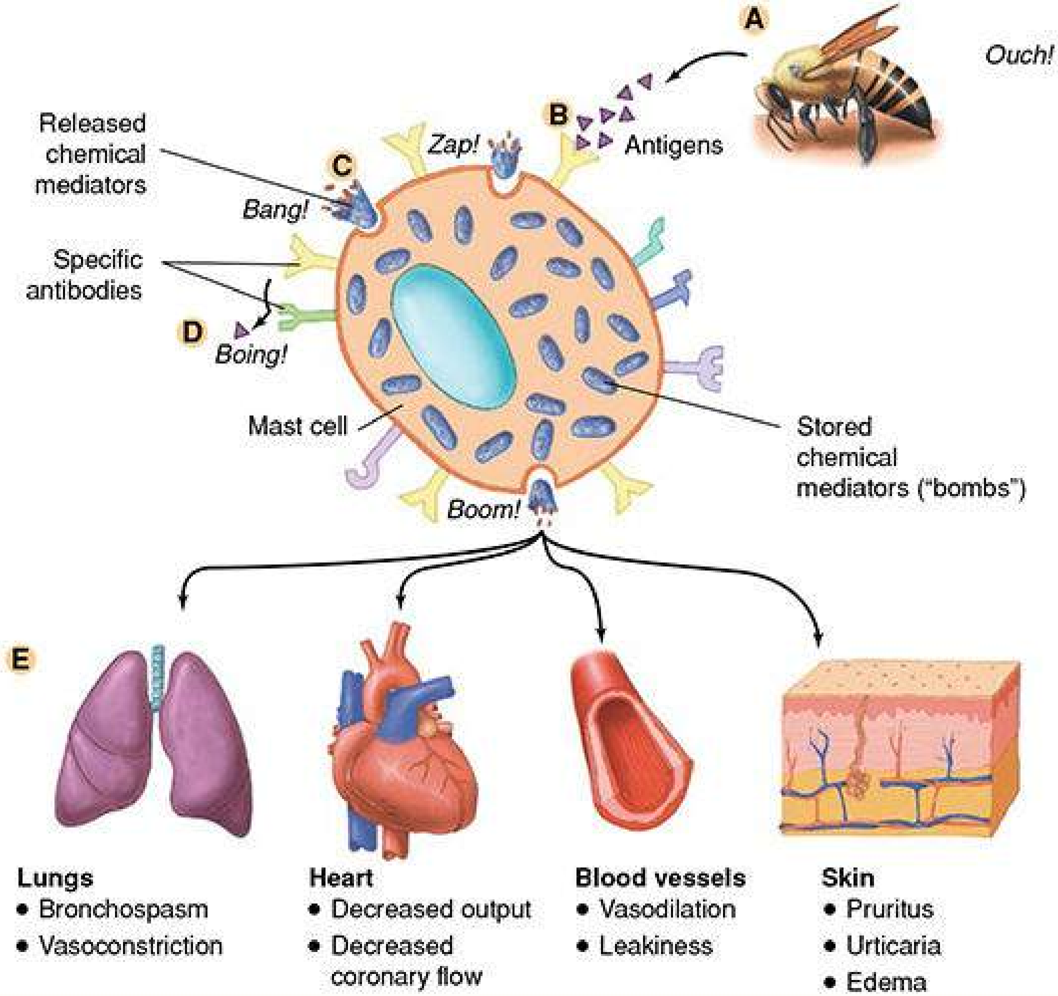


Figure 15-9 The sequence of events in anaphylaxis. **A.** The antigen is introduced into the body. **B.** The antigen-antibody reaction at the surface of a mast cell. **C.** The release of mast cell chemical mediators. **D.** Specific antibody reacts with its corresponding antigen. **E.** Chemical mediators exert their effects on end organs.

▶ Spontaneous Pneumothorax

Pneumothorax is a partial or complete accumulation of air in the pleural space. Pneumothorax is most often caused by trauma, but it can also be caused by some medical conditions. In these cases, the condition is called a "spontaneous" pneumothorax.

Normally, the "vacuum" pressure in the pleural space keeps the lung inflated. When the surface of the lung is disrupted, however, air escapes into the pleural cavity and results in a loss of negative vacuum pressure. The natural elasticity of the lung tissue causes the lung to collapse. The accumulation of air in the pleural space may be mild or severe **Figure 15-10**.

Spontaneous pneumothorax may occur in patients with certain chronic lung infections or in young people born with weak areas of the lung. Patients with emphysema and asthma are at high risk for spontaneous pneumothorax when a weakened portion of lung ruptures, often during severe coughing. Tall, thin men are also more susceptible than the rest of the population to development of spontaneous pneumothorax, particularly while performing strenuous activities, such as heavy lifting.

A patient with a spontaneous pneumothorax has dyspnea and might report **pleuritic chest pain**, a sharp, stabbing pain on one side that is worse during inspiration and expiration or with certain movement of the chest wall. By listening to the chest with a stethoscope, you can sometimes detect that breath sounds are absent or decreased on the affected side. However, altered breath sounds are very difficult to detect in a patient with severe emphysema. Spontaneous pneumothorax may be the cause of sudden dyspnea in a patient with underlying emphysema. A spontaneous pneumothorax has the potential to evolve into a life-threatening pneumothorax. Continually reassess for anxiety, increased dyspnea, hypotension, absent or severely decreased breath sounds on one side, the presence of jugular vein distention, and cyanosis.

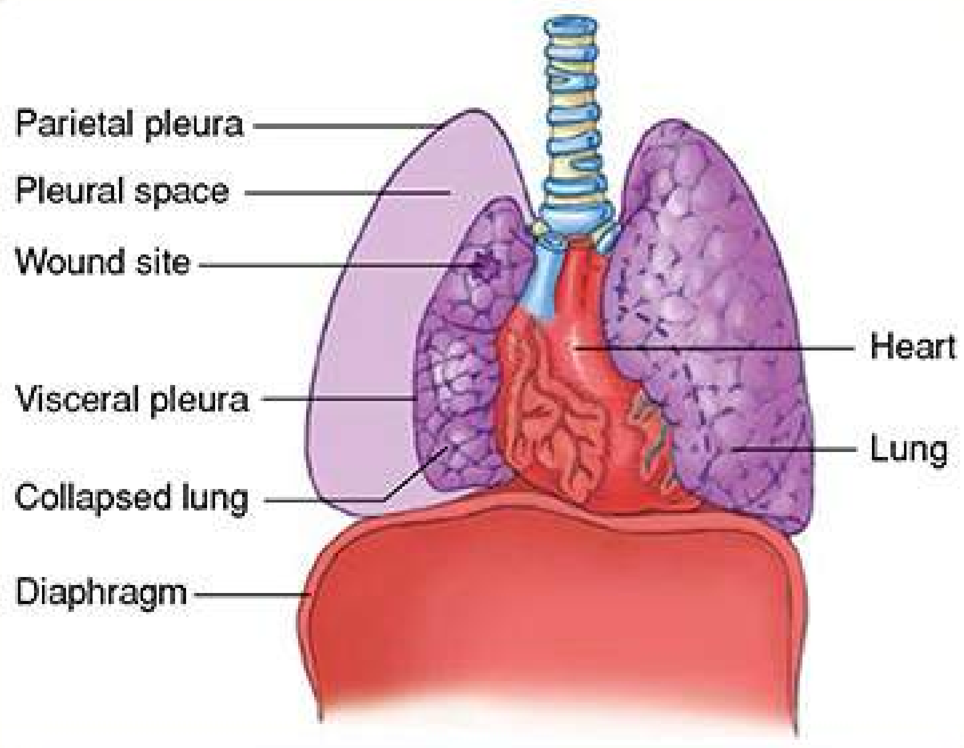


Figure 15-10 A pneumothorax occurs when air leaks into the pleural space from an opening in the chest wall or the surface of the lung. The lung collapses as air fills the pleural space and the two pleural surfaces are no longer in contact.

Pleural Effusion

A **pleural effusion** is a collection of fluid outside the lung on one or both sides of the chest. It compresses the lung or lungs and causes dyspnea **Figure 15-11**. This fluid may collect in large volumes in response to any irritation, infection, congestive heart failure, or cancer. Though it can build up gradually, over days or even weeks, patients often report that their dyspnea came on suddenly. Pleural effusions may also contribute to shortness of breath in a patient with lung cancer.

When you listen with a stethoscope to the chest of a patient with dyspnea resulting from pleural effusion, you will hear decreased breath sounds over the region of the chest where fluid has moved the lung away from the chest wall. These patients frequently feel better if they are sitting upright. Nothing will completely relieve their symptoms, however, except removal of the fluid, which must be done by a physician in the hospital.

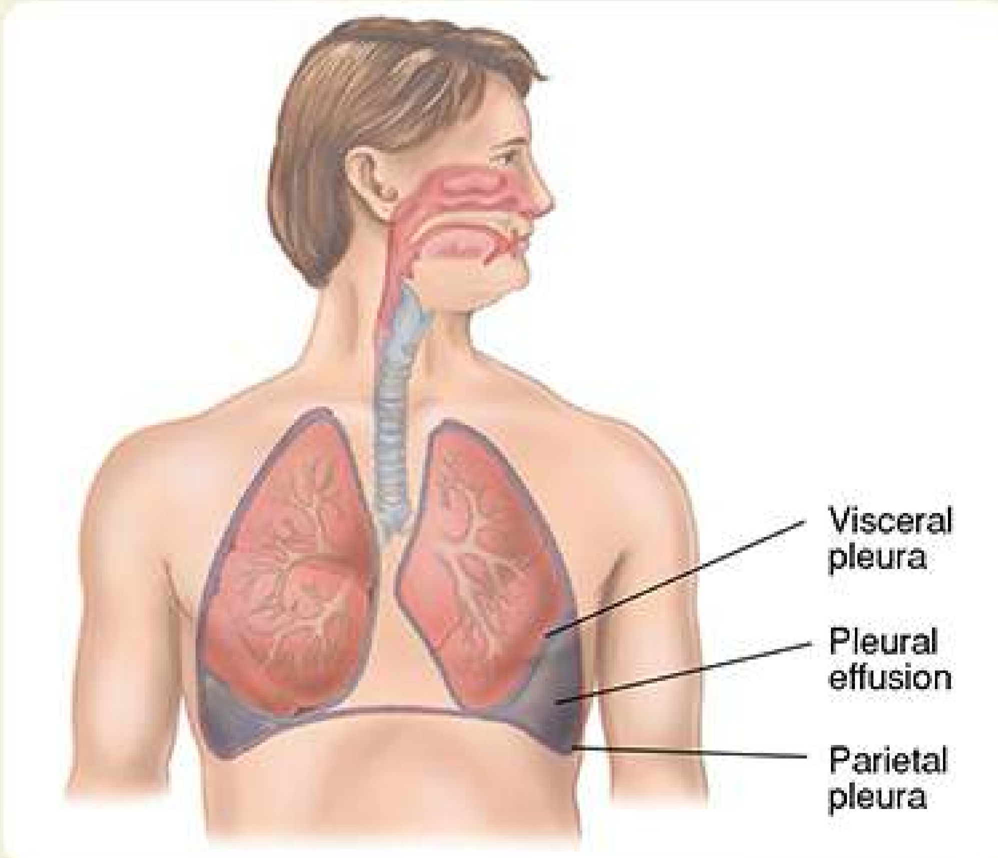


Figure 15-11 With a pleural effusion, fluid may accumulate in large volumes on one or both sides, compressing the lungs and causing dyspnea.

Obstruction of the Airway

As an EMT, always be aware of the possibility that a patient with dyspnea may have a mechanical obstruction of the airway and be prepared to treat it quickly. In semiconscious and unconscious patients, the obstruction may be the result of aspiration of vomitus or a foreign object **Figure 15-12A** or improper positioning of the head so that the tongue is blocking the airway **Figure 15-12B**.

Always consider upper airway obstruction from a foreign body first in patients who were eating just before becoming short of breath.

Pulmonary Embolism

An embolus is anything in the circulatory system that moves from its point of origin to a distant site and lodges there, obstructing subsequent blood flow in that area. Beyond the point of obstruction, circulation can be significantly decreased or completely blocked, which can result in a life-threatening condition. Emboli can be fragments of blood clots in an artery or vein that break off and travel through the bloodstream, or foreign bodies that enter the circulation, such as a bubble of air.

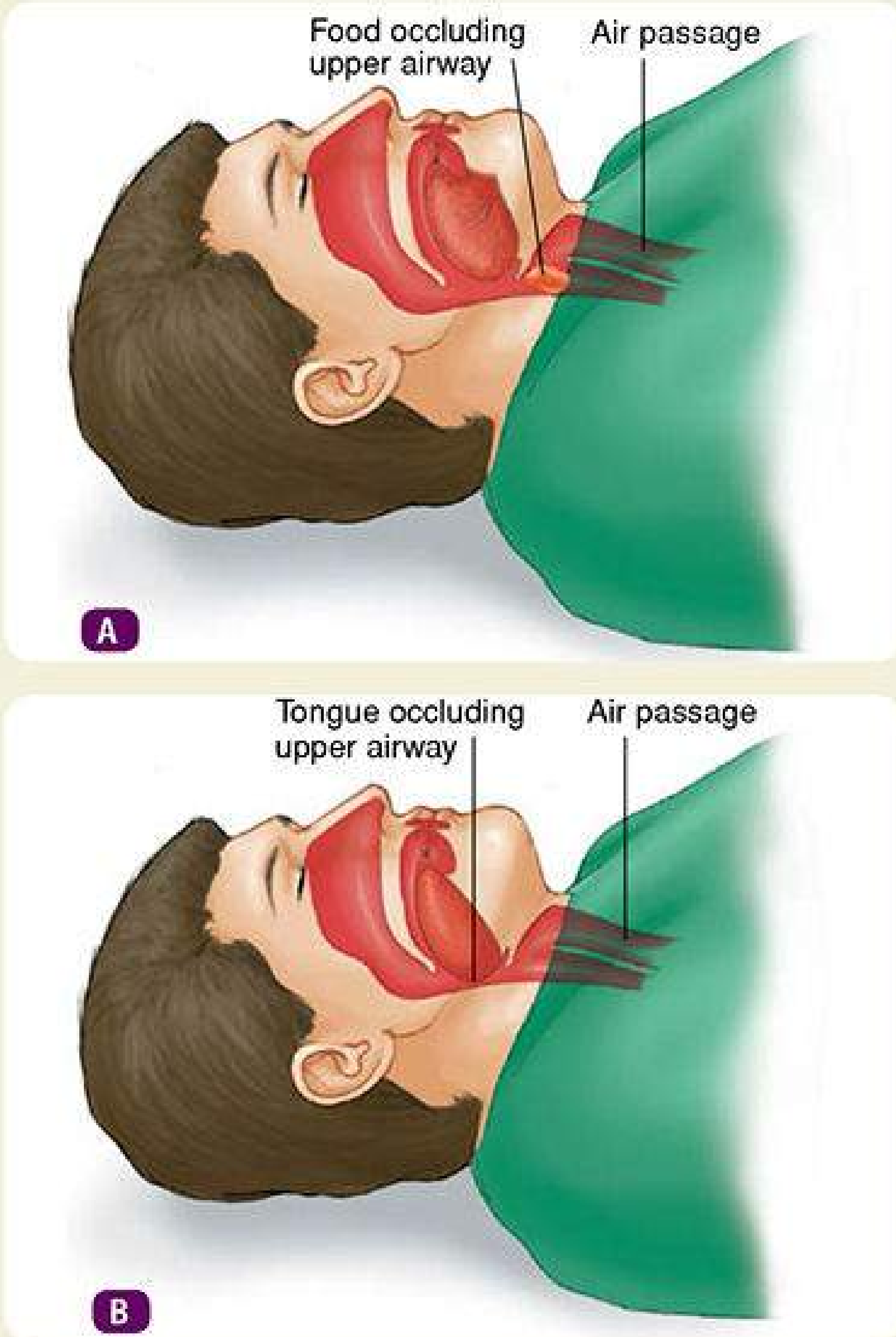


Figure 15-12 **A.** Foreign body obstruction occurs when an object, such as food, is lodged in the airway. **B.** Mechanical obstruction also occurs when the head is not properly positioned, causing the tongue to fall back into the throat.

A **pulmonary embolism** is a blood clot formed in a vein, usually in the legs or pelvis, that breaks off and circulates through the venous system. The embolus can also come from the right atrium in a patient with atrial fibrillation. The clot moves through the right side of the heart and into the pulmonary artery, where it becomes lodged, significantly decreasing or blocking blood flow Figure 15-13. Even though the lung itself can continue the process of inhalation and exhalation, no exchange of oxygen or carbon dioxide takes place in the areas of blocked blood flow because there is no effective circulation. In this circumstance, oxygen levels in the bloodstream may drop enough to cause cyanosis. The severity of cyanosis and dyspnea is directly related to the size of the embolism and the amount of tissue affected.

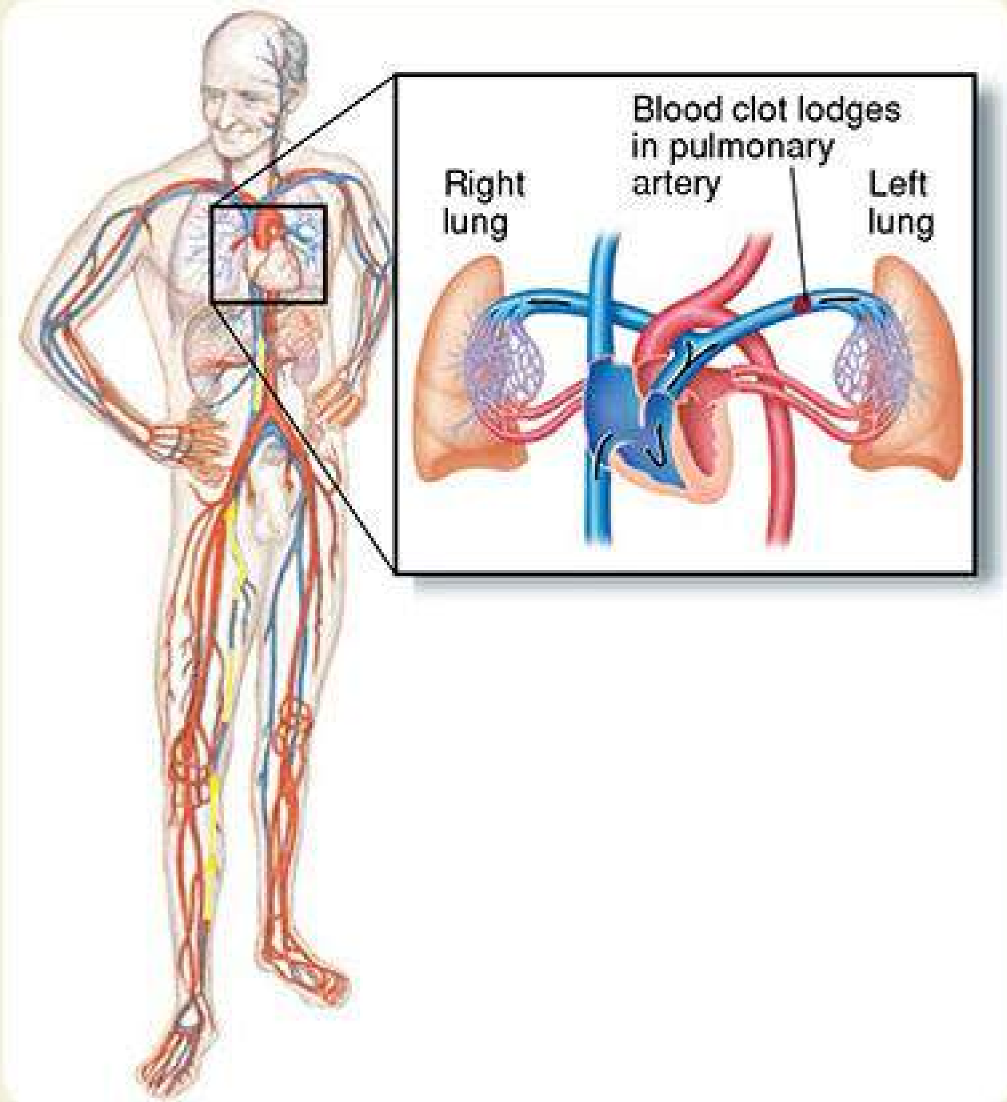


Figure 15-13 A pulmonary embolus is a blood clot from a vein that breaks off, circulates through the venous system, and moves through the right side of the heart into the pulmonary artery. Here, it can become lodged and significantly obstruct blood flow.

Pulmonary emboli may occur as a result of damage to the lining of vessels, a tendency for blood to clot unusually fast, or, most often, slow blood flow in a lower extremity. Slow blood flow in the legs is usually caused by long-term bed rest, which can lead to the collapse of veins. Patients whose legs are immobilized following a fracture or recent surgery are at risk for pulmonary emboli for days or weeks after the incident. Pregnancy, active cancer, and bed rest are other risk factors. Only rarely do pulmonary emboli occur in active, healthy people.

Although they are fairly common, pulmonary emboli are difficult to diagnose. According to the US Department of Health and Human Services, 100,000 cases of pulmonary embolism occur each year in the United States. Symptoms and signs of pulmonary emboli include the following:

- Dyspnea
- Tachycardia
- Tachypnea
- Varying degrees of hypoxia
- Cyanosis
- Acute chest pain
- Hemoptysis (coughing up blood)

With a large enough embolus, complete, sudden obstruction of the output of blood flow from the right side of the heart can result in sudden death.

Hyperventilation

Hyperventilation is defined as overbreathing to the point that the level of arterial carbon dioxide falls below normal. This may be an indicator of a life-threatening illness. For example, a patient with diabetes who has a high blood glucose level, a patient who has taken an overdose of aspirin, or a patient with a severe infection is likely to hyperventilate. In these cases, rapid, deep breathing is the body's attempt to stay alive. The body is trying to compensate for **acidosis**, the buildup of excess acid in the blood or body tissues that results from the primary illness. Because carbon dioxide, mixed with water in the bloodstream, can add to the blood's acidity, lowering the level of carbon dioxide helps to compensate for the other acids.

Similarly, in an otherwise healthy person, blood acidity can be diminished by excessive breathing because it "blows off" too much carbon dioxide. The result is a relative lack of acids. The resulting condition, **alkalosis**, is the buildup of excess base (lack of acids) in the body fluids.

Alkalosis is the cause of many of the symptoms associated with **hyperventilation syndrome (panic attack)**, including anxiety, dizziness, numbness, tingling of the hands and feet, and painful spasms of the hands and/or feet (carpopedal spasms). Patients often feel they cannot catch their breath despite the rapid breathing. Although hyperventilation can be the response to illness and a buildup of acids, hyperventilation syndrome is not the same thing. Instead, this syndrome occurs in the absence of other physical problems. It commonly occurs when a person is experiencing psychological stress and affects some 10% of the population at one time or another. The respirations of an individual who is experiencing hyperventilation syndrome may be as high as 40 shallow breaths/min or as low as only 20 deep breaths/min.

The decision whether hyperventilation is being caused by a life-threatening illness or a panic attack should not be made outside the hospital. Initially, you can verbally instruct the patient to slow his or her breathing; however, if that does not work, give supplemental oxygen and provide transport to the hospital where physicians will determine the cause of the hyperventilation.

Environmental/Industrial Exposure

Many accidental exposures that cause inhalation injury and dyspnea occur at industrial sites. Pesticides, cleaning solutions, chemicals, chlorine, and other gases can be accidentally released and inhaled by employees. Sometimes chemicals like ammonia and chlorine bleach are mixed and create a hazardous by-product.

In many cases, industrial sites have their own medical, fire, and/or hazardous materials (HazMat) teams that are familiar with all the chemicals used at their site and know what to do in case of an exposure. They will begin immediate decontamination and medical care. In these cases, the patient needs to be decontaminated by trained responders before you take responsibility.

Once the patient is decontaminated, gather information from the first responders about the substance and the cause of dyspnea. Assess the patient, paying special attention to breath sounds. Inhalation injuries can cause aspiration pneumonia that can result in eventual pulmonary edema. The inhaled substance can also cause lung damage. Blood coming from the airway is an ominous sign. Chapter 39, *Incident Management*, discusses HazMat in more detail.

Carbon Monoxide Poisoning

Toxic gases can also affect people outside the industrial setting. One common type of exposure is **carbon monoxide**, a colorless, odorless, tasteless, and highly poisonous gas known as “the silent killer.” Carbon monoxide is the leading cause of accidental poisoning deaths in the United States, according to the CDC. People who survive carbon monoxide poisoning can have permanent brain damage.

Carbon monoxide is produced by fuel-burning household appliances such as gas water heaters, space heaters, grills, and generators; it is also present in smoke from fire or cigarettes. The onset of cold weather commonly leads to an increase in carbon monoxide poisonings as people turn on heaters for the first time. The combined effects of incomplete combustion and a poorly ventilated building can cause a buildup of carbon monoxide. Another common source of carbon monoxide poisoning is motor vehicle exhaust. Some people will attempt suicide by running the engine inside a closed garage and inhaling the fumes.

People who are exposed to carbon monoxide may think they have the flu. They initially report headache, dizziness, fatigue, and nausea and vomiting. They may report dyspnea on exertion and chest pain and display nervous system symptoms like impaired judgment, confusion, or even hallucinations. The worst exposures may result in syncope or seizure. Carbon monoxide has a much stronger bond with hemoglobin than does oxygen; therefore, oxygen is not being delivered to the tissues of the body. This can lead to cellular death and organ failure if uncorrected.

When you assess the scene, do not put yourself at risk of exposure **Figure 15-14**. Consider toxic gas exposure if more than one patient in the same environment is experiencing the same signs and symptoms. The symptoms of patients will start to improve as soon as they are removed from the toxic environment. High-flow oxygen by nonrebreathing mask is the best treatment for conscious patients. Patients who are unconscious or have an altered level of consciousness may need full airway control with insertion of an airway adjunct and BVM ventilation. In the worst cases, patients may be treated with hyperbaric or pressurized oxygen therapy.

Patient Assessment

Your assessment of patients in respiratory distress should be a calm and systematic process. The patients are usually anxious, and they may be some of the most ill and challenging patients you will encounter.

Scene Size-up

As always, first consider standard precautions and use of PPE. The patient may have a respiratory infection that could be passed to you through sputum and/or air droplets. Follow local protocols.

Figure 15-14 A portable carbon monoxide alarm can be attached to your medical bag to alert you to its presence at potential toxic scenes.

Next, consider whether the respiratory emergency may have been caused by a toxic substance that was inhaled, absorbed, or ingested.

Once you have determined the scene is safe, determine how many patients there are and whether you need additional or specialized resources. If there are multiple people with dyspnea, consider the possibility of an airborne hazardous material release.

If the nature of illness (NOI) is in question, ask why 9-1-1 was activated. By questioning the patient, family, and/or bystanders, you should be able to determine the NOI.

Primary Assessment

Perform a rapid examination to identify immediate life threats, which includes problems with the ABCs: airway, breathing, and circulation (discussed next). If any major problem is identified, treat it immediately. If you find life-threatening issues, provide rapid transport.

Note your general impression of the patient. What is his or her age and position? A patient in significant respiratory distress will want to sit up. In a worst-case scenario, you will arrive to see the patient in the tripod position.

Does the patient appear calm? Is he or she anxious and restless, or listless and tired? How severe is his or her breathing complaint? This initial impression will help you decide whether the patient's condition is stable or unstable.

Use the AVPU scale to check for responsiveness. If the patient is alert or responding to verbal stimuli, you know that the brain is still receiving oxygen. Ask the patient about his or her chief complaint. If the patient is responsive only to painful stimuli or unresponsive, the brain may not be oxygenating well and the potential for an airway or breathing problem is more likely. If there is no gag or cough reflex, you need to immediately assess the patient's airway status. Within seconds you will be able to determine if there are any immediate threats to life.

Assessing ABCs in Respiratory Patients

Assess the airway; air must flow in and out of the chest easily for the airway to be considered patent. If there is any question about airway patency, immediately open the airway using the head tilt–chin lift maneuver in nontrauma patients and the jaw-thrust maneuver for patients with suspected spinal trauma.

If the airway is patent, next evaluate whether the patient's breathing is adequate. What are the rate, rhythm, and quality of the respirations? Is the rate within normal limits for the patient's age? Is the patient using accessory muscles to assist the respiratory effort, and can you see retractions? Is there abdominal breathing? What is the depth of breathing, and is the tidal volume adequate? Is there adequate rise and fall of the chest? What are the color, temperature, and condition of the patient's skin? Are the patient's respirations labored? If the patient can speak only one or two words at a time before gasping for a breath, ventilations are considered labored. If the respiratory effort is inadequate, you must provide the necessary intervention. If the patient is in respiratory distress, place him or her in a position that best facilitates breathing (generally sitting upright in a full or semi-Fowler position) and begin administering oxygen at 15 L/min via nonrebreathing mask, unless contraindicated because of preexisting medical conditions. If the patient's breathing has inadequate depth or the rate is too slow, ventilations may need to be assisted with a BVM.

Ask yourself the following questions:

1. Is the air going in?
2. Does the chest rise and fall with each breath?
3. Is the rate adequate for the age of the patient?

If the answer to any of these questions is "no," something is wrong. Try to reposition the patient and insert an oral airway to keep the tongue from blocking the airway. Refer to Chapter 10, *Airway Management*, for a review of airway management and ventilation techniques. Continue to monitor the airway for fluid, secretions, and other problems as you move on to assess the adequacy of your patient's breathing.

The next step in assessing breathing in a patient with a respiratory emergency is to assess breath sounds. Techniques for this assessment are described at the end of this section.

YOU are the Provider — PART 3

Your partner obtains the patient's vital signs as you continue your assessment. You notice she is breathing through pursed lips and has a prolonged exhalation phase, and cyanosis is present in her fingernail beds. You auscultate her breath sounds and hear scattered wheezing in all lung fields. When you talk to her, you note she is now confused, is slow to answer your questions, and appears fatigued.

Recording Time: 3 Minutes	
Respirations	28 breaths/min, labored; prolonged exhalation phase
Pulse	110 beats/min; weak
Skin	Cyanotic, cool, clammy
Blood pressure	116/54 mm Hg
Oxygen saturation (Spo_2)	88% (on oxygen)

5. Why do patients with emphysema breathe through pursed lips?
6. What does a prolonged exhalation phase indicate in patients with obstructive lung disease?
7. What treatment is indicated for the patient at this point?

After assessing breath sounds, assess circulation—the pulse rate, quality, and rhythm. If the pulse rate is too fast or too slow, the patient may not be getting enough oxygen. Determine the quality of the pulse. Is it strong, bounding, or weak? Also determine whether the rhythm is regular or irregular. Irregular beats could indicate a cardiac problem.

Assessing a patient's circulation includes an evaluation for the presence of shock and bleeding. Respiratory distress in a patient could be caused by an insufficient number of red blood cells to transport the oxygen. Assess capillary refill in infants and children. Normal capillary refill is less than 2 seconds; abnormal capillary refill is greater than 2 seconds. Capillary refill is not considered a reliable assessment tool in the adult patient.

Assess the patient's perfusion by evaluating skin color, temperature, and condition. A loss of perfusion may be caused by chronic anemia, a wound, internal bleeding, or simply shock overwhelming the body's ability to compensate for the illness.

You now know enough to be able to identify any life threats in your patient. They would include any of the following signs or symptoms:

- Problems with the ABCs
- Poor initial general impression
- Unresponsiveness
- Potential hypoperfusion or shock
- Chest pain associated with a low blood pressure
- Severe pain anywhere
- Excessive bleeding

If the patient's condition is unstable and there is a possible life threat, address the life threat and proceed with rapid transport. This means you will keep your scene time short, providing only lifesaving interventions. Perform a secondary assessment en route to the hospital. If the patient's condition is stable and there are no life threats, you may decide to perform a thorough secondary assessment on scene, after obtaining the patient history.

Assessing Breath Sounds

Obtaining breath sounds, or lung sounds, is an important step when you assess a patient who is experiencing respiratory distress. Listen over the bare chest. Trying to listen over clothing or chest hair may give you inaccurate information. The diaphragm of the stethoscope must be in firm contact with the skin. If your patient is lying down, bring him or her to a sitting position, which is a better position for assessing breath sounds.

You need to determine whether your patient's breath sounds are normal (**vesicular breath sounds**, **bronchial breath sounds**) or decreased, absent, or abnormal (**adventitious breath sounds**). With your stethoscope, check breath sounds on the right and left sides of the chest, and compare each side **Figure 15-15**. When listening on the patient's back, place the stethoscope head between and below the scapulae, not over them, or you will have an inaccurate assessment.

Figure 15-15 Auscultation of breath sounds.

Make sure you listen for a full respiratory cycle so you can detect the adventitious sounds that may be heard at the end of the inspiratory or expiratory phase. When you assess for fluid collection, pay special attention to the lower lung fields. Start from the bottom up and determine at which level you start hearing clear breath sounds.

You want to hear clear flow of air in both lungs. Not hearing the flow of air is considered an absent lung sound. The lack of air movement in the lung is a significant finding. Listen carefully and do not confuse absent breath sounds with clear breath sounds. See Table 15-5 for examples of breath sounds, the diseases that may be associated with them, and important signs and symptoms.

Snoring sounds are indicative of a partial upper airway obstruction, usually in the oropharynx. **Wheezing** indicates constriction and/or inflammation in the bronchus. Wheezing is generally heard on exhalation as a high-pitched, almost musical or whistling sound. This sound is commonly heard in patients with asthma and sometimes in patients with COPD.

Crackles (formerly called rales) are the sounds of air trying to pass through fluid in the alveoli. It is a crackling or bubbling sound typically heard on inspiration. High-pitched sounds are called "fine" crackles, and low-pitched sounds are called "coarse" crackles. These sounds are often a result of congestive heart failure or pulmonary edema.

Rhonchi are low-pitched rattling sounds caused by secretions or mucus in the larger airway. Rhonchi are sometimes referred to as "junky" lung sounds and can be heard with infections such as pneumonia and bronchitis or in cases of aspiration.

Table 15-5 Signs, Symptoms, and Adventitious Breath Sounds Associated With Specific Respiratory Diseases

Breath Sounds	Disease	Signs and Symptoms
Wheezes	Asthma COPD Congestive heart failure/pulmonary edema Pneumonia Bronchitis Anaphylaxis	Dyspnea Productive or nonproductive cough Dependent edema, pink frothy sputum Fever, pleuritic chest pain Clear or white sputum Hives, facial swelling, stridor, nonproductive cough
Rhonchi	COPD Pneumonia Bronchitis	Productive cough Fever, pleuritic chest pain Clear or white sputum
Crackles	Congestive heart failure/pulmonary edema Pneumonia	Dependent edema, pink frothy sputum Fever, pleuritic chest pain
Stridor	Croup Epiglottitis	Fever, barking cough Fever, sore throat, drooling
Decreased or absent breath sounds	Asthma COPD Pneumonia Hemothorax Pneumothorax Atelectasis	Nonproductive cough, dyspnea Productive cough Fever, pleuritic chest pain Shock, respiratory distress Dyspnea, pleuritic chest pain Fever, decreased oxygen saturation

Stridor is the high-pitched sound heard on inspiration as air tries to pass through an obstruction in the upper airway. This sound indicates a partial obstruction of the trachea and occurs in patients with anatomic or foreign body airway obstruction.

Words of Wisdom

Adventitious breath sounds are sounds heard by auscultation of abnormal lungs. These sounds can include wheezing, crackles, rhonchi, gurgling, snoring, crowing, and stridor. The ability to hear and distinguish different kinds of breath sounds can give you important clues as to what is wrong with your patient. The only way to develop your ability to identify breath sounds is through practice. Ask your instructor if you can accompany a physician, nurse, or respiratory therapist in the hospital to help you develop this ability.

History Taking

The next step of your assessment will provide more information specific to the patient's chief complaint (history of present illness) through history taking. The information you obtain during history taking will be subjective (what the patient expresses, or symptoms) and objective (what you observe, or signs). Both sets of information are important in building a general assessment. Rule out any findings that warrant no care or intervention. Report pertinent negatives to health care providers or ED staff members. Recall that a pertinent negative is any sign or symptom that commonly accompanies a particular condition, but is absent. Examples of pertinent negatives would be a patient in respiratory distress who denies chest pain, or a patient with severe chest pain who denies shortness of breath.

Find out what the patient has done for the breathing problem. Does the patient have home oxygen? Does the patient use a prescribed inhaler or a small-volume nebulizer? If so, when was it used last? How many doses have been taken? Does the patient use more than one inhaler or treatment? Be sure to record the name of each device and when it was used.

Chronic Respiratory Conditions

Different respiratory complaints offer different clues and different challenges. Patients with chronic conditions may have long periods in which they are able to live relatively normal lives but then sometimes experience acute worsening of their conditions. That is when you are called, and it is important for you to be able to determine your patient's baseline status; in other words, his or her normal condition (and what is different this time that made the patient call you). For example, patients with COPD do not cope well with pulmonary infections because the existing airway damage makes them unable to cough up the mucus or sputum produced by the infection. The chronic lower airway obstruction makes it difficult for the patient to breathe deeply enough to clear the lungs. Gradually, the arterial oxygen level falls, and the carbon dioxide level rises. If a new infection of the lung occurs in a patient with COPD, the arterial oxygen level may fall rapidly. In a few patients, the carbon dioxide level may become high enough to cause sleepiness. In these cases, patients require respiratory support and careful administration of oxygen.

Recall that the patient with COPD usually has a long history of dyspnea with a sudden increase in shortness of breath. There is rarely a history of chest pain. More often, the patient will remember having had a recent "chest cold" with fever and either an inability to cough up mucus or a sudden increase in thick green or yellow sputum. The blood pressure of patients with COPD is often normal; however, the pulse may be rapid and occasionally irregular. Pay particular attention to the respirations. They may be rapid, or they may be very slow.

Patients with asthma may have different "triggers," including allergens, cold, exercise, stress, infection, and noncompliance with medication prescriptions. It is important to try to determine what may have triggered the attack so that it can be treated appropriately. For example, an asthma attack that occurred while your patient was jogging in the cold will probably not respond to antihistamines, whereas one brought on by a reaction to pollen might.

Patients with congestive heart failure often walk a fine line between compensating for their diminished cardiac capacity and decompensating. Many take several medications, most often including diuretics ("water pills") and blood pressure medications. Obtain a list of all medications and ask about the events leading up to the present problem.

Questioning a Patient With Difficulty Breathing

With patients in respiratory distress, many of the SAMPLE questions can be answered by the family or bystanders if they are present. Limit the number of questions to pertinent ones—a patient who is in respiratory distress does not need to be using any additional air to answer questions.

Ask the following questions about a patient in respiratory distress:

- What is the patient's general state of health?
- Has the patient had any childhood or adult diseases?
- Have there been any recent surgical procedures or hospitalizations?
- Have there been any traumatic injuries?

To help determine the cause of your patient's problem, be a detective. Look for medications, medical alert bracelets, environmental conditions, and other clues to what may be causing the problem. Each part of the SAMPLE history may give you clues, so be thorough. For example, you forget to ask about allergies, only to find out later that your patient has a severe allergy to cat dander and that her 8-year-old son had been playing with a cat shortly before the onset of her problem. You would have missed important and possibly lifesaving information.

The OPQRST assessment, generally used for determining the specifics of pain, can also be modified to obtain more specific information about the breathing problem. Begin by asking the patient to describe the problem. Pay close attention to OPQRST and include the following open-ended questions:

- When did the breathing problem begin (Onset)?
- What makes the breathing difficulty worse (Provocation or palliation)?
- How does the breathing feel (Quality)?
- Does the discomfort move (Radiation/region)?
- How much of a problem is the patient having (Severity)?
- Is the problem continuous or intermittent? If it is intermittent, how frequently does it occur and how long does it last (Timing)?

An additional assessment for a complaint of shortness of breath or difficulty breathing uses the mnemonic PASTE:

P *Progression*. Similar to the O in OPQRST, you want to know if the problem started suddenly or has worsened over time.
A *Associated chest pain.* Dyspnea can be a significant symptom of a cardiac problem.
S *Sputum*. Has the patient been coughing up sputum? Mucus-like sputum could indicate a respiratory infection, pink frothy sputum is indicative of fluid in the lungs, and a problem like a pulmonary embolus may not result in any sputum at all.
T *Talking tiredness.* This is an indicator of how much distress the patient is in. Ask the patient to repeat a sentence and see how many words he or she can speak without needing to take a breath. The assessment results would be reported as the patient "speaks in full sentences" or, perhaps, "speaks in two-to-three-word sentences."
E *Exercise tolerance*. Ask the patient a question about what he or she was able to do before this problem started, like walk across the room, and then ask if the patient could do it now. If the answer is "no," then it is another indicator that your patient is in distress. Exercise tolerance will decrease as the breathing problem and hypoxia incease.

Secondary Assessment

During the secondary assessment, further investigate the specific chief complaint (for example, dyspnea) by performing a physical examination and taking vital signs.

In respiratory emergencies, as in all other emergencies, only proceed to history taking and the secondary assessment once all life threats have been identified and treated during the primary assessment. If you are busy treating airway or breathing problems, you may not have the opportunity to proceed to a physical examination prior to arriving at the ED. Never compromise the assessment and treatment of airway and breathing problems to conduct a physical examination.

Sometimes it is not possible to quickly and definitively determine what is causing your patient's respiratory distress. If your patient is a 20-year-old woman at a picnic who rapidly develops difficulty breathing and hives after being stung by a bee, you have a clearcut diagnostic picture. Conversely, if your patient is an older woman in a nursing home who is receiving 12 medications and has a cough and increasing shortness of breath that developed during the past week, this is more perplexing. Keep an open mind, gather as complete a history as possible, and perform a secondary assessment.

Conduct an in-depth assessment when a patient reports shortness of breath. In addition to the signs of air hunger present in all patients with respiratory distress, such as the tripod position, rapid breathing, and use of accessory muscles, restriction of the small lower airways in patients with asthma often causes wheezing. Patients may have a prolonged expiratory phase of breathing as they attempt to exhale trapped air from the lungs. In severe cases, you may actually not hear wheezing because of insufficient airflow. Remember that the brain needs a constant, adequate supply of oxygen to function normally. As your patient tires from the effort of breathing and oxygen levels drop, the respiratory and heart rates may drop, and you will notice an altered level of consciousness. This may manifest itself as confusion, lack of coordination, bizarre behavior, or even combativeness. Your patient may seem to relax or fall asleep. A change in affect or level of consciousness is one of the early warning signs of respiratory inadequacy, and you must act immediately.

When you perform a secondary assessment on the respiratory system, look for overall symmetry of the chest, adequate rise and fall of the chest, and evidence of retractions or accessory muscle use. Are the patient's respirations labored or unlabored? Assess breath sounds, and do a physical assessment if warranted.

A secondary assessment of the cardiovascular system, especially when there is associated chest pain, should include checking and comparing distal pulses, reassessing the skin condition, and being alert for bradycardia and tachycardia.

Feel for the skin temperature, and look for color changes in the extremities and in the core of the body. Cyanosis is an ominous sign that requires immediate, aggressive intervention.

Blood pressure should be auscultated (by listening) when possible to obtain the systolic and diastolic numbers. If you are in an environment where you cannot hear well enough to auscultate the blood pressure, then palpation (by feeling) is an alternative.

Words of Wisdom

Never delay the assessment and treatment of airway and breathing problems to conduct a physical examination.

It is important to assess the neurologic system because the level of consciousness can change. Check the patient's mental status, and determine if the patient's activity can be described as anxious or restless. If so, that would be an indicator of hypoxia. Does the patient have clear thought processes? Disorientation may be another indicator of hypoxia.

Use monitoring devices if you have them available, including, but not limited to, a pulse oximeter. Pulse oximetry is an effective diagnostic tool when used in conjunction with experience, good assessment skills, and clinical judgment. Pulse oximeters measure the percentage of hemoglobin that is saturated by oxygen. In patients with normal levels of hemoglobin, pulse oximetry can be an important tool in evaluating oxygenation. To use pulse oximetry properly, it is important for you to be able to evaluate the quality of the reading and correlate it with the patient's condition. For example, it is doubtful a patient with congestive heart failure in severe respiratory distress will have a pulse oximetry reading of 98% or that a pulse oximetry reading of 80% is reliable in a conscious, alert, active patient with good skin color.

If you get a good reading consistent with your patient's condition, the pulse oximeter can help you determine the severity of the respiratory component of the patient's problem. Also, if the reading goes steadily up or down, it can give you an indication of improvement or deterioration of the patient's oxygenation status, often even prior to changes in the patient's appearance or vital signs.

Words of Wisdom

Be aware of conditions that can skew pulse oximeter results. Bright light, darkly pigmented skin, and nail polish can cause errors in the readings. Remember that it only measures the percentage of hemoglobin that is saturated with oxygen. Therefore, a patient with a low hemoglobin level, such as a patient with anemia or hypovolemia, may have 100% oxygen saturation. This means that the hemoglobin is saturated, but the reading does not tell you that the hemoglobin level in the bloodstream is insufficient to sustain organ function. Other conditions that may cause false readings are sickle cell disease and carbon monoxide poisoning.

Secondary Assessment of COPD Versus Congestive Heart Failure

Additional pieces to the assessment and treatment puzzle may be revealed during the physical examination. For example, you are treating a patient in acute respiratory distress who is breathing at a rate of 40 breaths/min and has audible wheezing. On the basis of this information, you may be unsure as to whether the patient is in congestive heart failure or is having an asthma attack. The secondary assessment may provide you with some clues, such as a consistently elevated blood pressure and swollen legs and feet (pedal edema) that would lead you in the direction of congestive heart failure.

Assume you are assessing a patient with COPD. What would you notice? Patients with COPD are usually older than 50 years. They will often have a history of recurring lung problems and are almost always long-term active or former cigarette smokers. Patients may report tightness in the chest and constant fatigue. Because air has been gradually and continuously trapped in their lungs in increasing amounts, their chests often have a barrel-like appearance. Patients with COPD often use accessory muscles to breathe **Figure 15-16**. If you listen to the patient's chest with a stethoscope, you will hear abnormal breath sounds. Patients with COPD will often exhale through pursed lips as a strategy to keep airways open longer. Digital clubbing (abnormal enlargement of the ends of the fingers) is also a sign of COPD.

Reassessment

Once the assessment and treatment have been completed, you need to reassess the patient and closely watch patients with shortness of breath. Repeat the primary assessment, and maintain an open airway. Monitor the patient's breathing, and reassess circulation.

Determine if there have been changes in the patient's condition. Confirm the adequacy of interventions and patient status. Is the current treatment improving the patient's condition? Has an already identified problem improved? Has an already identified problem gotten worse? What is the nature of any newly identified problems?

If the changes you find are improvements, simply continue the treatments; however, if your patient's condition deteriorates, prepare to modify treatments. Be prepared to assist ventilations with a BVM. Monitor the skin color and temperature. Reassess and record vital signs at least every 5 minutes for a patient in unstable condition and/or after the patient uses an inhaler. If the patient's condition is stable and no life threat exists, vital signs should be obtained at least every 15 minutes.

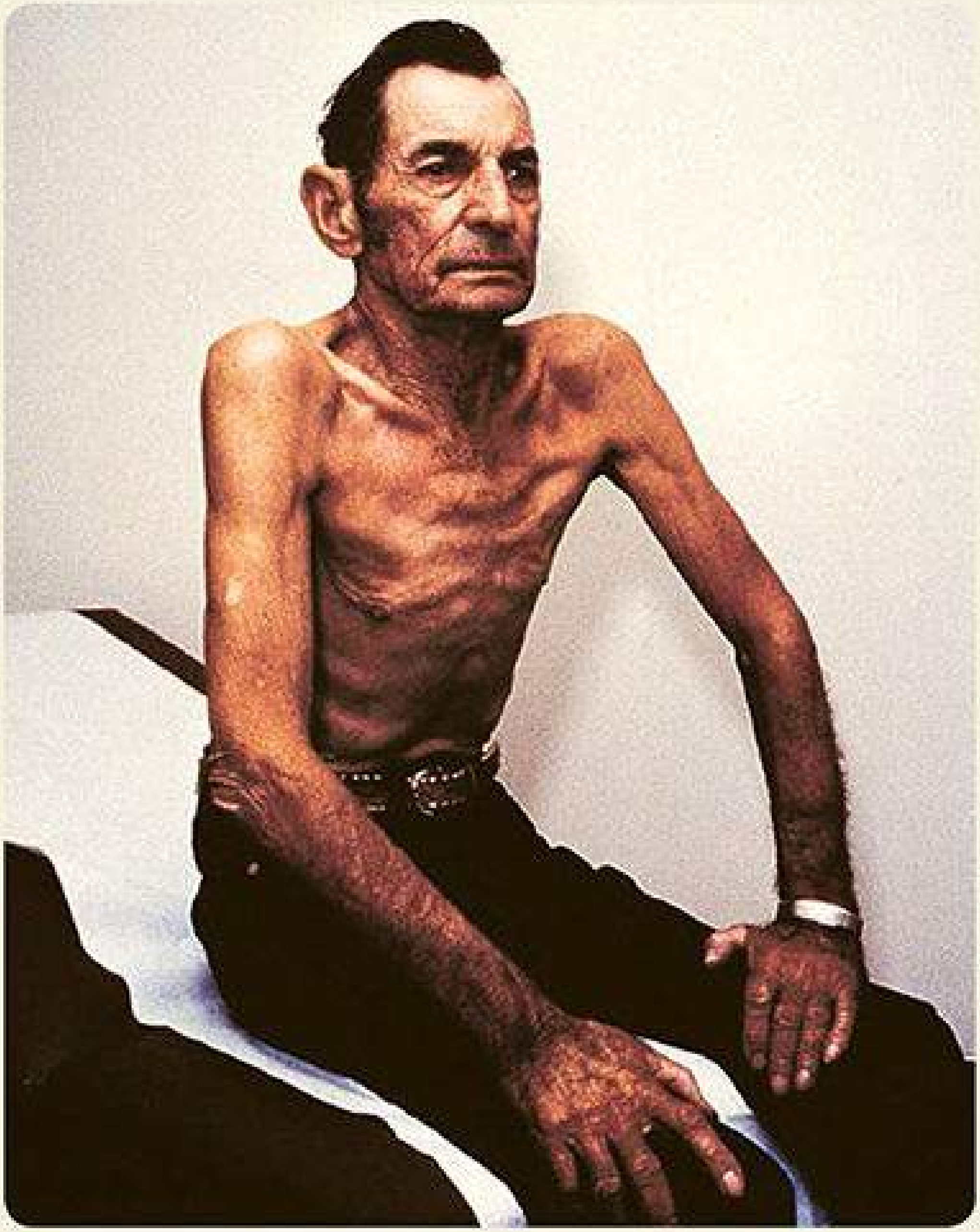


Figure 15-16 Patients with COPD often use accessory muscles and pursed lips for breathing. The increased work of breathing leads to decreased food intake (malnutrition) and muscle wasting. Notice, also, that this patient is sitting in the tripod position.

Now that you have completed the secondary assessment and have gathered information about your patient with difficulty breathing, it is time to provide interventions for the problems that are not immediate life threats. Your interventions may be based on standing orders, or contact the hospital and ask for specific directions. Remember, interventions for immediate life threats should be been completed during the primary assessment and should not require contacting the hospital first. Interventions for respiratory problems may include the following:

- Providing oxygen via a nonrebreathing mask at 15 L/min
- Providing positive-pressure ventilations using a BVM, pocket mask, or a flow-restricted oxygen-powered ventilation device
- Using airway management techniques such as an oropharyngeal (oral) airway, a nasopharyngeal (nasal) airway, suctioning, or airway positioning
- Providing noninvasive ventilatory support with continuous positive airway pressure (CPAP)
- Positioning the patient in a high-Fowler's position or a position of choice to facilitate breathing
- Assisting with respiratory medications found in a patient-prescribed metered-dose inhaler or a small-volume nebulizer

Some of these interventions were performed in the primary assessment to address life threats. Others are used to support breathing problems until definitive care can be provided at the hospital. Some of your interventions may even correct the problem.

Contact medical control with any change in level of consciousness or difficulty breathing. Depending on local protocols, contact medical control prior to assisting with any prescribed medications. Be sure to document any changes (and at what time) and any orders given by medical control.

Emergency Medical Care

Management of respiratory distress involves continuing awareness of scene safety and the use of standard precautions. Management of ABCs and positioning are primary treatments along with oxygen and suction.

You will usually administer oxygen. If a patient reports breathing difficulty, administer supplemental oxygen immediately. Adult patients breathing more than 20 breaths/min or fewer than 12 breaths/min should receive high-flow oxygen (defined as 15 L/min). Depending on the level of distress, some patients may benefit from CPAP (discussed later in the chapter). In addition, patients may require ventilatory support with a BVM, particularly if their mental status is declining or if they are in moderate to severe respiratory distress.

Take great care in monitoring the patient's respirations as you provide oxygen. Reevaluate the respirations and the patient's response to oxygen repeatedly, at least every 5 minutes, until you reach the ED. In a person with a chronically high carbon dioxide level (eg, certain patients with COPD), this is critical, because the supplemental oxygen may cause a rapid rise in the arterial oxygen level. This, in turn, may depress the patient's hypoxic drive and cause respiratory arrest.

In patients who have long-standing COPD and probable carbon dioxide retention, administration of low-flow oxygen (2 L/min) is a good place to start, with adjustments to 3 L/min, then 4 L/min, and so on, until symptoms have improved (for example, the patient's breathing becomes easier or he or she becomes more responsive). Pulse oximetry will help you understand the degree of oxygen deprivation and adjust oxygen therapy accordingly. When in doubt, err on the side of more oxygen, and monitor the patient closely.

Remember, do *not* withhold oxygen for fear of depressing or stopping breathing in a patient with COPD who needs oxygen. A decreased respiratory rate after administration of oxygen does not necessarily mean that the patient no longer needs the oxygen; he or she may need it even more. If respirations slow and the patient becomes unconscious, assist breathing with a BVM.

Always provide emotional support to the patient who is anxious. Always speak with assurance and assume a concerned, professional approach to reassure the patient, who is probably very frightened.

Words of Wisdom

Some states allow EMTs to administer inhalers or assist patients in the administration of their own inhalers. With this increased scope of practice comes an increased responsibility to know the names, doses, indications, contraindications, side effects, and precautions of the numerous inhalers available for a variety of conditions. Patients sometimes do not know the difference between their "rescue" inhalers (immediately effective medication, such as albuterol) and their "maintenance" inhalers (such as corticosteroids, which have no immediate effect). It is essential, then, that you know the difference!

Metered-Dose Inhaler and Small-Volume Nebulizer

Patients who call for help because of difficulty breathing are likely to have had the same problem before. They probably have prescribed medications to use that are delivered by an inhaler or small-volume nebulizer. If so, you may be able to help them use these devices depending on local protocols. Some of the most common medications used for shortness of breath are inhaled beta-agonists, which dilate breathing passages. The following medications may be administered via a **metered-dose inhaler (MDI)**, which is a miniature spray canister used to direct such substances through the mouth and into the lungs, such as the following: albuterol (Proventil, Ventolin), albuterol/ipratropium (Combivent), metaproterenol (Alupent, Metaprel), and terbutaline (Brethine).

Medications typically administered by small-volume nebulizer include, but are not limited to, albuterol, metaproterenol, and epinephrine. The **small-volume nebulizer** works by providing a means for a fine mist of aerosolized medicine to get deep into the patient's lungs and start to work quickly. The patient inhales the mist through a mouthpiece. When the medicine is breathed in correctly, it goes directly into the lungs.

Medical Control

Consult medical control (online), or follow standing orders (off-line). Remember to report what the medication is, when the patient last self-administered a treatment, how much medication was used at that time, and what the label states regarding dosage. If medical control or standing orders permit, you may assist the patient to self-administer the medication. Be certain that the inhaler belongs to the patient, it contains the correct medication, the expiration date has not passed, and the correct dose is being administered. There may be times in which the prescribed dose is not explicitly listed on the inhaler. In this situation, ask the patient how many inhalations of the medication he or she takes. Administer repeated doses of the medication if the maximum dose has not been exceeded and the patient is still experiencing shortness of breath.

Unlike an MDI, a small-volume nebulizer must be assembled prior to use. An oxygen tank is also required to administer the aerosolized medication. The patient may have a tank available, or you will need to use your own tank.

Indications and Contraindications

Before helping a patient to self-administer any MDI or small-volume nebulizer medication, make sure that the medication is indicated—that is, the patient has signs and symptoms of shortness of breath. The most common use for an MDI is asthma, and a small-volume nebulizer is used in asthma, bronchiolitis, COPD, and anaphylaxis. Check that there are no contraindications for its use, such as the following:

- The patient is unable to help coordinate inhalation with depression of the trigger on an MDI or is too confused to effectively administer medication through a small-volume nebulizer. These devices will be only minimally effective when patients are in respiratory failure and have only minimal air movement.
- The MDI or small-volume nebulizer is not prescribed for this patient.
- You did not obtain permission from medical control and/or it is not permissible by local protocol.
- The patient has already met the maximum prescribed dose before your arrival.
- The medication is expired.
- There are other contraindications specific to the medication.

Actions

Most respiratory inhalation medications used relax the muscles that surround the air passages in the lungs, leading to enlargement (dilation) of the airways and easier movement of air. See Table 15-6 for a list of respiratory inhalation medications. The medications used for acute symptoms are designed to give the patient rapid relief from symptoms if the condition is reversible. Medications used for chronic symptoms are administered for preventive measures or as maintenance doses. The medications for long-term use will provide little relief of acute symptoms.

Table 15-6 Respiratory Inhalation Medications

Medication			Indications			Use: Acute Versus Chronic Disease	
Generic Drug Name	Trade Names	Action	Asthma	Bronchitis	COPD	Acute	Chronic
Albuterol	Proventil, Ventolin, Volmax	Dilates bronchioles	Yes	Yes	Yes	Yes	No
Beclomethasone	Beclovent, Beconase, Qvar, Vanceril	Anti-inflammatory, reduces swelling	Yes	No	No	No	Yes
Cromolyn	Intal	Decreases release of histamines	Yes	No	No	No	Yes
Fluticasone	Flovent Diskus	Anti-inflammatory, reduces swelling	Yes	No	No	No	Yes
Fluticasone, salmeterol	Advair Diskus	Decreases secretions	Yes	No	No	No	Yes
Ipratropium bromide	Atrovent	Dilates bronchioles	Yes	Yes	Yes	Yes	No
Levalbuterol	Xopenex	Dilates bronchioles	Yes	Yes	Yes	Yes	No
Metaproterenol sulfate	Alupent, Metaprel	Dilates bronchioles	Yes	Yes	Yes	Yes	No
Montelukast	Singulair	Anti-inflammatory, reduces swelling	Yes	No	Yes	No	Yes
Salmeterol	Serevent Diskus	Dilates bronchioles	Yes	Yes	Yes	No	Yes

Side Effects

Common side effects of inhalers used for acute shortness of breath include increased pulse rate, nervousness, and muscle tremors. Often, a patient will begin coughing *after* administration of an inhaler as the airways are opened and secretions start to loosen and clear.

If the patient has a prescribed MDI or small-volume nebulizer, read the label carefully to make sure that the medication is to be used for shortness of breath and that it has, in fact, been prescribed by a physician **Figure 15-17**. When in doubt, consult medical control.

Dose and Route

Medication from an inhaler is delivered through the respiratory tract to the lung. The dose is one puff for an MDI and continuation of the small-volume nebulizer until all the medication has been administered or the patient no longer feels the need for the medication.

Figure 15-17 Some inhalers have spacer devices to better control the medication delivery to the patient.

Administration of a Metered-Dose Inhaler

To help a patient self-administer medication from an inhaler, follow the steps in **Skill Drill 15-1**:

1. Follow standard precautions.
2. Obtain an order from medical control or local protocol.
3. Check that you have the right medication, right patient, right dose, and right route and that the medication is not expired.
4. Make sure that the patient is alert enough to use the inhaler.
5. Check to see whether the patient has already taken any doses.
6. Make sure the inhaler is at room temperature or warmer **Step 1**.
7. Shake the inhaler vigorously several times.
8. Stop administering supplemental oxygen, and remove any mask from the patient's face.
9. Ask the patient to exhale deeply and, before inhaling, to put his or her lips around the opening of the inhaler **Step 2**.
10. Have the patient depress the hand-held inhaler as he or she begins to inhale deeply.
11. Instruct the patient to hold his or her breath for as long as is comfortable to help the body absorb the medication **Step 3**.
12. Continue to administer supplemental oxygen.
13. Allow the patient to breathe a few times, then repeat a second dose per direction from medical control or local protocol **Step 4**.

YOU are the Provider — PART 4

After initiating the appropriate treatment, you place the patient onto the stretcher, load her into the ambulance, and begin transport to the hospital. You reassess her and note that her condition has acutely deteriorated.

You insert a nasopharyngeal airway and begin assisting her ventilations with a BVM and high-flow oxygen.

Recording Time: 9 Minutes	
Level of consciousness	Responsive only to pain
Respirations	8 breaths/min; shallow
Pulse	124 beats/min; weak
Skin	Cool and dry; cyanosis of the nail beds and around the lips
Blood pressure	108/50 mm Hg
Spo_2	82% (on oxygen)

8. Why is cyanosis a later sign of hypoxemia in patients with emphysema?

9. Why does tachycardia develop in hypoxemic patients?

Skill Drill 15-1 Assisting a Patient With a Metered-Dose Inhaler

Step 1

Check to make sure you have the correct medication for the correct patient. Check the expiration date. Ensure inhaler is at room temperature or warmer.

Step 2

Remove oxygen mask. Hand inhaler to patient. Instruct about breathing and lip seal.

Step 3

Instruct patient to press inhaler and inhale one puff. Instruct about breath holding.

Step 4

Reapply oxygen. After a few breaths, have patient repeat dose if order or protocol allows.

▶ Administration of Small-Volume Nebulizer

To help a patient self-administer medication from a small-volume nebulizer, follow the steps in **Skill Drill 15-2**:

1. Follow standard precautions.
2. Obtain an order from medical control or local protocol.
3. Check that you have the right medication, right patient, right dose, and right route and that the medication is not expired. Ensure there are no issues with contamination, discoloration, or clarity of the medication **Step 1**.

4. Make sure that the patient is alert enough to use the device.

Skill Drill 15-2 Assisting a Patient With a Small-Volume Nebulizer

Step 1

Check to make sure you have the correct medication for the correct patient. Check the expiration date. Confirm you have the correct patient.

Step 2

Insert the medication into the container on the nebulizer. In some cases, sterile saline may be added (about 3 mL) to achieve the optimum volume of fluid for the nebulized application.

Step 3

Attach the medication container to the nebulizer, mouthpiece, and tubing. Attach oxygen tubing to the oxygen tank. Set the flowmeter at 6 L/min.

Step 4

Instruct the patient on how to breathe.

5. Check to see whether the patient has already taken any treatments.
6. If assisting to assemble the device, maintain aseptic technique.
7. Open the medication container on the nebulizer, and insert the medication (generally the whole volume of the medication). In some cases, sterile saline may be added (about 3 mL) to achieve the optimum volume of fluid for the nebulized application **Step 2**.
8. Attach the medication container to the nebulizer, mouthpiece, and tubing. Attach oxygen tubing to the oxygen tank.
9. Adjust oxygen flow to 6 L/min to establish misting effect **Step 3**.

10. Stop administering supplemental oxygen, and remove nonrebreathing mask from the patient's face.
11. Ask the patient to put his or her lips around the mouthpiece of the device, inhale the mist, and hold it for 3 to 5 seconds before exhaling Step 4.
12. When the mist dissipates and the medication has been used or the patient is no longer experiencing shortness of breath, discontinue use of the device.
13. Place the nonrebreathing mask back on the patient if the patient continues to report shortness of breath.
14. Reassess vital signs, and document your actions and the patient's response.
15. Consult with medical control and/or follow local policy if repeated doses are necessary.

Treatment of Specific Conditions

Upper or Lower Airway Infection

Dyspnea associated with acute infections is common. Except in the patient with pneumonia, acute bronchitis, or epiglottitis, it is rarely serious. The acute congestion and stuffiness of a common cold hardly ever require emergency care. Indeed, most people with colds treat themselves with over-the-counter medications. However, people with a common cold who have underlying problems such as asthma or heart failure may experience a worsening of their condition as a result of the additional stress of the infection. In addition, medications for colds may also have stressful side effects, such as agitation, increased heart rate, and increased blood pressure.

For patients with upper airway infections and dyspnea, administer humidified oxygen (if available). Do not attempt to suction the airway or place an oropharyngeal airway in a patient with suspected epiglottitis. These maneuvers may cause a spasm and complete airway obstruction. Transport the patient promptly to the hospital. Allow the patient to sit in the position that is most comfortable. For someone with epiglottitis, this is usually sitting upright and leaning forward in the "sniffing position" Figure 15-18. To force a patient with epiglottitis to lie supine may cause upper airway obstruction that could result in death.

Figure 15-18 A child with epiglottitis may be more comfortable sitting up and leaning forward.

Acute Pulmonary Edema

Dyspnea caused by acute pulmonary edema may be associated with cardiac disease or direct lung damage. In either case, administer 100% oxygen, and, if necessary, carefully suction any secretions from the airway. The best position for a conscious patient who has a myocardial infarction or direct lung injury is the position in which it is easiest to breathe. Usually, this is sitting up. An unconscious patient with acute pulmonary edema may require full ventilatory support, including placement of an airway adjunct, positive pressure ventilation with oxygen, and suctioning.

Continuous positive airway pressure (CPAP) is a noninvasive means of providing ventilatory support for patients experiencing respiratory distress associated with obstructive pulmonary disease and acute pulmonary edema. As discussed in Chapter 10, *Airway Management*, CPAP increases pressure in the lungs, opens collapsed alveoli, pushes more oxygen across the alveolar membrane, and forces interstitial fluid back into the pulmonary circulation. CPAP systems use oxygen to deliver the positive ventilatory pressure to the patient. Many patients show dramatic improvement with the use of CPAP. CPAP can be used for patients who have moderate to severe respiratory distress from an underlying disease, such as pulmonary edema or obstructive pulmonary disease, are alert and able to follow commands, have tachypnea, or have a pulse oximetry reading of less than 90%. One potential contraindication to the use of CPAP is low blood pressure. Because of the increased pressure inside the chest, blood flow returning to the heart is diminished. CPAP is also not used in patients in respiratory arrest or who have signs and symptoms of a pneumothorax or chest trauma, a tracheostomy, have a decreased level of consciousness, inability to follow commands, or have active gastrointestinal bleeding.

If you are authorized to apply CPAP for acute pulmonary edema according to your local protocols, do so. Otherwise, provide prompt transport to the nearest appropriate ED. Continue to reassess patients using CPAP for signs of deterioration and/or respiratory failure.

▶ Chronic Obstructive Pulmonary Disease

Patients with COPD may have an altered level of consciousness or may be unresponsive from hypoxia or carbon dioxide retention. Patients with COPD often find breathing difficult when lying down. Assist with the patient's prescribed inhaler if there is one. Oftentimes a patient with COPD will overuse an inhaler, so watch for side effects. Promptly transport patients with COPD to the ED, allowing them to sit upright if this is most comfortable.

▶ Asthma, Hay Fever, and Anaphylaxis

Many lung problems are incorrectly labeled "asthma"; therefore, you must critically assess the patient. Asthma is often a recurring pathologic condition. Confirm whether the patient is able to breathe normally at other times. If possible, ask family members to describe the patient's asthma. Even if they only identify wheezing as a problem, be aware that some forms of heart failure, foreign body aspiration, toxic fumes inhalation, or allergic reactions may cause wheezing.

As you assess the patient's vital signs, note that the pulse rate will be normal or elevated, the blood pressure may be slightly elevated, and respirations will be increased. Ask questions about how and when the symptoms began.

As you care for the patient, be prepared to suction large amounts of mucus from the mouth and to administer oxygen. If you do suction, do not withhold oxygen for more than 15 seconds for adult patients, 10 seconds for a child, and 5 seconds for an infant. Allow some time for oxygenation between suction attempts. If the patient is unconscious, you may have to provide airway management.

If the patient has medication, such as an inhaler for an asthma attack, you may help with its administration, as directed by local protocol. Even patients who use their inhaler may continue to get worse. Reassess breathing frequently and be prepared to assist ventilations with a BVM in severe cases. If you must assist ventilations in a patient who is having an asthma attack, use slow, gentle breaths. Remember, the problem in asthma is getting the air out of the lungs, not into them. Resist the temptation to squeeze the bag hard and fast. Always assist with ventilations as a last resort, and then provide only about 10 to 12 shallow breaths/min.

A prolonged asthma attack that is unrelieved may progress into a condition known as *status asthmaticus*. The patient is likely to be frightened, frantically trying to breathe, and using all the accessory muscles. Status asthmaticus is a true emergency. Give oxygen and promptly transport to the ED.

The effort to breathe during an asthma attack is very tiring, and the patient may be exhausted by the time you arrive at the hospital. An exhausted patient may have stopped feeling anxious or even struggling to breathe. This patient is not recovering; he or she is at a very critical stage and is likely to stop breathing. Aggressive airway management, oxygen administration, and prompt transport are essential in this situation. Advanced life support (ALS) should be considered. Follow local protocol.

The patient with hay fever is unlikely to need emergency treatment unless the condition has worsened from generalized cold symptoms. Manage the airway, and give oxygen according to the level of distress.

An anaphylactic reaction is a life-threatening emergency. The first step should be to remove the offending agent. For example, if the patient has a stinger from a bee sting still in place, you may need to remove the stinger. Remember to scrape the stinger off because you can inject more venom into the patient if you pinch or squeeze the stinger.

Maintain the airway—the airway is always a priority regardless of the situation. If the patient is still awake, allow him or her to assume a position that does not compromise breathing. Use an appropriate oxygen device for supplemental oxygen administration. Be prepared to assist breathing as needed. Rapid transport and the early administration of epinephrine, if allowed by protocol, should be a priority. Because epinephrine has immediate action, it can rapidly reverse the effects of anaphylaxis.

▶ Spontaneous Pneumothorax

Patients with spontaneous pneumothorax may have severe respiratory distress, or they may have no distress at all and report only pleuritic chest pain. Provide supplemental oxygen, and provide prompt transport to the hospital. Like most dyspneic patients, those with spontaneous pneumothorax are usually more comfortable sitting up. Monitor the patient carefully, watching for any sudden deterioration in the respiratory status. Be ready to support the airway, assist respirations, and provide CPR if it becomes necessary.

▶ Pleural Effusion

Treatment of pleural effusion consists of removal of fluid collected outside the lung, which must be done by a physician in a hospital setting. However, you should provide oxygen and other routine support measures to these patients.

▶ Obstruction of the Airway

If the patient is a small child or someone who was eating just before dyspnea developed, you may assume that the problem is an inhaled or aspirated foreign body. If the patient is old enough to talk but cannot make any noise, upper airway obstruction is the likely cause.

Upper airway obstruction may be either partial or complete. If your patient is able to talk and breathe, the wisest course may be to provide supplemental oxygen and transport carefully in a position of comfort to the hospital. As long as the patient is able to obtain sufficient oxygen, avoid doing anything that might turn a partial airway obstruction into a complete airway obstruction.

There is no condition more immediately life threatening than a complete airway obstruction. The obstructing body must be removed before any other actions will be effective. Clear the patient's upper airway according to basic life support guidelines. Opening the airway with the head tilt–chin lift maneuver (or the jaw-thrust maneuver for patients with suspected spinal trauma) may solve the problem. You should perform this maneuver only after you have ruled out a head or neck injury. If simply opening the airway does not correct the breathing problem, you will have to assess the upper airway for the obstruction. Then, whether or not you are successful in clearing the airway, administer supplemental oxygen and transport the patient promptly to the ED.

▶ Pulmonary Embolism

Because a considerable amount of lung tissue may not be functioning, supplemental oxygen is mandatory in a patient with a pulmonary embolism. Place the patient in a comfortable position, usually sitting, and assist breathing as necessary. Hemoptysis, if present, is usually not severe, but any blood that has been coughed up should be cleared from the airway. The patient may have an unusually rapid and possibly irregular heartbeat. Transport the patient to the ED promptly. Be aware that large pulmonary emboli may cause cardiac arrest.

▶ Hyperventilation

When you respond to a patient who is hyperventilating, complete a primary assessment and gather a history of the event. Is the patient having chest pain? Is there a history of cardiac problems or diabetes? You must always assume a serious underlying problem even if you suspect that the underlying problem is stress. Do not have the patient breathe into a paper bag, even though it was once thought to be the technique for managing hyperventilation syndrome. In theory, breathing into a paper bag causes the patient to rebreathe exhaled carbon dioxide, allowing the level of carbon dioxide in the blood to return to normal. In fact, if the patient is hyperventilating because of a serious medical problem, this maneuver could make things worse. A patient with underlying pulmonary disease who breathes into a bag may become severely hypoxic. Treatment should instead consist of reassuring the patient in a calm, professional manner; supplying supplemental oxygen; and providing prompt transport to the ED. Patients who hyperventilate need to be evaluated in the hospital.

▶ Environmental/Industrial Exposure

The commonality in these kinds of respiratory problems is the inhalation of a toxic chemical. There are many different types of chemicals, different types of presentations, and certainly different levels of severity. Ensure that all patients are decontaminated prior to treatment. Treat with oxygen, adjuncts, and suction on the basis of presentation, level of consciousness, and level of distress that is observed in your patient.

Foreign Body Aspiration

Upper airway obstruction is common in young children, who put objects in their mouths as a way to learn about them. If you have evidence of a partial or complete airway obstruction in a young child, especially a crawling baby, consider that the child may have swallowed and choked on a small object. Perform the appropriate airway clearing technique specific to the age of the child.

Another scenario to consider is that an object passed through the airway and has been aspirated (inhaled) into the lung. This problem will not be as obvious as an airway obstruction.

Most deaths from foreign body aspiration occur in patients who are younger than 5 years, and most of them are infants. Typical items aspirated include balloons, small balls, and small parts of toys. Toddlers may aspirate pieces of food like hot dogs or peanuts.

One sign of aspiration in a child may be an abnormality in the voice. The aspirated object will most likely go down the right mainstem bronchus. If the bronchus is fully obstructed, the lung could collapse. Aspiration pneumonia may also develop.

Provide oxygen, and transport any child with a suspected aspiration. An X-ray will be needed to confirm the aspiration, its location, and the treatment.

For an older person, the normal process of aging creates conditions that contribute to breathing problems. For example, weakening of the airway musculature can cause decreased breathing capacity. Decreased cough and gag reflexes cause a decreased ability to clear secretions. Difficulty in swallowing means the risk for aspiration is markedly increased. Older people can aspirate food or oral secretions that, in many cases, can develop into a potentially life-threatening aspiration pneumonia.

Tracheostomy Dysfunction

Children with chronic pulmonary medical conditions may use a home ventilator that is connected by a tracheostomy tube. This tube is placed in an opening in the neck (stoma) and can sometimes become obstructed by secretions, mucus, or foreign bodies. Other tracheostomy tube complications include bleeding, leaking, dislodgement, and infection. Your main goal is to establish a patent airway. Place the patient in a position of comfort and provide suctioning to clear the obstruction. If you are unable to clear the airway, consider ALS intervention. Once the obstruction is clear, oxygenate the patient and treat based on the patient's presentation.

Geriatric patients may have a tracheostomy tube in place because of airway obstruction, laryngeal cancer, severe infection, trauma, or the inability to manage secretions. As with children, the tube can become obstructed by secretions, foreign bodies, or airway swelling. The stoma itself can become infected. Your immediate goal is to establish airway patency.

Asthma

Asthma is a common childhood illness. When you assess a pediatric patient, look for retractions of the skin above the sternum and between the ribs. Retractions are typically easier to see in children than in adults. Cyanosis is a late finding in children.

Keep in mind that a cough is not always a symptom of a cold; it could signal pneumonia or asthma. Even if you do not hear much wheezing, the presence of a cough can indicate that some degree of reactive airway disease or an acute asthma attack may be taking place.

Figure 15-19 Because children may refuse to wear an oxygen mask, you may have to hold the mask in front of the child's face or ask the parents or caregivers for help.

The emergency care of a child with shortness of breath is the same as it is for an adult, including the use of supplemental oxygen. However, many small children will not tolerate (or may refuse to wear) a face mask. Rather than fighting with the child, provide blow-by oxygen by holding the oxygen mask in front of the child's face or ask the parent or caregiver to hold the mask **Figure 15-19**.

Many children with asthma also will have prescribed hand-held MDIs. Use these inhalers just as you would with an adult. Pediatric patients and some geriatric patients are more likely to use spacers to assist in inhaler use. Treat as in adult asthma.

Asthma in an older patient causes bronchospasm, swelling of the lining of the airways, and an accumulation of secretions. Attacks are easily triggered by air pollutants, viral infections, allergens, and sometimes something as simple as exposure to cold air. Asthma, as with any chronic disease, can become life threatening in older people, especially in patients who have problems with airway control. The condition is made worse by anxiety and dehydration, which is typical in older people. Geriatric patients with asthma tend to have both inspiratory and expiratory wheezes.

Cystic Fibrosis

Cystic fibrosis (CF) is a genetic disorder that affects the lungs and digestive system. CF disrupts the normal function of cells that make up the sweat glands in the skin and that also line the lungs and the digestive and reproductive systems. The disease predisposes the child to repeated lung infections.

The disease process in CF disrupts the essential balance of salt and water necessary to maintain a normal coating of fluid and mucus inside the lungs and other organs. The end result is that the mucus becomes thick, sticky, and hard to move. The mucus holds germs, causing the lungs to become infected.

In CF, the child's symptoms range from sinus congestion to wheezing and asthma-like complaints. A chronic cough that produces thick, heavy, discolored mucus may develop in the child. As lung function decreases, so does the ability to breathe effectively. The child often has dyspnea; this generally results in the parents or caregivers calling EMS. Treat the child with suction and oxygen using age-appropriate adjuncts.

Cystic fibrosis often causes death in childhood because of chronic pneumonia secondary to the very thick, pathologic mucus in the airway. It also causes malabsorption of nutrients in the intestines. Because of advances in treatment, the life expectancy for CF patients becomes better each year. Adults with CF are predisposed to other medical conditions, including arthritis, osteoporosis, diabetes, and liver problems.

Special Populations

Most geriatric patients take medications, sometimes many, to treat various ailments that are part of the aging process. Some of these medications will blunt the body's normal reactions to stress and the mechanisms the body uses to compensate for respiratory compromise and hypoxia. For example, beta-blockers, used for a variety of conditions, prevent the heart from speeding up to compensate for when the blood pressure drops. Keep this in mind when you evaluate vital signs in geriatric patients.

YOU are the Provider — PART 5

With an estimated time of arrival at the hospital of 8 minutes, you ask your partner to radio in the patient report. The patient's level of consciousness has not changed; however, the cyanosis around her mouth and in her nail beds has resolved and her oxygen saturation has improved. You complete your reassessment and continue treatment.

Recording Time: 15 Minutes	
Level of consciousness	Responsive to pain only
Respirations	12 breaths/min; shallow
Pulse	118 beats/min; weak
Skin	Cool and dry; cyanosis has resolved
Blood pressure	112/70 mm Hg
Spo_2	90% (on oxygen)

You deliver the patient to the ED staff and give your verbal report to the nurse. Because of the patient's decreased level of consciousness and the need for ongoing ventilation assistance, the physician elects to intubate her. She is diagnosed with acute exacerbation of her emphysema and is admitted to the intensive care unit.

10. How can positive-pressure ventilation cause a decrease in a patient's blood pressure?

11. What does *exacerbation* mean?

YOU are the Provider — SUMMARY

1. What is emphysema? What is the typical cause?

Emphysema, a form of COPD, is a disease of the respiratory system in which airways develop chronic inflammation, excessive mucus is produced and narrows the airways, and destruction of alveoli and small airways leads to a loss of lung elasticity. As a result, the expiratory phase of respiration becomes difficult and gas exchange in the lungs becomes impaired. Although emphysema is an irreversible condition, its symptoms can be reduced and the disease progression slowed with lifestyle changes (eg, quitting smoking) and certain medications.

The single most common cause of emphysema is heavy, long-term cigarette smoking. Other causes include frequent pulmonary infections and long-term exposure to toxic agents, such as by working in an industrial setting for a long period.

2. Why is it especially significant that this patient called 9-1-1?

Patients with chronic diseases call 9-1-1 when something is different or has gotten worse. The patient could be experiencing an acute flare of her emphysema, a secondary respiratory illness to which she is predisposed (ie, pneumonia), or complete respiratory failure. Just because she has refused EMS transport in the past does not mean that she will this time; she has a known respiratory illness, which you should assume has gotten worse, and she should be treated no differently from any other patient with a respiratory emergency.

3. What should be your *most* immediate action?

Oxygen and lit cigarettes—or any other source of fire—do not go together! Ask the patient to immediately extinguish her cigarette and then continue your assessment. Although oxygen is not flammable or explosive, it does support the process of combustion. A small spark or lit cigarette can become a flame in an oxygen-rich atmosphere. Oxygen will cause a fire to burn more vigorously, as well as hotter. The patient could literally light her face on fire; you and your partner could be injured as well.

4. How does emphysema differ from chronic bronchitis?

As previously discussed, emphysema is a disease in which small airways and the inner walls of alveoli are progressively destroyed, resulting in a loss of lung elasticity. Chronic bronchitis is caused by persistent inflammation in larger airways. With chronic bronchitis, excess mucus is constantly produced, which obstructs the bronchioles and alveoli. As a result, pulmonary gas exchange is less efficient. Many patients with chronic bronchitis have a chronic productive cough. In some patients, however, the cough reflex is weakened; this causes sputum to settle in the lungs and become infected, resulting in pneumonia. Emphysema and chronic bronchitis are both forms of COPD and are both usually caused by heavy, long-term cigarette smoking.

5. Why do patients with emphysema breathe through pursed lips?

With emphysema, the force of exhalation increases intrathoracic pressure and causes premature closure of the small airways, causing air to be trapped in the alveoli. The harder the patient tries to push air out, the more air gets trapped in the alveoli. Chronic air trapping in the lungs explains why many patients with long-term emphysema have a characteristic barrel-shape appearance to their chest. Over time, patients with emphysema learn that if they push air out slowly at a higher residual airway pressure, they can exhale more air than if they try to push it out faster because their airways will remain open for longer. One of the ways they do this is by breathing through pursed lips during exhalation. Pursed lip breathing allows the patient to push air out slowly under controlled pressure.

6. What does a prolonged exhalation phase indicate in patients with obstructive lung disease?

A prolonged exhalation phase indicates that the patient is experiencing difficulty exhaling air from the lungs, which, as a result, causes chronic air trapping in the lungs. The inhalation-to-exhalation ratio in healthy people during normal breathing is typically 1:2. In other words, it takes about twice as long to exhale as it does to inhale. Depending on the severity of their disease process, patients with obstructive lung disease may have an I:E ratio of 1:4, 1:5, or longer. Because the patient's bronchioles significantly narrow when he or she exhales, wheezing—a whistling sound—is often heard during the exhalation phase while auscultating the lungs.

7. What treatment is indicated for the patient at this point?

Compared with the patient's condition during your initial assessment, it has deteriorated. She is now confused and slow to answer your questions, which indicates decreased oxygen delivery to the brain. Her oxygen saturation level of 88% indicates significant hypoxemia, and the fatigue indicates that she is less able to compensate for her condition. She clearly needs a higher concentration of oxygen than what her nasal cannula is supplying. Apply a nonrebreathing mask, set the flow rate at 12 to 15 L/min, and reassess her condition. If it does not improve, assisted ventilation with a BVM may be necessary. If you must assist the patient's breathing, however, ensure that you allow complete exhalation between positive-pressure breaths. Remember, patients with emphysema have a lot of air trapped in the alveoli.

8. Why is cyanosis a later sign of hypoxemia in patients with emphysema?

Patients with emphysema maintain chronically low blood oxygen levels and chronically elevated carbon dioxide levels. In many patients, this leads to excessive red blood cell production (polycythemia), which is why the patients tend to maintain a pink skin color, even in the presence of hypoxemia. This, and the fact that many patients with emphysema breathe through pursed lips, is why they are often referred to as "pink puffers." Unlike otherwise healthy people, patients with emphysema often do not develop cyanosis until significantly more hemoglobin is desaturated (not carrying oxygen). The absence of cyanosis does not rule out hypoxemia in any patient, especially a patient with emphysema.

9. Why does tachycardia develop in hypoxemic patients?

Whenever the body's demand for oxygen increases and its supply decreases (eg, hypoxemia), the nervous system increases the production of epinephrine from the adrenal glands. Epinephrine is a hormone that causes tachycardia (rapid heart rate) and an increase in the strength of cardiac contraction. Tachycardia is a critical physiologic compensatory mechanism that circulates oxygenated blood faster, thus helping to maintain adequate perfusion of the body's vital organs. However, if the underlying cause of the patient's hypoxemia is not corrected, the nervous system, which also requires oxygen, will no longer be able to compensate and the patient's heart rate will begin to fall.

10. How can positive-pressure ventilation cause a decrease in a patient's blood pressure?

Recall from Chapter 10, *Airway Management*, that negative-pressure ventilation—the process that occurs with normal breathing—involves contraction of the diaphragm and intercostal muscles and a decrease in intrathoracic pressure; as a result, air is pulled into the lungs. Positive-pressure ventilation involves pushing air into the lungs, as with artificial ventilation. It is critical to perform positive-pressure ventilation correctly. Deliver each breath over a period of 1 second, just enough to produce visible chest rise, at a rate that is appropriate for the patient (10 to 12 breaths/min for adults; 12 to 20 breaths/min for infants and children). If positive-pressure ventilation is delivered too fast or with too much force (hyperventilation), the resultant increase in intrathoracic pressure may compress the venae cavae and thereby impair blood return to the right atrium. If blood return is impaired, less blood is pumped from the left ventricle per contraction (stroke volume). As a result, the patient's blood pressure (and perfusion status) will deteriorate.

11. What does *exacerbation* mean?

Exacerbation means to intensify or worsen in severity. In acute exacerbation of COPD, no copathologic (secondary) condition exists that would clearly explain the patient's sudden deterioration (ie, congestive heart failure, pneumonia). Patients with COPD often experience acute exacerbation of their disease secondary to a change in environmental conditions, such as weather, humidity, or sudden activation of central heating or cooling in the home. As with diseases such as asthma, COPD can also be exacerbated by certain triggers, such as cat dander, dust, and seasonal allergens. In some cases, acute exacerbation is idiopathic (of unknown cause). As the patient's disease progresses, he or she will eventually reach a point at which the lungs simply cannot support oxygenation and ventilation (end-stage COPD). In end-stage COPD, it can be difficult to determine whether the patient is experiencing an exacerbation that can be treated effectively or if he or she has reached the end of the disease process. This will not affect your treatment, however, which involves airway management and ensuring adequate oxygenation and ventilation.

EMS Patient Care Report (PCR)

Date: 3-12-16	**Incident No.:** 130309	**Nature of Call:** Respiratory		**Location:** 109 East Lawler	
Dispatched: 0430	**En Route:** 0432	**At Scene:** 0440	**Transport:** 0449	**At Hospital:** 0510	**In Service:** 0519

Patient Information

Age: 72 **Sex:** F **Weight (in kg [lb]):** 50 kg (110 lb)	**Allergies:** Sulfa, ibuprofen, aspirin **Medications:** Oxygen, Combivent, albuterol, lisinopril **Past Medical History:** Emphysema, hypertension, gout **Chief Complaint:** Trouble breathing

Vital Signs

Time: 0443	**BP:** 116/54	**Pulse:** 110	**Respirations:** 28	**Spo_2:** 88%
Time: 0449	**BP:** 108/50	**Pulse:** 124	**Respirations:** 8	**Spo_2:** 82%
Time: 0455	**BP:** 112/70	**Pulse:** 118	**Respirations:** 12	**Spo_2:** 90%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

Dispatched to the residence of a 72-year-old woman with difficulty breathing. On arrival at the scene, found the patient sitting on the edge of her couch; she was wearing home oxygen via nasal cannula and was smoking a cigarette. Immediately asked patient to extinguish cigarette and continued with the primary assessment. Patient could only speak in two-word sentences and was experiencing marked respiratory distress. Past medical history significant for emphysema, hypertension, and gout. The patient states that she is normally short of breath; however, it suddenly worsened today. Further assessment revealed pursed lip breathing, prolonged exhalation, and scattered wheezing on auscultation. Obtained vital signs and applied high-flow oxygen via nonrebreathing mask because of signs of worsened hypoxemia. Patient takes numerous medications and states that she has been compliant with all of them. Placed patient onto stretcher, loaded her into the ambulance, and reassessed her condition. Patient's level of consciousness had markedly decreased (responsive to pain only), her respirations became slow and shallow, her oxygen saturation decreased, and she developed cyanosis around her mouth and to her nail beds. Inserted nasal airway and began assisting her ventilations with a BVM and high-flow oxygen. Began transport to hospital and continued treatment. En route, noted that patient's oxygen saturation had improved and her cyanosis had resolved; however, her LOC remained unchanged. Continued treatment and reassessment until arrival at the hospital. Transferred patient care to ED staff w/o incident. Verbal report given to staff nurse.**End of report**

Prep Kit

Ready for Review

- Dyspnea is a common complaint that may be caused by numerous medical problems, including infections of the upper or lower airways, acute pulmonary edema, COPD, spontaneous pneumothorax, asthma, allergic reactions, pleural effusion, mechanical obstruction of the airway, pulmonary embolism, and hyperventilation.
- Each of these lung disorders has the ability to interfere with the exchange of oxygen and carbon dioxide that takes place during respiration. This interference may be in the form of damage to the alveoli, separation of the alveoli from the pulmonary vessels by fluid or infection, obstruction of the air passages, or air or excess fluid in the pleural space.
- Patients with chronic lung diseases often have high levels of blood carbon dioxide; in some cases, giving too much oxygen to them may depress or stop respirations (hypoxic drive). However, never withhold oxygen from patients with dyspnea.
- Patients often develop breathing difficulty and/ or hypoxia with the following medical conditions: upper or lower airway infection, acute pulmonary edema, COPD, hay fever, asthma, anaphylaxis, spontaneous pneumothorax, and pleural effusion.
- Infectious diseases associated with dyspnea include epiglottitis, bronchitis, tuberculosis, pneumonia, and pertussis.
- Breath sounds (lung sounds) are some of the most important vital signs you should assess when treating a patient in respiratory distress.
- Signs and symptoms of breathing difficulty include adventitious breath sounds (wheezing, stridor, crackles, and rhonchi); nasal flaring; pursed lip breathing; cyanosis; inability to talk; use of accessory muscles to breathe; and sitting in the tripod position, which allows the diaphragm the most room to function.
- Interventions for respiratory problems may include the following:
  - Oxygen via a nonrebreathing mask at 15 L/min, positive-pressure ventilations using a BVM, pocket mask, or a flow-restricted oxygen-powered ventilation device
  - Airway management techniques such as use of an oropharyngeal (oral) airway, a nasopharyngeal (nasal) airway, suctioning, or airway positioning
  - Providing noninvasive ventilatory support with continuous positive airway pressure (CPAP)
  - Positioning the patient in a high-Fowler's position or a position of comfort to facilitate breathing
  - Assistance with respiratory medications found in a prescribed MDI or a small-volume nebulizer (Consult medical control to assist with its use, or follow standing orders if the orders allow for this.)
- Remember, a patient who is breathing rapidly may not be getting enough oxygen as a result of respiratory distress from a variety of problems, including pneumonia or a pulmonary embolism; trying to "blow off" more carbon dioxide to compensate for acidosis caused by a poison, a severe infection, or a high level of blood glucose; or having a stress reaction.
- In every case, prompt recognition of the problem, administration of oxygen, and prompt transport are essential.

Vital Vocabulary

acidosis The buildup of excess acid in the blood or body tissues that results from a primary illness.

adventitious breath sounds Abnormal breath sounds such as wheezing, stridor, rhonchi, and crackles.

alkalosis The buildup of excess base (lack of acids) in the body fluids.

allergen A substance that causes an allergic reaction.

anaphylaxis (anaphylactic shock) An extreme, life-threatening, systemic allergic reaction that may include shock and respiratory failure.

asthma An acute spasm of the smaller air passages, called bronchioles, associated with excessive mucus production and with swelling of the mucous lining of the respiratory passages.

atelectasis Collapse of the alveolar air spaces of the lungs.

bronchial breath sounds Normal breath sounds made by air moving through the bronchi.

bronchiolitis Inflammation of the bronchioles that usually occurs in children younger than 2 years and is often caused by the respiratory syncytial virus.

bronchitis An acute or chronic inflammation of the lung that may damage lung tissue; usually associated with cough and production of sputum and, depending on its cause, sometimes fever.

carbon dioxide retention A condition characterized by a chronically high blood level of carbon dioxide in which the respiratory center no longer responds to high blood levels of carbon dioxide.

carbon monoxide An odorless, colorless, tasteless, and highly poisonous gas that results from incomplete oxidation of carbon in combustion.

chronic bronchitis Irritation of the major lung passageways from infectious disease or irritants such as smoke.

chronic obstructive pulmonary disease (COPD) A slow process of dilation and disruption of the airways and alveoli caused by chronic bronchial obstruction.

continuous positive airway pressure (CPAP) A method of ventilation used primarily in the treatment of critically ill patients with respiratory distress; can prevent the need for endotracheal intubation.

crackles Crackling, rattling breath sounds signaling fluid in the air spaces of the lungs; formerly called rales.

croup An inflammatory disease of the upper respiratory system that may cause a partial airway obstruction and is characterized by a barking cough; usually seen in children.

diphtheria An infectious disease in which a membrane forms, lining the pharynx; this lining can severely obstruct the passage of air into the larynx.

dyspnea Shortness of breath or difficulty breathing.

embolus A blood clot or other substance in the circulatory system that travels to a blood vessel where it causes a blockage.

emphysema A disease of the lungs in which there is extreme dilation and eventual destruction of the pulmonary alveoli with poor exchange of oxygen and carbon dioxide; it is one form of chronic obstructive pulmonary disease.

epiglottitis A disease in which the epiglottis becomes inflamed and enlarged and may cause an upper airway obstruction.

hay fever An allergic response usually to outdoor airborne allergens such as pollen or sometimes indoor allergens such as dust mites or pet dander; also called allergic rhinitis.

hyperventilation Rapid or deep breathing that lowers the blood carbon dioxide level below normal.

hyperventilation syndrome (panic attack) This syndrome occurs in the absence of other physical problems. The respirations of a person who is experiencing hyperventilation syndrome may be as high as 40 shallow breaths/min or as low as only 20 very deep breaths/min.

hypoxia A condition in which the body's cells and tissues do not have enough oxygen.

hypoxic drive A condition in which chronically low levels of oxygen in the blood stimulate the respiratory drive; seen in patients with chronic lung diseases.

influenza type A Virus that has crossed the animal/ human barrier and has infected humans, recently reaching a pandemic level with the H1N1 strain.

metered-dose inhaler (MDI) A miniature spray canister used to direct medications through the mouth and into the lungs.

orthopnea Severe dyspnea experienced when lying down and relieved by sitting up.

oxygenation The process of delivering oxygen to the blood.

pandemic An outbreak that occurs on a global scale.

paroxysmal nocturnal dyspnea Severe shortness of breath, especially at night after several hours of reclining; the person is forced to sit up to breathe.

pertussis (whooping cough) An airborne bacterial infection that affects mostly children younger than 6 years. Patients will be feverish and exhibit a "whoop" sound on inspiration after a coughing attack; highly contagious through droplet infection.

pleural effusion A collection of fluid between the lung and chest wall that may compress the lung.

pleuritic chest pain Sharp, stabbing pain in the chest that is worsened by a deep breath or other chest wall movement; often caused by inflammation or irritation of the pleura.

pneumonia An infectious disease of the lung that damages lung tissue.

pneumothorax A partial or complete accumulation of air in the pleural space.

pulmonary edema A buildup of fluid in the lungs, usually as a result of congestive heart failure.

pulmonary embolism A blood clot that breaks off from a large vein and travels to the blood vessels of the lung, causing obstruction of blood flow.

respiration The exchange of oxygen and carbon dioxide.

respiratory syncytial virus (RSV) A virus that causes an infection of the lungs and breathing passages; can lead to other serious illnesses that affect the lungs or heart, such as bronchiolitis and pneumonia. RSV is highly contagious and spread through droplets.

rhonchi Coarse breath sounds heard in patients with chronic mucus in the airways.

small-volume nebulizer A respiratory device that holds liquid medicine that is turned into a fine mist. The patient inhales the medication into the airways and lungs as a treatment for conditions such as asthma.

stridor A harsh, high-pitched, barking inspiratory sound often heard in acute laryngeal (upper airway) obstruction.

tuberculosis (TB) A disease that can lay dormant in a person's lungs for decades, then reactivate; many strains are resistant to antibiotics. TB is spread by cough.

ventilation Exchange of air between the lungs and the environment, spontaneously by the patient or with assistance from another person, such as an EMT.

vesicular breath sounds Normal breath sounds made by air moving in and out of the alveoli.

wheezing A high-pitched, whistling breath sound, characteristically heard on expiration in patients with asthma or chronic obstructive pulmonary disease.

Assessment *in Action*

It is mid-February and you respond to a local movie theater for a 42-year-old man with respiratory distress. Upon arrival, you and your partner are directed to the lobby where you observe a patient who appears to be having trouble breathing. The patient is leaning forward and speaking in short bursts. You notice the patient is using accessory muscles in his neck to help with breathing. The patient informs you he was standing outside in the cold for over 20 minutes waiting for a friend. He has a remote history of asthma, but has not had an attack in several years. The patient denies any other past medical history, takes no medications, and has no allergies. Vital signs show: pulse, 106 beats/min; respirations, 26 breaths/min and labored; blood pressure, 142/88 mm Hg; and Spo_2, 91%. Your physical examination reveals obvious accessory muscle use to the chest and neck and diffuse wheezing in all lung fields.

1. Which of the following medications can be used for the treatment of an acute asthma attack?

   A. Cromolyn
   B. Albuterol
   C. Fluticasone
   D. Salmeterol

2. Which of the following statements is true regarding asthma?

   A. Asthma involves accumulation of air in the pleural space.
   B. Asthma involves a collection of fluid in the pleural space.
   C. Asthma involves excessive mucus production.
   D. Asthma involves a collection of fluid in the alveoli.

3. The patient is exhibiting signs of respiratory distress, such as accessory muscle use and difficulty speaking. Which of the following is also a sign of respiratory distress?

   A. Pursed lip breathing
   B. Respiratory rate of 16 breaths/min
   C. Warm, pink skin
   D. Clear and equal breath sounds

4. You ask your partner to administer oxygen therapy. What is the most appropriate method for oxygen delivery to this patient?

   A. Nasal cannula at 2 to 6 L/min
   B. Nonrebreathing mask at 15 L/min
   C. Venturi mask at 8 L/min
   D. BVM at 15 L/min

5. When assisting an asthmatic patient with a small-volume nebulizer attached to oxygen, what is the appropriate flow rate for the oxygen?

   A. 2 L/min
   B. 4 L/min
   C. 6 L/min
   D. 10 L/min

6. In addition to asthma, which of the following conditions is associated with wheezing?

   A. Croup
   B. Epiglottitis
   C. Pulmonary embolism
   D. Bronchitis

7. While administering a nebulizer of albuterol to your patient, you assess for possible side effects to the medication. Which of the following is typically *NOT* a side effect of nebulized albuterol?

   A. Vomiting
   B. Increased pulse rate
   C. Nervousness
   D. Muscle tremors

8. In addition to asthma, wheezing can be caused by COPD. What are the underlying causes of chronic bronchitis and emphysema?
9. What are the signs and symptoms of a pulmonary embolism?
10. Explain why carbon monoxide has been called “the silent killer.”

CHAPTER
16

Cardiovascular Emergencies

National EMS Education Standard Competencies

Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Cardiovascular

Anatomy, signs, symptoms, and management of

› Chest pain (pp 629–665)
› Cardiac arrest (pp 629–639, 654–665)

Anatomy, physiology, pathophysiology, assessment, and management of

› Acute coronary syndrome (pp 629–639, 642–652)
  • Angina pectoris (pp 629–638, 642–652)
  • Myocardial infarction (pp 629–639, 654–665)
› Aortic aneurysm/dissection (pp 629–636, 642–652)
› Thromboembolism (pp 629–637, 642–652)
› Heart failure (pp 629–636, 640–652)
› Hypertensive emergencies (pp 629–636, 642–652)

Knowledge Objectives

1. Discuss the basic anatomy and physiology of the cardiovascular system. (pp 629–636)
2. Discuss the pathophysiology of the cardiovascular system. (pp 636–642)
3. Describe the anatomy, physiology, pathophysiology, assessment, and management of thromboembolism. (pp 636–639)

4. Describe the anatomy, physiology, pathophysiology, assessment, and management of angina pectoris. (pp 637–638)
5. Describe the anatomy, physiology, pathophysiology, assessment, and management of myocardial infarction. (pp 638–639)
6. Describe the anatomy, signs and symptoms, and management of hypertensive emergencies. (p 642)
7. Describe the anatomy, physiology, pathophysiology, assessment, and management of aortic aneurysm/ dissection. (p 642)
8. Explain the assessment for patients with cardiovascular problems. (pp 642–647)
9. Explain the relationship between airway management and the patient with cardiac compromise. (pp 643–644)
10. Give the indications and contraindications for the use of aspirin and nitroglycerin. (p 648)
11. Recognize that many patients will have had cardiac surgery and may have implanted pacemakers or defibrillators. (pp 653–654)
12. Define cardiac arrest. (p 654)
13. Compare the difference between the fully automated and the semiautomated defibrillator. (pp 654–655)
14. Describe the different types of AEDs. (p 655)
15. Explain the use of remote adhesive defibrillator pads. (p 656)
16. Recognize that not all patients in cardiac arrest require an electric shock. (p 656)
17. List the indications and contraindications for use of an automated external defibrillator (AED). (pp 656–657)
18. Discuss the reasons for early defibrillation. (pp 656–657)
19. Explain the circumstances that may result in inappropriate shocks from an AED. (p 657)
20. Explain the reason not to touch the patient, such as by delivering CPR, while the AED is analyzing the heart rhythm and delivering shocks. (p 657)
21. Describe AED maintenance procedures. (pp 657–659)
22. Explain the relationship of age to energy delivery. (p 659)
23. Explain the role of medical direction in the use of AEDs. (p 659)
24. Discuss the importance of practice and continuing education with the AED. (p 659)
25. Explain the need for a case review of each incident in which an AED is used. (p 659)
26. List quality improvement goals relating to AEDs. (p 659)
27. Discuss the procedures to follow for standard operation of the various types of AEDs. (pp 659–661)
28. Describe the emergency medical care for the patient with cardiac arrest. (pp 659–665)
29. Describe the components of patient care following AED shocks. (pp 661–663, 665)
30. Explain criteria for transport of the patient for advanced life support (ALS) following CPR and defibrillation. (pp 663–664)
31. Discuss the importance of coordinating with ALS personnel. (pp 664–665)

Skills Objectives

1. Describe the steps to take in the assessment of a patient with chest pain or discomfort. (pp 642–647)
2. Demonstrate how to provide emergency medical care for a patient with chest pain or discomfort. (pp 647–649)
3. Demonstrate the administration of nitroglycerin. (pp 648–649, Skill Drill 16-1)
4. Demonstrate how to attach a cardiac monitor to obtain an ECG. (pp 651–652, Skill Drill 16-2)
5. Demonstrate how to perform maintenance of an AED. (pp 657–659)
6. Demonstrate how to perform CPR. (pp 660–663, Skill Drill 16-3)
7. Demonstrate the use of an AED. (pp 660–663, Skill Drill 16-3)

Introduction

The American Heart Association reports that cardiovascular disease claimed 786,641 lives in the United States in 2011. This is 31.3% of all deaths, or approximately 1 of every 3 deaths. Although this is a decline from previous years, heart disease has been the leading killer of Americans since 1900.

It is important for EMS providers to understand that many deaths caused by cardiovascular disease occur because of problems that may have been avoided by people living more healthful lifestyles and by access to improved medical technology. We can help to reduce the number of deaths with better public awareness, early access to medical care, increased numbers of laypeople trained in cardiopulmonary resuscitation (CPR), increased use of evolving technology in dispatch and cardiac arrest response, public access to defibrillation devices, the recognition of the need for advanced life support (ALS) services and use of cardiac specialty centers when they are available.

This chapter begins with a brief description of the heart and how it works. It then discusses the relationship between chest pain or discomfort and ischemic heart disease. It explains how to recognize and treat acute myocardial infarction (classic heart attack) and its complications—sudden death, cardiogenic shock, and congestive heart failure (CHF). The use of nitroglycerin and aspirin are described. The last part of the chapter is devoted to the use and maintenance of the automated external defibrillator (AED).

Anatomy and Physiology

The heart is a relatively simple organ with a simple job. It has to pump blood to supply oxygen-enriched red blood cells to the tissues of the body. The heart is divided down the middle into two sides (left and right) by a wall called the septum. Each side of the heart has an **atrium**, or upper chamber, to receive incoming blood, and a **ventricle**, or lower chamber, to pump outgoing blood **Figure 16-1**. Blood leaves each of the four chambers of the heart through a one-way valve. These valves keep the blood moving through the circulatory system in the proper direction. The **aorta**, the body's main artery, receives the blood ejected from the left ventricle and delivers it to all the other arteries so they can carry blood to the tissues of the body.

The right side of the heart receives oxygen-poor (deoxygenated) blood from the veins of the body **Figure 16-2A**. Blood from the vena cava enters the right atrium, which then fills the right ventricle. After contraction of the right ventricle, blood flows into the pulmonary artery and the pulmonary circulation in the lungs, where the blood is oxygenated. As the blood reaches the lungs, it receives fresh oxygen from the alveoli and carbon dioxide waste is removed from the blood and moved into the alveoli. The blood then returns to the heart through the pulmonary veins. The left side of the heart receives oxygen-rich (oxygenated) blood from the lungs through the pulmonary veins **Figure 16-2B**. Blood enters the left atrium and then passes into the left ventricle. The left ventricle is more muscular than the right ventricle because it must pump blood into the aorta to supply all the other arteries of the body.

YOU are the Provider — PART 1

You and your partner are returning to your station after completing a call when you are dispatched to 1152 Blanco Road for a 60-year-old woman with chest pain. Dispatch advises you that the patient's son, who called 9-1-1, stated that she has a history of heart problems. You proceed to the scene, which is approximately 5 minutes away. The time is 0942 hours, traffic is light, the weather is clear, and the temperature is 80°F (27°C).

1. What is the function of the heart?
2. What does the heart require to function effectively?
3. What should you include in your primary assessment of a patient with cardiac problems?

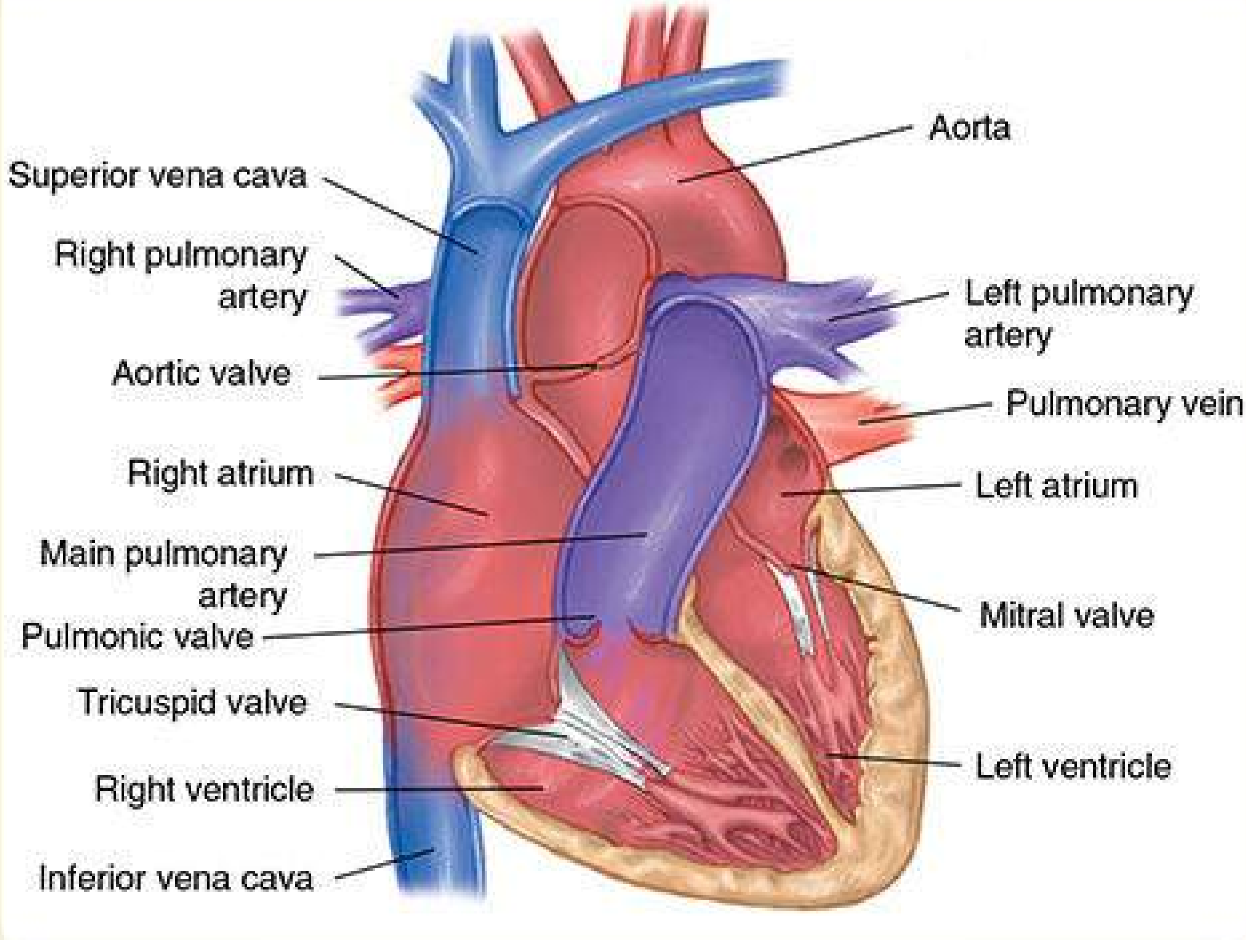


Figure 16-1 The heart is a four-chambered muscle that pumps blood to all parts of the body.

The heart contains more than muscle tissue. The heart's electrical system controls heart rate and enables the atria and ventricles to work together **Figure 16-3**. Normal electrical impulses begin in the sinus node, which is in the upper part of the right atrium and is also known as the sinoatrial (SA) node. The impulses travel across both atria, stimulating them to contract. Between the atria and the ventricles, the impulses cross a bridge of special electrical tissue called the atrioventricular (AV) node. Here, the signal is slowed for about one- to two-tenths of a second to allow blood time to pass from the atria to the ventricles. The impulses then exit the atrioventricular node and spread throughout both ventricles via the bundle of His, the right and left bundle branches, and the Purkinje fibers, causing the ventricular muscle cells to contract.

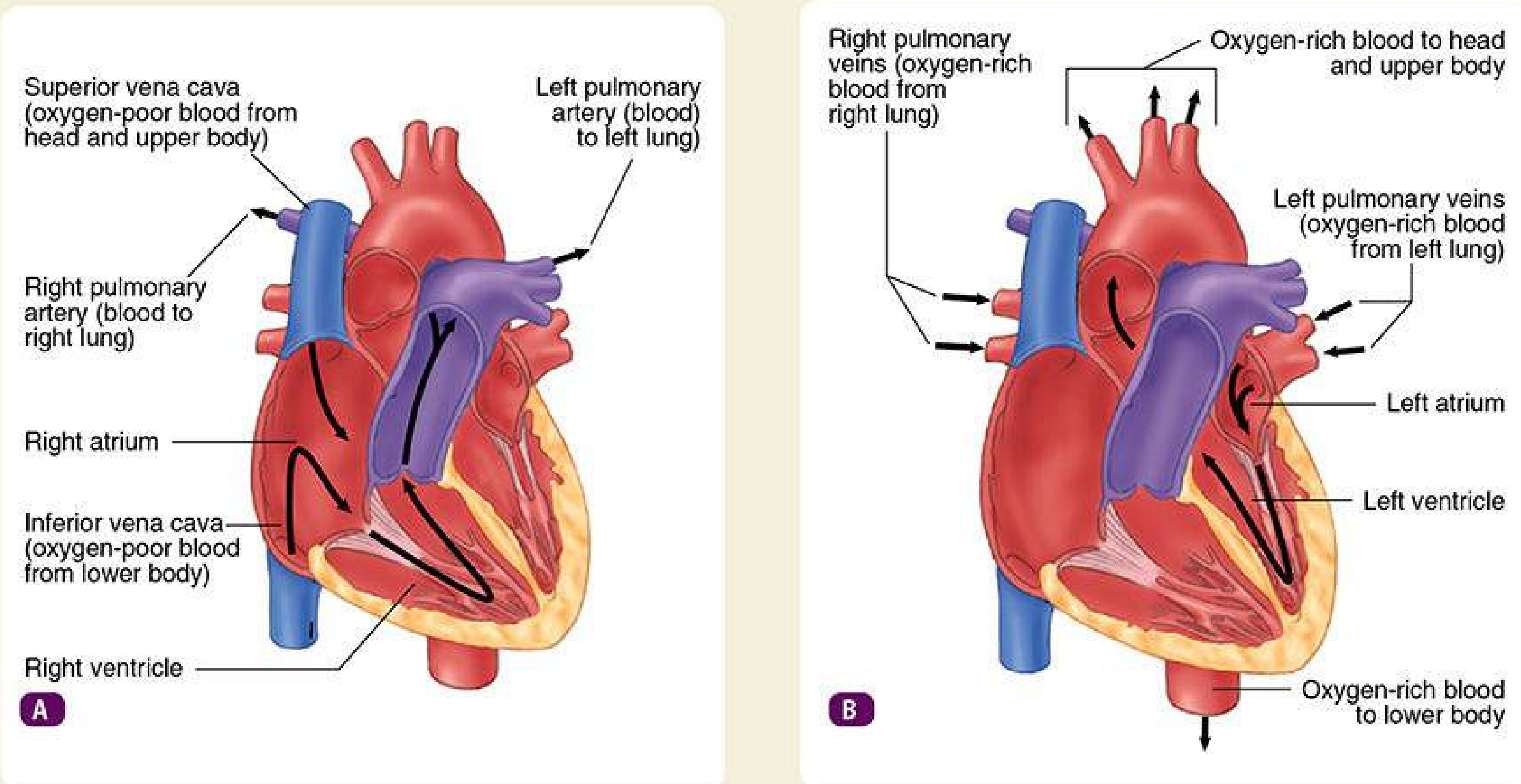


Figure 16-2 **A.** The right side of the heart receives oxygen-poor blood from the venous circulation. **B.** The left side of the heart receives oxygen-rich blood from the lungs through the pulmonary veins.

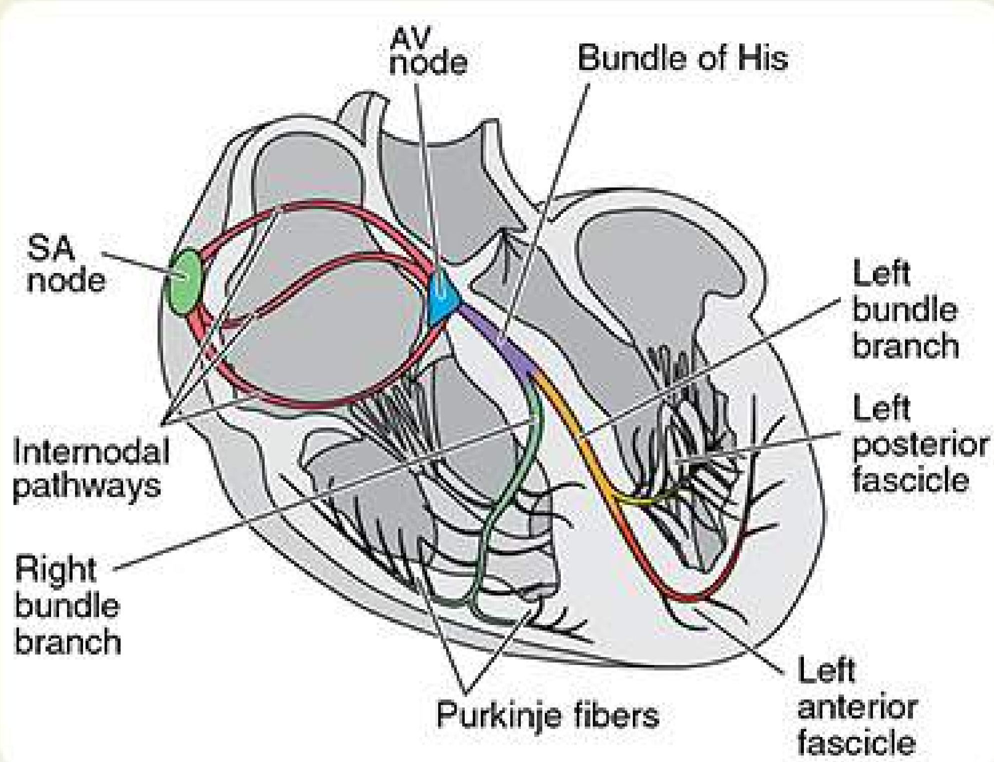


Figure 16-3 The electrical conduction system of the heart controls most aspects of heart rate and enables the four chambers to work together.

Cardiac muscle cells have a special characteristic called **automaticity** that is not found in any other type of muscle cells. Automaticity allows a cardiac muscle cell to contract spontaneously without a stimulus from a nerve source. Normal impulses in the heart start at the sinoatrial node. As long as impulses come from the sinoatrial node, the other myocardial cells will contract when the impulse reaches them. If no impulse arrives, however, the other myocardial cells are capable of creating their own impulses and stimulating a contraction of the heart, although at a generally slower rate.

The stimulus that originates in the sinoatrial node is controlled by impulses from the brain, which arrive by way of the **autonomic nervous system**. The autonomic nervous system is the part of the brain that controls the functions of the body that do not require conscious thought, such as the heartbeat, respirations, dilation and constriction of blood vessels, and digestion of food. The autonomic nervous system has two parts, the **sympathetic nervous system** and the **parasympathetic nervous system**. The sympathetic nervous system is also known as the "fight-or-flight" system and makes adjustments to the body to compensate for increased physical activity. The sympathetic nervous system speeds up the heart rate, increases respiratory rate and depth, dilates blood vessels in the muscles, and constricts blood vessels in the digestive system. The parasympathetic nervous system directly opposes the sympathetic nervous system. The parasympathetic nervous system slows the heart and respiratory rates, constricts blood vessels in the muscles, and dilates blood vessels in the digestive system. Normally, these two systems balance each other, but in times of stress, the sympathetic nervous system gains primary control, whereas in times of relaxation, the parasympathetic system takes control.

Circulation

To carry out its function of pumping blood, the **myocardium**, or heart muscle, must have a continuous supply of oxygen and nutrients. During periods of physical exertion or stress, the myocardium requires more oxygen. The heart must increase cardiac output to meet the increased metabolic requirements of the body. Cardiac output is increased by increasing the heart rate or stroke volume. The **stroke volume** is the volume of blood ejected with each ventricular contraction. In the normal heart, increased oxygen demand of the myocardium itself is supplied by **dilation**, or widening, of the coronary arteries, which increases blood flow. The **coronary arteries** are the blood vessels that supply blood to the heart muscle **Figure 16-4**. They start at the first part of the aorta, just above the **aortic valve**. The right coronary artery supplies blood to the right atrium and right ventricle and, in most people, the bottom part, or inferior wall, of the left ventricle. The left coronary artery supplies blood to the left atrium and left ventricle and divides into two major branches, just a short distance from the aorta.

Two major arteries branching from the upper aorta supply blood to the head and arms **Figure 16-5**. The right and left carotid arteries supply the head and brain with blood. The right and left subclavian arteries (under the clavicles) supply blood to the upper extremities. As the subclavian artery enters each arm, it becomes the brachial artery, the major vessel that supplies blood to each arm. Just below the elbow, the brachial artery divides into two major branches: the radial and ulnar arteries, supplying blood to the lower arms and hands.

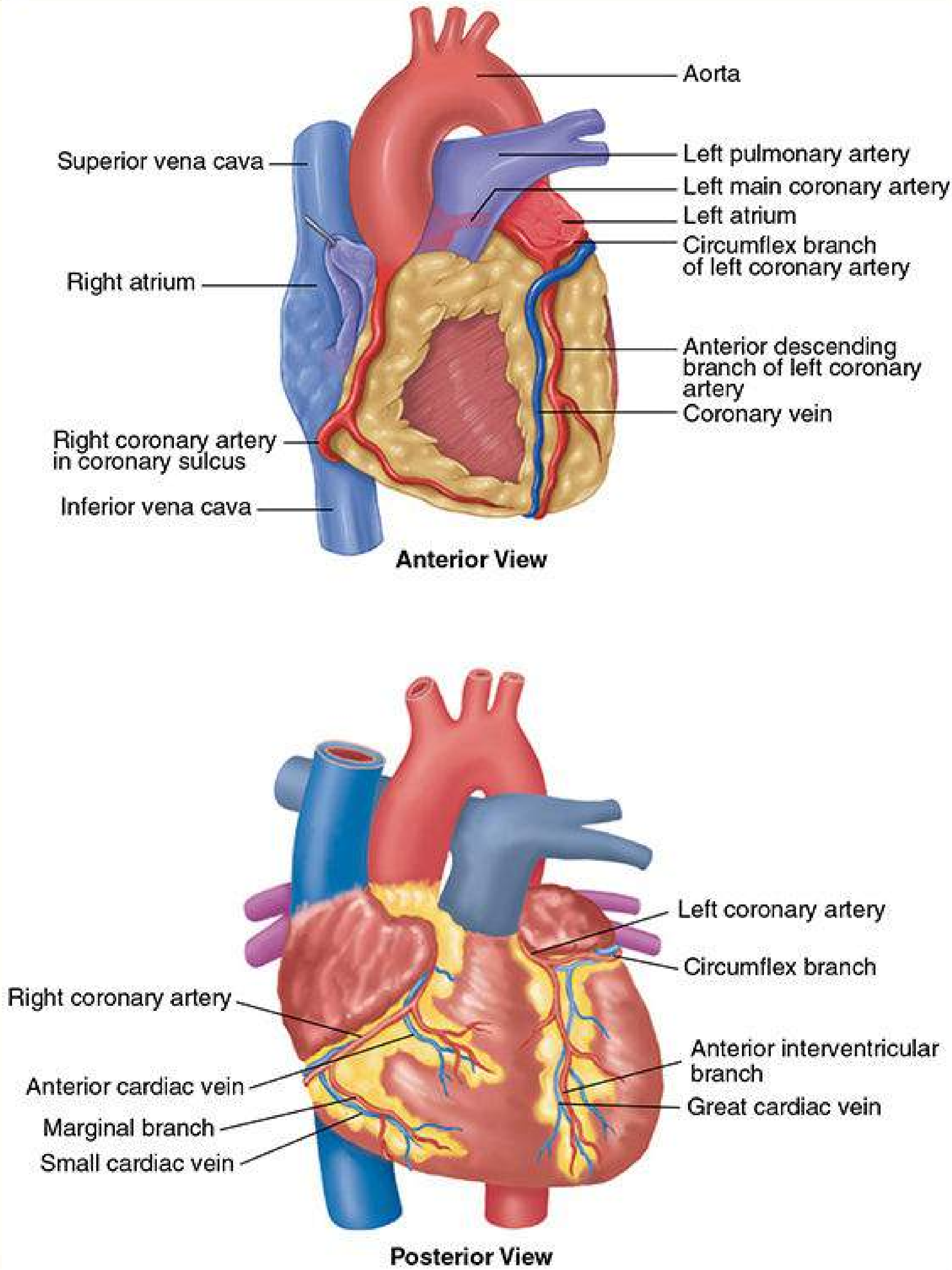


Figure 16-4 The coronary arteries carry the blood supply to the heart.

At the level of the umbilicus, the descending aorta divides into two main branches called the right and left iliac arteries, which supply blood to the groin, pelvis, and legs. As the iliac arteries enter the legs through the groin, they become the right and left femoral arteries. At the level of the knee, the femoral artery divides into the **anterior** (front) and **posterior** (back) tibial arteries and the peroneal artery, supplying blood to the lower legs and feet.

After blood travels through the arteries, it enters smaller and smaller vessels called arterioles and eventually enters the capillaries. Capillaries are tiny blood vessels about one cell thick that connect arterioles to venules. Capillaries, which are found in all parts of the body, allow the exchange of nutrients and waste at the cellular level. As the blood passes through the capillaries, it gives up oxygen to the tissues and picks up carbon dioxide and other waste products to be removed from the body.

Venules are the smallest branches of veins. After traveling through the capillaries, oxygen-poor blood enters the system of veins, starting with the venules, on its way back to the heart. The veins become larger and larger and eventually form the two large venae cavae: the superior vena cava and the inferior vena cava. The **superior** (upper) vena cava carries blood from the head and arms back to the right atrium. The **inferior** (lower) vena cava carries blood from the abdomen, kidneys, and legs back to the right atrium. The superior and inferior venae cavae join at the right atrium of the heart, where blood is eventually returned into the pulmonary circulation for oxygenation.

Blood consists of fluid and several types of cells **Figure 16-6**. Red blood cells are the most numerous and give the blood its color. Red blood cells carry oxygen to the body's tissues and remove carbon dioxide. Larger white blood cells help to fight infection. Platelets, which help the blood to clot, are much smaller than either red or white blood cells. Plasma is the fluid that the cells float in. It is a mixture of water, salts, nutrients, and proteins.

Blood pressure is the force of circulating blood against the walls of the arteries. Systolic blood pressure is the maximum pressure generated in the arms and legs during the contraction of the left ventricle, during the time period known as systole. As the left ventricle relaxes in the stage known as diastole, the arterial pressure falls. When the left ventricle relaxes, the aortic valve closes and blood flow between the left ventricle and the aorta stops. The diastolic blood pressure is the pressure exerted against the walls of the arteries while the left ventricle is at rest. Remember that the top number in a blood pressure reading is the systolic pressure, and the bottom number is the diastolic, or resting, pressure. The cardiac cycle consists of one systolic and one diastolic time period.

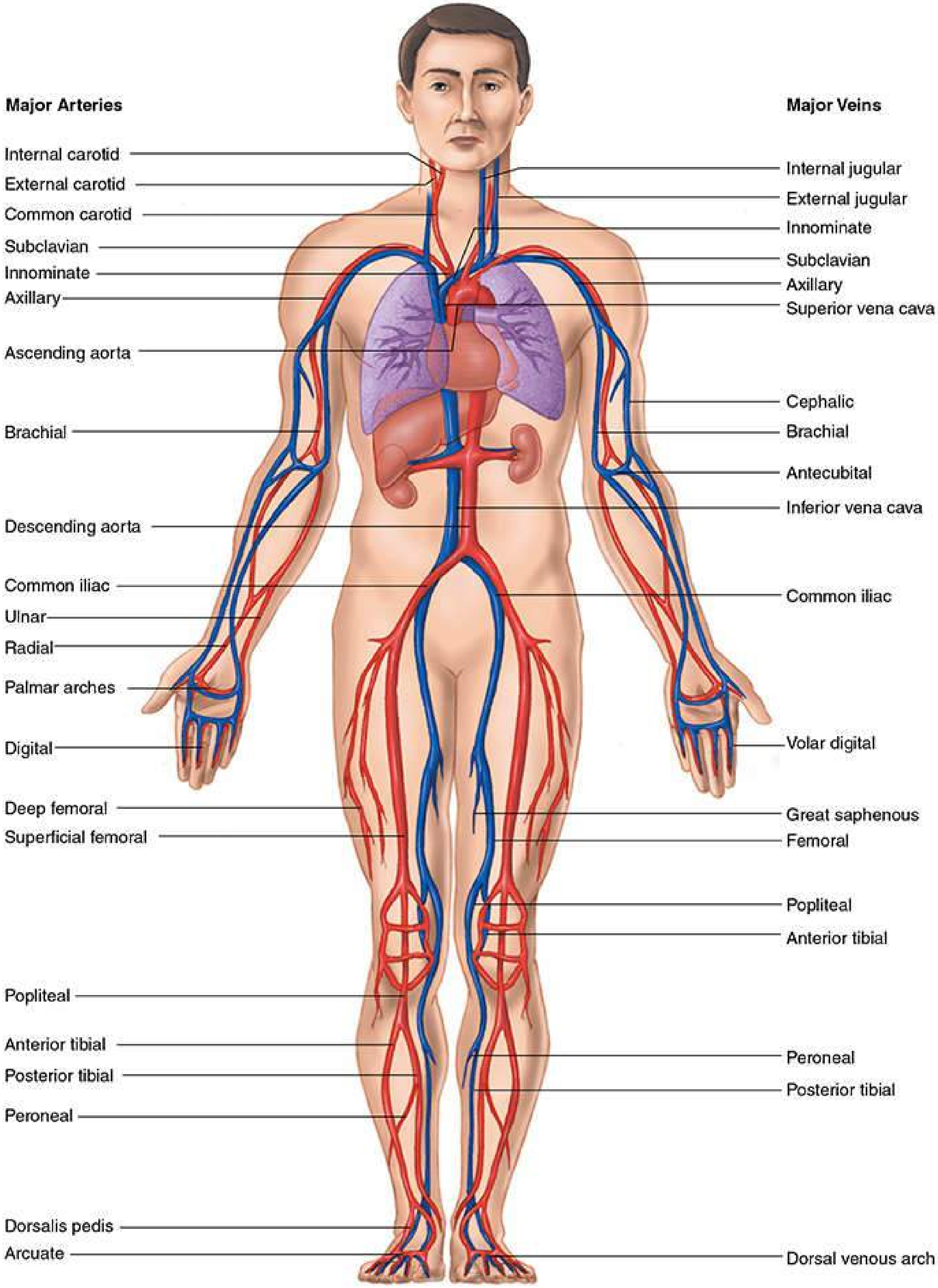


Figure 16-5 The major arteries of the body carry oxygen-rich blood to all parts of the body. The major veins of the body carry deoxygenated blood back to the heart.

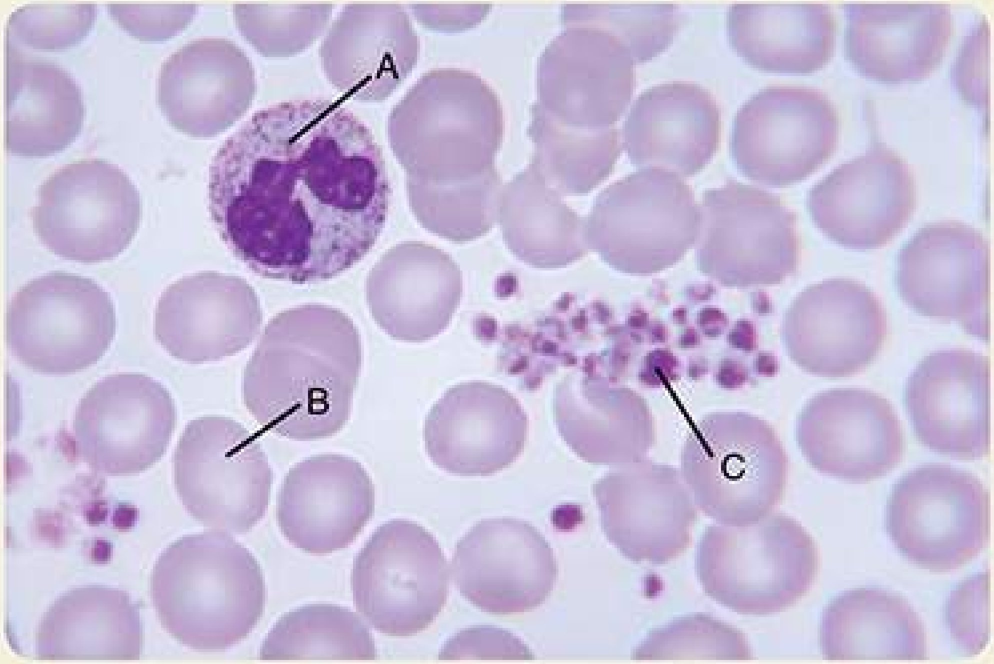


Figure 16-6 Blood consists of fluid and several types of cells, including red blood cells (B), white blood cells (A), and platelets (C).

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As the blood passes through an artery during systole, a pulse is generated. This pulse can be felt by placing a finger on the skin over the artery at a point where the artery lies near the skin surface and gently compressing. Pulses felt in the extremities, such as the radial and the posterior tibial, are called peripheral pulses, whereas pulses near the trunk of the body, such as the femoral and carotid pulses, are known as central pulses.

The rate of cardiac contractions can be increased or decreased by the autonomic nervous system. The heart also has the ability to increase or decrease the volume of blood it pumps with each contraction based on the autonomic nervous system response. To obtain an accurate measure of the efficiency of the heart, we have to measure the volume of blood pumped and the heart rate. This is determined by calculating the cardiac output. The **cardiac output** is calculated by multiplying the heart rate by the volume of blood ejected with each contraction, or the stroke volume. This is the volume of blood that passes through the heart in 1 minute and is the best measure of the output of the heart. In the field, we have no way of directly measuring the volume of blood being pumped; therefore, we must rely on the heart rate and the strength of the pulse to estimate the cardiac output.

The constant flow of oxygenated blood to the tissues is known as **perfusion**. Good perfusion requires three primary components. The first is a well-functioning heart, or “pump.” The heart must operate at an appropriate rate because a rate that is too slow or too fast will reduce the volume of blood circulated and, thus, reduce the cardiac output. When the heart beats too rapidly, there is not enough time between contractions for the heart to refill completely, and when the heart beats too slowly, the volume of blood circulated per minute decreases due to the slow pulse rate. The second component of good perfusion is an adequate volume of “fluid,” or blood. If there is blood loss through hemorrhage, the reduced volume will limit the amount of tissue that can be perfused. Third, the blood must be carried in a properly sized “container.” This means that the blood vessels must be appropriately constricted to match the volume of blood available so that circulation can occur without problems. If the blood vessels dilate, thereby increasing the size of the container, and the volume of fluid remains the same, there will not be enough blood to fill the blood vessels and perfusion will be reduced. If there is a problem with the functioning of the heart, the functioning of the blood vessels, or the volume of blood, perfusion will fall, which will lead to cellular death and, eventually, death of the patient.

Words of Wisdom

Pulsation

As the left ventricle contracts, it ejects a forceful wave of blood through the arteries. You can feel that wave in areas where the artery lies near the surface of the skin. This wave of blood is called the pulse. The evaluation of a patient's pulse is important in the assessment and treatment of cardiovascular emergencies. EMTs should be skilled at finding multiple pulse points and should compare proximal and distal pulses bilaterally, when applicable, to determine any differences in quality or strength that could indicate the patient's condition is progressing to decompensated shock.

Common places to feel for a pulse include the following **Figure 16-7**:

- The carotid pulse can be felt in the neck by placing two fingertips in the center of the throat on the windpipe, and then sliding them towards you into the groove between the trachea and the neck muscle. Do not assess both carotid pulses at the same time as this could greatly reduce blood flow to the brain.
- The femoral pulse can be felt in the groin at the crease dividing the lower abdomen from the leg.
- The brachial pulse can be felt on the medial aspect of the elbow at the level of the crease. This is the pulse that you listen for when you take blood pressure. Pulsations also can be palpated on the medial side of the arm midway between the elbow and armpit.
- The radial pulse can be felt on the thumb side of the wrist, about one fingerbreadth above the wrist crease.
- The posterior tibial pulse can be felt on the inside of the ankle, just behind the medial malleolus. The medial malleolus is the bony bump at the bottom end of the tibia.
- The dorsalis pedis pulse can be felt at the top of the foot. This artery is not in the same place in all people. To find the pulse, place your hand across the top of the foot just below the ankle crease. Once you feel something that might be a pulse, use your fingertips to confirm that finding.

Practice feeling for these pulses on yourself and on friends and family members.

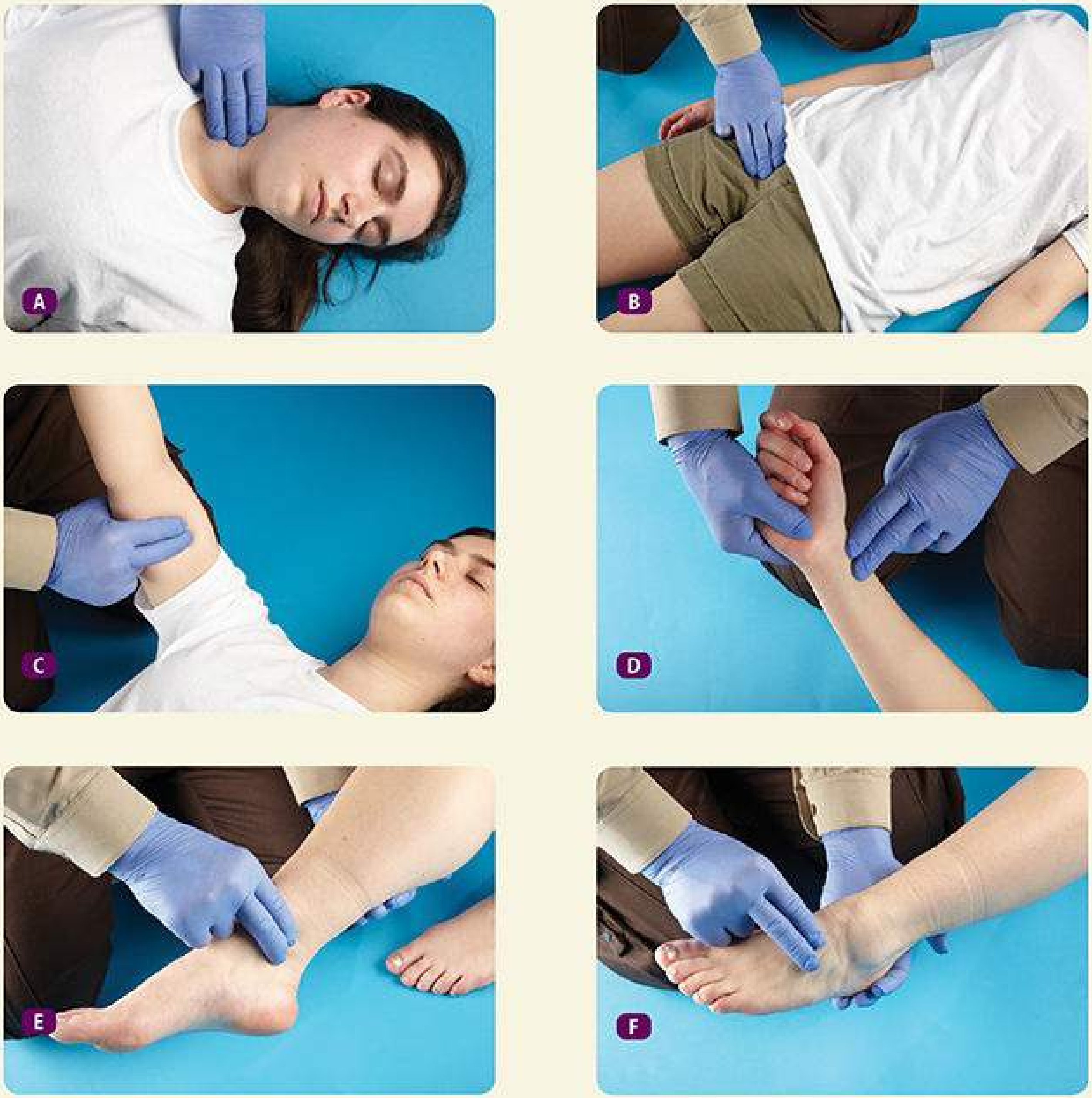


Figure 16-7 Common pulse points. **A.** The carotid pulse is felt in the neck. **B.** The femoral pulse is felt in the groin area. **C.** The brachial pulse is felt on the inside of the upper arm. **D.** The radial pulse is felt on the thumb side of the wrist. **E.** The posterior tibial pulse is felt on the inside of the ankle. **F.** The dorsalis pedis pulse is felt on the top of the foot.

Words of Wisdom

Cardiac Output = Heart Rate × Stroke Volume

Cardiac output is the amount of blood pumped out of the left ventricle in 1 minute.

Heart rate is the number of times the heart contracts in 1 minute.

Stroke volume is the volume of blood pumped out by the left ventricle in one contraction.

Stroke volume is affected by preload, afterload, and contractility. Preload is related to the venous return to the right atrium. Afterload is associated with systemic vascular resistance, which is a function of the constriction of the systemic blood vessels. As the blood vessels constrict, it is harder for the ventricle to push the blood into them. Contractility refers to how forcefully the heart contracts.

Pathophysiology

Chest pain or discomfort that is related to the heart usually stems from a condition called **ischemia**, which is decreased blood flow, in this case, to the heart. Because of a partial or complete blockage of blood flow through the coronary arteries, heart tissue fails to get enough oxygen and nutrients. The tissue soon begins to starve and, if blood flow is not restored, eventually dies. Ischemic heart disease, then, is disease involving a decrease in blood flow to one or more portions of the heart muscle.

Atherosclerosis

Most often, the low blood flow to heart tissue is caused by coronary artery atherosclerosis. **Atherosclerosis** is a disorder in which calcium and a fatty material called cholesterol build up and form a plaque inside the walls of blood vessels, obstructing flow and interfering with their ability to dilate or contract **Figure 16-8**. Eventually, atherosclerosis can even cause complete **occlusion**, or blockage, of a coronary artery. Atherosclerosis usually involves other arteries of the body as well.

The problem begins when the first trace of cholesterol is deposited on the inside of an artery. This may happen as early as the teenage years. As a person ages, more of this fatty material is deposited; the **lumen**, or the inside diameter of the artery, narrows. As the cholesterol deposits grow, calcium deposits can form as well. The inner wall of the artery, which is normally smooth and elastic, becomes rough and brittle with these atherosclerotic plaques. Damage to the coronary arteries may become so extensive that they cannot accommodate increased blood flow during times of maximum need.

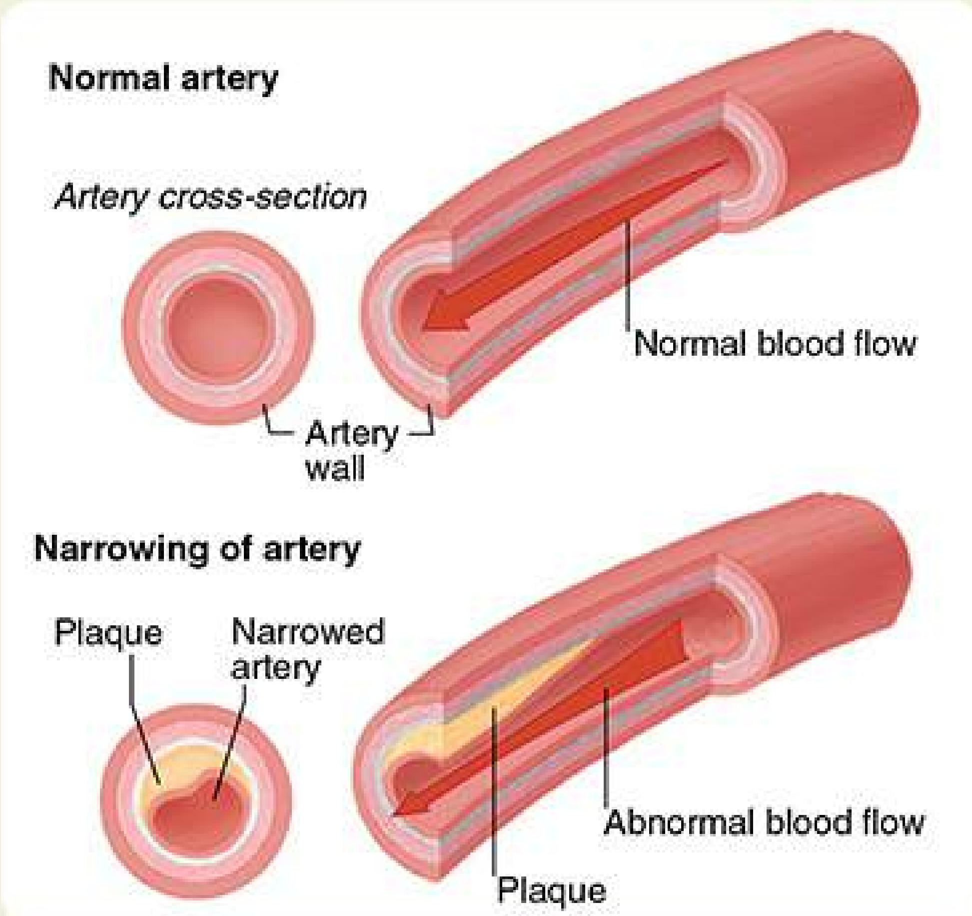


Figure 16-8 In atherosclerosis, calcium and cholesterol build up inside the walls of the coronary blood vessels, causing an obstruction in blood flow to the heart.

For reasons that are still not completely understood, a brittle plaque will sometimes develop a crack, exposing the inside of the atherosclerotic wall. Acting like a torn blood vessel, the ragged edge of the crack activates the blood-clotting system, just as when an injury has caused bleeding. In this situation, however, the resulting blood clot will partially or completely block the lumen of the artery. If it does not occlude the artery at that location, the blood clot may break loose and begin floating in the blood, becoming what is known as a thromboembolism. A **thromboembolism** is a blood clot that is floating through blood vessels until it reaches an area too narrow for it to pass, causing it to stop and block the blood flow at that point. Tissues downstream from the blood clot will have a lack of oxygen (hypoxia). If blood flow is resumed in a short time, the hypoxic tissues will recover. However, if too much time goes by before blood flow is resumed, the hypoxic tissues will die. If a blockage occurs in a coronary artery, the condition is known as an **acute myocardial infarction (AMI)**, a classic heart attack Figure 16-9. **Infarction** means the death of tissue. The same sequence may also cause the death of cells in other organs, such as the brain. The death of heart muscle can lead to severe diminishment of the heart's ability to pump or cause it to stop completely (**cardiac arrest**).

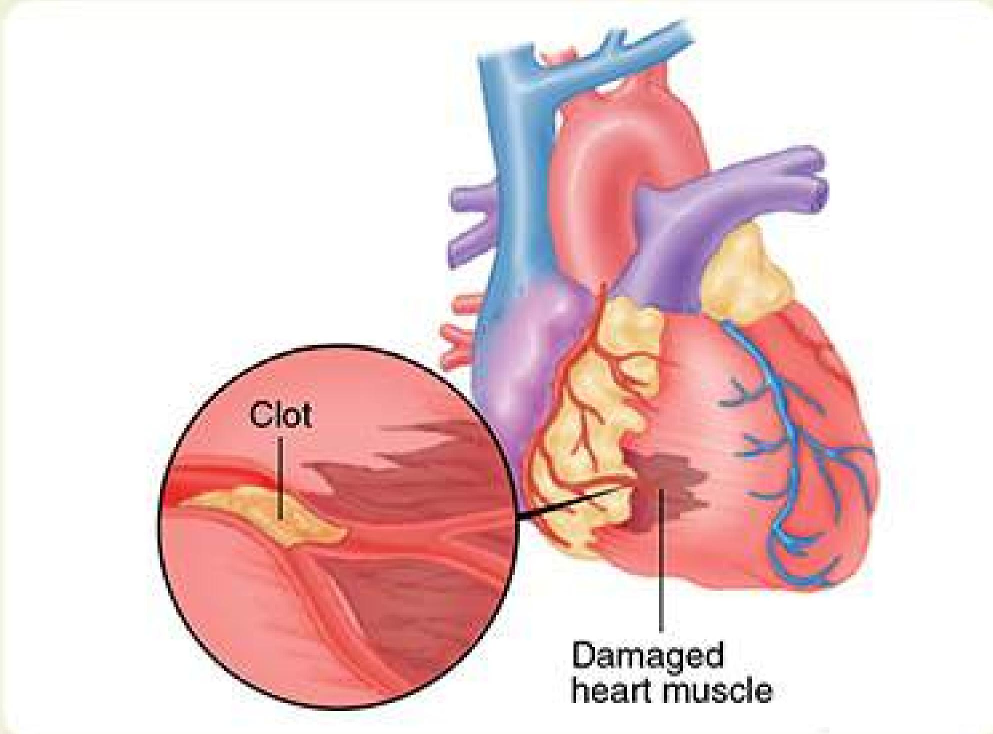


Figure 16-9 An acute myocardial infarction (heart attack) occurs when a blood clot prevents blood flow to an area of the heart muscle. If left untreated, death of heart tissue can result.

In the United States, coronary artery disease is the number one cause of death for men and women. The peak incidence of heart disease occurs between ages 45 and 64 years, but it can also strike teens and people in their 90s. You must be alert to the possibility that, although less likely, a 26-year-old with chest pain could actually be having an AMI, especially if he or she has a higher than usual risk.

Factors that place a person at higher risk for an AMI are called risk factors. The major controllable factors are cigarette smoking, high blood pressure, elevated cholesterol level, elevated blood glucose level (diabetes), lack of exercise, and obesity. The major risk factors that cannot be controlled are older age, family history of atherosclerotic coronary artery disease, race, ethnicity, and male sex. Lesser factors that play a role in heart disease are stress, excessive alcohol, and poor diet.

▶ Acute Coronary Syndrome

Many patients who call for EMS assistance because of chest pain have acute coronary syndrome. **Acute coronary syndrome**, also called ACS, is a term used to describe a group of symptoms caused by myocardial ischemia. As discussed earlier, myocardial ischemia is a decrease in blood flow to the heart, which leads to chest pain through reduction of oxygen and nutrients to the tissues of the heart. This can be a temporary situation known as angina pectoris, or a more serious condition, an AMI. Because the signs and symptoms of these two conditions are very similar, they are treated basically the same under the designation of acute coronary syndrome. To understand them better, we will look at each one separately.

Angina Pectoris

Chest pain does not always mean that a person is having an AMI. When, for a brief time, heart tissues are not getting enough oxygen, the pain is called **angina pectoris**, or angina. Although angina can result from a spasm of an artery, it is most often a symptom of atherosclerotic coronary artery disease. Angina occurs when the heart's need for oxygen exceeds its supply, usually during periods of physical or emotional stress when the heart is working hard. A large meal or sudden fear may also trigger an attack. When the increased oxygen demand goes away (eg, the person stops exercising), the pain typically goes away.

Anginal pain is commonly described as crushing, squeezing, or "like somebody standing on my chest." It is usually felt in the mid portion of the chest, under the sternum. However, it can radiate to the jaw, the arms (frequently the left arm), the midportion of the back or the epigastrium (the upper-middle region of the abdomen). The pain usually lasts from 3 to 8 minutes, rarely longer than 15 minutes. It may be associated with shortness of breath, nausea, or sweating. It usually disappears promptly with rest, supplemental oxygen, or nitroglycerin (NTG), all of which decrease the need or increase the supply of oxygen to the heart. Although angina pectoris is frightening, it does not mean that heart cells are dying, nor does it usually lead to death or permanent heart damage. It is, however, a warning that you and the patient should take seriously. Even with angina, because the oxygen supply to the heart is diminished, the electrical system can be compromised, and the person is at risk for significant cardiac rhythm problems.

Angina can be further differentiated into "stable" and "unstable" angina. Unstable angina is characterized by pain or discomfort in the chest of coronary origin that occurs in response to progressively less exercise or fewer stimuli than ordinarily required to produce angina. If untreated, it can lead to AMI. Stable angina is characterized by pain in the chest of coronary origin that is relieved by the things that normally relieve it in a given patient, such as resting or taking nitroglycerin. EMS usually becomes involved when stable angina becomes unstable, such as when a patient whose pain is normally relieved by sitting down and taking one nitroglycerin tablet has taken three tablets with no relief. Keep in mind that it can be difficult, even for physicians in hospitals, to distinguish between the pain of angina and the pain of an AMI. Patients experiencing chest pain or discomfort, therefore, should always be treated as if they are having an AMI.

Acute Myocardial Infarction

The pain of an AMI signals the actual death of cells in the area of the heart muscle where blood flow is obstructed. Once dead, the cells cannot be revived. Instead, they will eventually turn to scar tissue and become a burden to the beating heart. This is why fast action is so critical in treating a heart attack. The sooner the arterial blockage can be cleared, the fewer the cells that may die. About 30 minutes after blood flow is cut off, some heart muscle cells begin to die. After about 2 hours, as many as half of the cells in the area can be dead; in most cases, after 4 to 6 hours, more than 90% will be dead. In many cases, however, opening the coronary artery with "clot-busting" (thrombolytic) medications or angioplasty (mechanical clearing of the artery) can prevent permanent damage to the heart muscle if done within the first few hours after the onset of symptoms. Therefore, immediate prehospital treatment and transport to the emergency department (ED) are essential.

An AMI is more likely to occur in the larger, thick-walled left ventricle, which needs more blood and oxygen than the right ventricle.

Signs and Symptoms of Acute Myocardial Infarction. A patient with an AMI may show any of the following signs and symptoms:

- Sudden onset of weakness, nausea, and sweating without an obvious cause
- Chest pain, discomfort, or pressure that is often crushing or squeezing and that does not change with each breath
- Pain, discomfort, or pressure in the lower jaw, arms, back, abdomen, or neck
- Irregular heartbeat and syncope (fainting)
- Shortness of breath, or dyspnea
- Nausea/vomiting
- Pink, frothy sputum (indicating possible pulmonary edema)
- Sudden death

The Pain of Acute Myocardial Infarction. The pain of an AMI differs from the pain of angina in three ways:

- It may or may not be caused by exertion but can occur at any time, sometimes when a person is sitting quietly or even sleeping.
- It does not resolve in a few minutes; rather, it can last between 30 minutes and several hours.
- It may or may not be relieved by rest or nitroglycerin.

Note that not all patients who are having an AMI experience pain or recognize it when it occurs. In fact, about a third of patients never seek medical attention. This can be attributed, in part, to the fact that people are afraid of dying and do not want to face the possibility that their symptoms may be serious (cardiac denial). Middle-aged men, in particular, are likely to minimize their symptoms. However, some patients, particularly older people, women, and people with diabetes, do not experience any pain during an AMI but have other common complaints associated with ischemia discussed earlier. Others may feel only mild discomfort and call it indigestion. It is not uncommon for the only complaint, especially in older patients and women, to be fatigue. AMI without the classic chest pain is often referred to as a silent MI. Heart disease is the number one killer of women in the United States, and EMTs should consider AMI even when the classic symptom of chest pain is not present. This is also true for older people and people with diabetes.

Therefore, when you are called to a scene where the chief complaint is chest pain, complete a thorough assessment, no matter what the patient says. Patients with cardiac risk factors should also be carefully assessed if they have any of the associated symptoms, even if no chest pain is present. Any complaint of chest discomfort is a serious matter. In fact, the best thing you can do is to assume the worst.

Physical Findings of Acute Myocardial Infarction and Cardiac Compromise. The physical findings of AMI vary, depending on the extent and severity of heart muscle damage. The following are common:

- **General appearance.** The patient often appears frightened. There may be nausea, vomiting, and a cold sweat. The skin is often pale or ashen gray because of poor cardiac output and the loss of perfusion, or blood flow through the tissue. Occasionally, the skin will have a bluish tint, called cyanosis; this is the result of poor oxygenation of the circulating blood.
- **Pulse.** Generally, the pulse rate increases as a normal response to pain, stress, fear, or actual injury to the myocardium. Because dysrhythmias are common in an AMI, you may feel an irregularity or even a slowing of the pulse. The pulse may also be dependent on the area of the heart that has been affected by the AMI. Damage to the inferior area of the heart often presents with bradycardia.

Words of Wisdom

Documenting exactly how a patient describes chest discomfort, in the patient's own words, is a valuable source of information for hospital staff. Remember OPQRST (Onset, Provocation/Palliation, Quality, Radiation, Severity, Time of onset).

- **Blood pressure.** Blood pressure may fall as a result of diminished cardiac output and diminished capability of the left ventricle to pump. However, most patients with an AMI will have a normal or, possibly, elevated blood pressure.
- **Respiration.** The respiratory rate is usually normal unless the patient has CHF. In that case, respirations may become rapid and labored with a higher likelihood of cyanosis and possibly frothy sputum. A complaint of difficulty breathing is common with cardiac compromise, so even if the rate seems normal, look at the work of breathing, and treat the patient as if respiratory compromise were present.
- **Mental status.** Patients with AMIs often experience confusion or agitation and sometimes experience an almost overwhelming feeling of impending doom. If a patient tells you, "I think I am going to die," pay attention.

Consequences of Acute Myocardial Infarction. An AMI can have three serious consequences:

- Sudden death
- Cardiogenic shock
- Congestive heart failure

Sudden Death. Approximately 40% of all patients with an AMI do not reach the hospital alive. Sudden death is usually the result of cardiac arrest, in which the heart fails to generate effective blood flow. Although you cannot feel a pulse in someone experiencing cardiac arrest, the heart may still be twitching, though erratically. The heart is using up energy without pumping any blood. Such an abnormality of heart rhythm is a ventricular **dysrhythmia**, known as ventricular fibrillation.

A variety of other lethal and nonlethal dysrhythmias may follow an AMI, usually within the first hour. In most cases, premature ventricular contractions, or extra beats in the damaged ventricle, occur. Premature ventricular contractions by themselves may be harmless and are common among healthy people, as well as sick people. Other dysrhythmias can be much more dangerous. These include the following

- **Tachycardia**. Rapid beating of the heart, 100 beats/min or more.
- **Bradycardia**. Unusually slow beating of the heart, 60 beats/min or less.
- **Ventricular tachycardia**. Rapid heart rhythm, usually at a rate of 150 to 200 beats/min. The electrical activity starts in the ventricle instead of the atrium. This rhythm usually does not allow adequate time between beats for the left ventricle to fill with blood. Therefore, the patient's blood pressure may fall, and the pulse may be lost altogether. The patient may also feel weak or light-headed or may even become unresponsive. In some cases, existing chest pain may worsen or

chest pain that was not there before onset of the dysrhythmia may develop. Most cases of ventricular tachycardia will be sustained and may deteriorate into ventricular fibrillation.

- **Ventricular fibrillation** (V fib). Disorganized, ineffective quivering of the ventricles. No blood is pumped through the body, and the patient usually becomes unconscious within seconds. The only way to convert this dysrhythmia is to defibrillate the heart. To **defibrillate** means to shock the heart with a specialized electric current in an attempt to stop the chaotic, disorganized contraction of the myocardial cells and allow them to start again in a synchronized manner to restore a normal rhythmic beat. Defibrillation is highly successful in terms of saving a life if delivered within the first few minutes of sudden death. If a defibrillator is not immediately available, CPR must be initiated until the defibrillator arrives. Even if CPR is begun at the time of collapse, chances of survival diminish approximately 10% each minute until defibrillation is accomplished.

If uncorrected, unstable ventricular tachycardia or ventricular fibrillation will eventually lead to **asystole**, the absence of all heart electrical activity. Without CPR, asystole may occur within minutes. Asystole usually reflects a long period of ischemia, and nearly all patients you find in asystole will die.

Cardiogenic Shock

Shock is a simple concept but one that few people without medical training really understand. For that reason, Chapter 12 is devoted to a discussion of shock. The discussion of shock in this chapter is limited to that associated with cardiac problems; however, many other medical problems may cause shock as well.

Shock is a critical concept. Shock is present when body tissues do not get enough oxygen, causing body organs to malfunction. In **cardiogenic shock**, often caused by a heart attack, the problem is that the heart lacks enough power to force the proper volume of blood through the circulatory system. Cardiogenic shock is more commonly found in an AMI that affects the inferior and posterior regions of the left ventricle of the heart because this provides circulation to the majority of the body. Cardiogenic shock can occur immediately or as late as 24 hours after the onset of the AMI. The various signs and symptoms of cardiogenic shock are produced by the improper functioning of the body's organs. The challenge for you is to recognize shock in its early stages, when treatment is much more likely to be successful.

Congestive Heart Failure

Failure of the heart occurs when the ventricular heart muscle is so permanently damaged that it can no longer keep up with the return flow of blood from the atria. **Congestive heart failure (CHF)** can occur any time after a myocardial infarction, in the setting of heart valve damage, or as a consequence of long-standing high blood pressure. Any condition that weakens the pumping strength of the heart may cause CHF and this often happens between the first few hours and the first few days after a heart attack.

Just as the pumping function of the left ventricle can be damaged by coronary artery disease, it can also be damaged by diseased heart valves or chronic hypertension. In any of these cases, when the muscle can no longer contract effectively, the heart tries other ways to maintain an adequate cardiac output. Two specific changes in heart function occur: The heart rate increases, and the left ventricle enlarges in an effort to increase the amount of blood pumped each minute.

When these adaptations can no longer make up for the decreased heart function, CHF eventually develops. It is called "congestive" heart failure because the lungs become congested with fluid once the left side of the heart fails to pump the blood effectively. Blood tends to back up in the pulmonary veins, increasing the pressure in the capillaries of the lungs. When the pressure in the capillaries exceeds a certain level, fluid (mostly water) passes through the walls of the capillary vessels and into the alveoli. This condition is called pulmonary edema. It may occur suddenly, as in an AMI, or slowly over months, as in chronic CHF. Sometimes, in patients with an acute onset of CHF, severe pulmonary edema will develop, in which the patient has pink, frothy sputum and severe dyspnea.

YOU are the Provider — PART 2

You arrive at the scene and are escorted by the patient's son to her bedroom. She is sitting up in bed with her fist clutched against her chest. She is conscious and alert, but is notably anxious. Her skin is pale and diaphoretic. Your partner opens the jump kit as you assess the patient.

Recording Time: 0 Minutes	
Appearance	Anxious; notably diaphoretic
Level of consciousness	Conscious and alert

Airway	Open; clear of secretions and foreign bodies
Breathing	Increased respiratory rate; adequate depth
Circulation	Radial pulse, rapid and irregular; skin, pale and diaphoretic

After confirming that she has not taken any medication and that she is not allergic to any medications, you give the patient four 81-mg aspirins to chew and swallow according to your protocols. As you continue your assessment and further inquire about her medical history, your partner applies the pulse oximeter, which shows that the patient's oxygen saturation is 91%. Based on this he applies oxygen via nasal cannula at 4 L/ min and prepares to take her vital signs. She tells you that she had a heart attack 3 years ago; has high blood pressure; and takes enalapril (Vasotec), nitroglycerin, and one aspirin per day.

4. Why is aspirin given to patients with an acute cardiac event?
5. What type of medication is nitroglycerin? How may it help relieve chest pain, pressure, or discomfort?
6. When is nitroglycerin indicated for a patient? What is the typical dose?

Words of Wisdom

Cardiogenic Shock

Signs and Symptoms

- One of the first signs of shock is anxiety or restlessness as the brain becomes relatively starved for oxygen. The patient may report "air hunger." Think of the possibility of shock when the patient is saying that he or she cannot breathe. Obviously, the patient can breathe, because he or she can talk. However, the patient's brain is sensing that it is not getting enough oxygen.
- As the shock continues, the body tries to send blood to the most important organs, such as the brain and heart, and away from less important organs, such as the skin. Therefore, you may see pale, cool, clammy skin in patients with shock.
- As the shock gets worse, the body will attempt to compensate by increasing the amount of blood pumped through the heart. Therefore, the pulse rate will be higher than normal. In severe shock, the heart rate usually, but not always, is greater than 120 beats/min. As the shock progresses, the pulses may become irregular and weak.
- Shock can also present with rapid and shallow breathing, nausea and vomiting, and a decrease in body temperature.
- Finally, as the heart and other organs begin to malfunction, the blood pressure will fall below normal. A systolic blood pressure less than 90 mm Hg is easy to recognize, but it is a late finding that indicates decompensated shock. It is very important though not to assume that shock is not present just because the blood pressure is normal (compensated shock).

Treatment of Cardiogenic Shock

Take the following steps when treating patients with signs and symptoms of cardiogenic shock:

1. Position the patient comfortably. Some patients will be more comfortable in a semi-Fowler position (head and knees slightly elevated); however, patients with low blood pressure may not tolerate a semi-upright position but may be more comfortable and more alert in a supine position.
2. Administer high-flow oxygen.
3. Assist ventilations as necessary.
4. Cover the patient with sheets or blankets as necessary to preserve body heat. Be sure to cover the top of the patient's head in very cold weather, as this is where much heat is lost.
5. Provide prompt transport to the ED.

Congestive Heart Failure

Signs and Symptoms

- The patient finds it easier to breathe when sitting up. When the patient is lying down, more blood is returned to the right ventricle and lungs, causing further pulmonary congestion.
- Often, the patient is agitated.
- Chest pain may or may not be present.
- The patient often has distended neck veins that do not collapse even when the patient is sitting.
- The patient may have swollen ankles from dependent edema (backup of fluid).

- The patient generally will have high blood pressure, a rapid heart rate, and rapid respirations.
- The patient will usually be using accessory breathing muscles of the neck and ribs, reflecting the additional hard work of breathing.
- Skin is usually pale or cyanotic and sweaty.
- The fluid surrounding small airways may produce rales (crackles), best heard by listening to either side of the patient's chest, about midway down the back. In severe CHF, these soft sounds can be heard even at the top of the lung.

Once CHF develops, it can be treated but not cured. Regular use of medications may alleviate the symptoms. However, patients with CHF often become ill again and are frequently hospitalized. Approximately half will die within 5 years of the onset of symptoms.

Treatment of Congestive Heart Failure

Treat a patient with CHF the same way as a patient with chest pain:

1. Take the vital signs, and give oxygen by nonrebreathing mask with an oxygen flow of 10 to 15 L/min. Medical control may, either by protocol or in response to your request, order the use of continuous positive airway pressure (CPAP) to move some of the fluid out of the lungs to provide better oxygenation.
2. Allow the patient to remain sitting in an upright position with the legs down.
3. Be reassuring; many patients with CHF are quite anxious because they feel as if they cannot breathe.
4. Patients who have had problems with CHF before will usually have specific medications for its treatment. Gather these medications, and take them along to the hospital.
5. Nitroglycerin may be of value in reducing pulmonary edema if the patient's systolic blood pressure is more than 100 mm Hg. If the patient has been prescribed nitroglycerin, and medical control or standing orders advise you to do so, you can administer it sublingually.
6. Prompt transport to the ED is essential.

If the right side of the heart is damaged, fluid collects in the body, often showing up as swelling in the feet and legs. The collection of fluid in the part of the body that is closest to the ground is called **dependent edema**. The swelling causes relatively few symptoms other than discomfort. However, chronic dependent edema may indicate underlying heart disease even in the absence of pain or other symptoms. Since the right side of the heart supplies the preload for the left side of the heart, right heart failure can result in an inadequate supply of blood to the left ventricle resulting in a drop in the systemic blood pressure. It is important to realize that some patients may present with signs of both left-sided and right-sided heart failure because left-sided failure often leads to right-sided failure.

Hypertensive Emergencies

Hypertension is defined as any systolic blood pressure greater than 140 mm Hg or a diastolic blood pressure greater than 90 mm Hg. Another cardiac-related condition is a hypertensive emergency. A **hypertensive emergency** usually occurs only with a systolic pressure greater than 180 mm Hg or a rapid rise in the systolic pressure. Because patients do not feel their blood pressure, the signs and symptoms of hypertensive emergency are related to the effects of the hypertension. Some patients with chronic hypertension may not experience signs or symptoms until their systolic pressure is significantly higher than this value. One of the most common signs is a sudden severe headache. If described as "the worst headache I have ever felt," this may also be a sign of cerebral hemorrhage. Other signs and symptoms include strong bounding pulse, ringing in the ears, nausea and vomiting, dizziness, warm skin (dry or moist), nosebleed, altered mental status, and even the sudden development of pulmonary edema. Untreated hypertensive emergencies can lead to a stroke or a dissecting aortic aneurysm.

If you suspect your patient is experiencing a hypertensive emergency, attempt to make him or her comfortable and monitor the blood pressure regularly. Position the patient with the head elevated, and transport rapidly to the ED. Depending on the distance and time involved in transport, you should consider ALS assistance for the patient. Paramedics may be able to administer medications to lower the blood pressure to a safer level. If ALS personnel can be on the scene quickly, contact them early and allow them to transport the patient from the scene. If the transport distance is long, consider asking for an ALS unit to meet you along the way and take over patient care and transportation from that point. Remember that getting the patient with a hypertensive emergency to the hospital as quickly and safely as possible is the best prehospital treatment you can provide.

An **aortic aneurysm** is a weakness in the wall of the aorta. The aorta dilates at the weakened area, which makes it susceptible to rupture. A **dissecting aneurysm** occurs when the inner layers of the aorta become separated, allowing blood (at high pressures) to flow between the layers. Uncontrolled hypertension is the primary cause of dissecting aortic aneurysms. This separation of layers weakens the wall of the aorta significantly, making it more likely to be ruptured under conditions of continued high blood pressure. If the aorta ruptures, the amount of internal blood loss will be so large that the patient will die almost immediately. The signs and symptoms of a dissecting aortic aneurysm include very sudden chest pain located in the anterior part of the chest or in the back between the shoulder blades. It may be difficult to differentiate the chest pain of a dissecting aortic aneurysm from that of an AMI, but a number of distinctive features may help. The pain from an AMI is often preceded by other symptoms—nausea, indigestion, weakness, and sweating—and tends to come on gradually, getting more severe with time and often described as "pressure" rather than "stabbing." By contrast, the pain of a dissecting aortic aneurysm usually comes on full force from one minute to the next Table 16-1. A patient with a dissecting aortic aneurysm also may exhibit a difference in blood pressure between arms or diminished pulses in the lower extremities. Aortic aneurysms are almost impossible to diagnose in the prehospital setting, but you must consider them a possibility in any patient with significant hypertension. Transport the patient without delay.

Patient Assessment

While en route to the scene, consider the standard precautions that will be needed. The precautions can be as simple as gloves for a patient with chest pain or full precautions for a patient in cardiac arrest. Remember, the patient's condition can change rapidly between the time you are dispatched and your arrival.

Table 16-1 AMI Versus Dissecting Aortic Aneurysm

	AMI	Dissecting Aneurysm
Onset of pain	Gradual, with additional symptoms	Abrupt, without additional symptoms
Quality of pain	Tightness or pressure	Sharp or tearing
Severity of pain	Increases with time	Maximal from onset
Timing of pain	May wax and wane	Does not abate once it has started
Region/radiation	Substernal; back is rarely involved	Back possibly involved, between the shoulder blades
Clinical signs	Peripheral pulses equal	Blood pressure discrepancy between arms or decrease in a femoral or carotid pulse

Scene Size-up

Do not let your guard down on medical calls. Always ensure that the scene is safe for all. As you approach the scene, look for and address any hazards. Determine the necessary standard precautions and whether you will need additional resources.

Identification of the nature of illness is important to start your patient assessment in the right direction. Use the information you get from the dispatcher, clues at the scene, and comments of bystanders or family members to begin to develop an idea about the type of problem your patient might be experiencing. For patients with cardiac problems, the clues often include a report of chest pain, difficulty breathing, or sudden loss of consciousness. Once you establish a preliminary nature of illness, you will be able to guide your assessment to find the important information much more effectively. Just remember not to become fixated on a specific condition at this early point in the assessment; sometimes the situation turns out to be very different from how it initially appeared.

Primary Assessment

As you approach the patient, form a general impression of his or her condition to recognize and address life threats. You will likely begin by determining whether the patient is responsive. Perform a primary assessment of the patient. If the patient is unresponsive and is not breathing, begin CPR, starting with chest compressions, and call for an AED. Use of the AED is discussed in the section on cardiac arrest later in this chapter. Generally, an AED should be applied if the patient is pulseless, not breathing (apneic), and unresponsive. Consider calling for ALS backup if possible.

Once you have formed a general impression, the next step in the primary assessment is to assess airway and breathing. Unless the patient is unresponsive, the airway will most likely be patent. Responsive patients should be able to maintain their own airway. Some episodes of cardiac compromise may produce dizziness or even fainting spells (syncope). If dizziness or fainting has occurred, consider the possibility of a spinal injury from a fall. Assess and treat the patient as appropriate.

Assess the patient's breathing to determine if it is adequate to provide enough oxygen to an ailing heart. If the rate is too fast or too slow, the depth of respiration seems to be too shallow, or the patient is struggling to breathe, respirations are inadequate. Listen for abnormal breath sounds at this time because these can also be important indicators of respiratory distress. Some patients feel shortness of breath even though there are no obvious signs of respiratory distress. Pulse oximetry is a valuable tool in treatment of respiratory distress and should be applied at this time. If the patient is having chest pain and their oxygen saturation is less than 95%, administer oxygen at 4 L/min via a nasal cannula. If they do not improve quickly, increase the oxygen concentration. Apply a nonrebreathing mask at 15 L/min. In general, the goal is to maintain the oxygen saturation level between 95% and 99%. If the patient is not breathing or has inadequate breathing, ensure adequate ventilations with a bag-valve mask (BVM) and 100% oxygen.

Patients experiencing pulmonary edema may require positive-pressure ventilation with a BVM or CPAP. CPAP is the most effective way to assist a person with CHF to breathe effectively and prevent an invasive airway management technique. Be aware of the indications and contraindications of CPAP and be competent in utilizing this equipment.

After assessing airway and breathing, assess the patient's circulation. Determine the rate and quality of the patient's pulse. Is the pulse rhythm regular or irregular? Is the pulse too fast or too slow? If you find abnormalities in the pulse, you should be more suspicious. Assess the patient's skin condition, color, moisture, and temperature, as well as the capillary refill time. Changes in perfusion may indicate more serious cardiac compromise. Consider treatment for cardiogenic shock early to reduce the workload of the heart. Place the patient in a comfortable position, usually sitting up and well supported. Provide reassurance that appropriate treatment is being given for the condition to reduce the patient's anxiety.

Make a transport decision based on whether you were able to stabilize life threats during the primary assessment. The remainder of the assessment can be performed en route, if time allows. Generally speaking, most patients with chest pain should be transported immediately. Whether to transport using the lights and siren is determined for each specific patient and may be partially based on the estimated transport time. As a general rule, however, patients with cardiac problems should be transported in the most gentle, stress-relieving manner possible. You will save very little time using the lights and siren, but you can do a lot to calm your patient and reduce the release of heart-damaging adrenaline through your reassurance and by creating a ride to the hospital that is as pleasant as possible. Try not to allow the patient to exert himself or herself, strain, or walk. If necessary, lift the patient, using care.

Your decision of where to transport the patient will depend on your local protocol. Patients are generally transported to the closest appropriate facility. If your service is served by one hospital, the transport decision is easy. In larger urban areas, there may be several hospitals within the service areas. Some medical directors have written protocols requiring patients with suspected cardiac emergencies to be transported to cardiac specialty centers with certain capabilities, such as cardiac catheterization or targeted temperature management after resuscitation from cardiac arrest. Others require the patient to be transported to the nearest facility for stabilization before transporting to a specialty hospital. Be sure you know your local protocol.

Words of Wisdom

Athletes may have a slower (bradycardic or <60 beats/min) heart rate as a result of normal physiologic changes related to physical conditioning. Tachycardia (>100 beats/min) is a normal physiologic response to exercise to ensure adequate tissue perfusion. Pain, fear, and excitement may also cause a person to be tachycardic. It is important that you assess the patient to determine whether a bradycardic or tachycardic heart rate is appropriate for the patient.

History Taking

Once you have stabilized life threats, you will want to determine and investigate the chief complaint and know more about the history of the present illness. For a conscious medical patient, begin with taking a brief past history, identifying associated signs and symptoms, and identifying pertinent negatives. Friends or family members who are present often have helpful information.

Remember that not all patients experiencing an AMI have the same signs and symptoms. A chief complaint of chest pain or discomfort, shortness of breath, or dizziness should be taken seriously. Many patients who suspect that something is wrong experience restlessness, appear anxious, and perhaps have a sense of impending doom. Act professionally; be calm. Speak to the patient in a normal voice that is neither too loud nor too soft. Let the patient know that trained responders, including you, are present to provide care and that he or she will soon be taken to the hospital. Remember, some patients may act carefree, while others may be demanding. Most patients, however, are frightened. Your professional attitude may be the single most important factor in winning the patient's cooperation and helping the patient through this event. Patients often have a good idea about what is happening, so do not lie and offer false reassurance. If asked, "Am I having a heart attack?" you can say, "I do not know for sure, but in case you are, we are taking care of you. We are going to help you now by giving oxygen, and we will be taking you to the hospital. You are in good hands."

Begin by asking questions about the current situation. Determine whether the patient is experiencing chest pain or discomfort and whether there are any other signs and symptoms. Determine whether the patient is having respiratory difficulty because this is common among patients with chest pain. If the patient is experiencing dyspnea, find out whether it is related to exertion and whether it is related to the patient's position. Often patients with chest pain experience worse difficulty breathing when they are lying down. Also determine whether the dyspnea is continuous or if it changes, especially with deep breathing. Note whether the patient has a cough and whether the cough produces sputum. Ask about other signs and symptoms that are commonly found such as nausea and vomiting, fatigue, headache, and palpitations (a feeling of the heart skipping a beat or racing). Make sure to ask about any trauma the patient might have experienced during the last few days. Be sure to record your findings, including those that are negative (known as pertinent negatives).

If the patient is responsive, obtain the SAMPLE history and ask the following questions specific to a cardiovascular emergency:

- Have you ever had a heart attack?
- Have you been told that you have heart problems?
  - Have you ever been diagnosed with angina, heart failure, or heart valve disease?
  - Have you ever had high blood pressure?
  - Have you ever been diagnosed with an aneurysm?
  - Do you have any respiratory diseases such as emphysema or chronic bronchitis?
  - Do you have diabetes or have you ever had any problems with your blood sugar?
  - Have you ever had kidney disease?
- Do you have any risk factors for coronary artery disease, such as smoking, high blood pressure, or high-stress lifestyle?
  - Is there a family history of heart disease?
  - Do you currently take any medications?

The SAMPLE history provides basic information on the patient's overall medical history. You will want to determine as many signs and symptoms as you can. For example, you may determine that the patient has chest pain at rest or absence of chest pain with respirations or movement. The more signs and symptoms a patient has, the easier it is to identify a particular problem. In addition, ask whether the patient has had the same pain before. If so, ask "Do you take any medications for the pain?" and "Do you have any of the medication with you?" If the patient has had a heart attack or angina before, ask whether the pain is similar.

Make sure to ask about allergies because the patient will very likely be given medication in the hospital. If the patient is taking medications, determine whether they are prescribed, over the counter, and/ or recreational drugs. Even when a patient may not be able to articulate his or her exact medical condition, knowing the patient's medications may give you important clues. For example, a patient may say he has "heart problems." You see that he is taking furosemide (Lasix), digoxin, and metoprolol (Toprol). Furosemide is a diuretic, digoxin increases the strength of heart contractions, and metoprolol lowers blood pressure. These medications are often prescribed together for patients with CHF and may alert you to carefully evaluate the lungs for the presence of crackles (rales), which indicate fluid in the lungs and a need to increase the amount of oxygen being delivered. When you ask about medical conditions next, be sure to ask whether the patient takes medications for any other condition he or she identifies. Also, if the patient tells you that he or she takes prescription medications, ask what condition these are taken for. Asking about the last oral intake may seem unnecessary, but this information can be very important; it is always better to have too much information rather than not enough. Also remember to ask about any home remedies the patient might have used because this information can be important too.

YOU are the Provider — PART 2

The patient took two of her prescribed nitroglycerin tablets before her son called 9-1-1; however, she is still experiencing chest pain, which she rates as a 7 on a scale of 0 to 10. Your partner takes her vital signs as you perform a more focused examination, inquire about her past medical history, and prepare for further treatment.

Recording Time: 2 Minutes	
Respirations	20 breaths/min; adequate depth
Pulse	118 beats/min; strong and irregular
Skin	Pale, cool, and diaphoretic
Blood pressure	150/90 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)

7. What is significant about the patient's vital signs?
8. Should you give her additional nitroglycerin? Why or why not?

Be sure to include the OPQRST questions when you are obtaining the symptoms as part of the SAMPLE history. Using OPQRST helps you to understand the details of specific complaints, such as chest pain Table 16-2.

Secondary Assessment

Circumstances will dictate which aspects of the physical examination will be used. The secondary assessment of a conscious patient with chest pain or discomfort would likely focus on the patient's cardiac and respiratory systems.

The physical examination of a patient with chest pain begins with the cardiovascular system. Evaluate the patient's circulation by assessing pulses at various locations, and assess skin color, temperature, and condition. Is the skin cool or moist? How do the mucous membranes look? Are they pink, ashen, or cyanotic? Are the pulses of equal strength bilaterally? Does the patient have any edema in the extremities, especially the lower extremities? All of these physical findings can help identify poor circulation, which may be caused by a failure of the cardiovascular system.

In addition to the cardiovascular system, examine the respiratory system for signs of inadequate ventilation. These two systems are closely related, and cardiovascular issues can cause problems with the respiratory system. Are the lung sounds clear? Wetsounding lungs indicate fluid is being moved into the lungs from the circulatory system, possibly because of a problem with the heart. Are the breath sounds equal? Are the neck veins distended? Is the trachea deviated, or is it midline? The answers to these questions can help determine whether a problem exists with the lungs or with the heart. While the physical examination is not usually as important as the history in a patient with a possible cardiac problem, it may produce important clues to the patient's condition.

Measure and record the patient's vital signs, including pulse, respirations, and blood pressure. You must obtain readings for systolic and diastolic blood pressures. Take blood pressure on both arms if time allows. If available, use pulse oximetry. Pulse oximetry may not give an accurate measurement if the patient has poor circulation, has been exposed to a toxic chemical, or is in cardiac arrest, but it should be used and the readings noted for all patients with possible cardiac problems.

Table 16-2 OPQRST Mnemonic for Assessing Pain

Onset	When did the problem begin, and what does the patient think may have caused it?
Provocation/ palliation	Ask what makes the pain or discomfort better or worse. Is it positional? Does a deep breath or palpation of the chest make it worse? Did you take anything for it (including anything nonprescribed)?
Quality	Ask the patient to describe his or her pain. Let the patient use his or her own words to describe what is happening. If the patient is unable to describe the pain, try to avoid supplying only one option. Do not ask, "Does it feel like an elephant is sitting on your chest?" Instead, say, "Tell me what the pain feels like." If the patient cannot answer an open-ended question, then provide a list of alternatives: "There are lots of different kinds of pain. Is your pain more like heaviness, pressure, burning, tearing, dull ache, stabbing, or needlelike?"
Region/radiation	Ask where the pain is located and whether the pain has spread to another part of the body.
Severity	Ask the patient to rate the pain on a simple scale. Often, a scale ranging from 0 to 10 is used; a 10 represents the worst pain imaginable. Do not use the patient's answer to determine whether the pain has a serious cause. Instead, use it to check whether the pain is getting better or worse. After a few minutes of oxygen or administration of nitroglycerin, ask the patient to rate the pain again.
Timing	Find out how long the pain lasts when it is present and whether it has been intermittent or continuous.

If you have access to continuous blood pressure monitoring, be sure to use it as well, making sure you get an accurate manual blood pressure first. Repeat the vital signs at appropriate intervals, and use the settings on the automatic blood pressure monitoring machine to remind you when it is time to recheck and record the vital signs. Be sure to note the time that each set of vital signs is taken.

In patients with chest pain, it is very valuable to have a 12-lead ECG tracing from as early as possible after the onset of the pain. EMTs may assist with placing electrodes. This is discussed later in this chapter.

Reassessment

Repeat the primary assessment by checking to see whether the patient's chief complaint and condition have improved or are deteriorating. Vital signs should be reassessed at least every 5 minutes or any time significant changes in the patient's condition occur. It is essential to monitor the patient with a suspected AMI closely because sudden cardiac arrest is always a risk. If cardiac arrest occurs, you must be ready to begin automated defibrillation or chest compressions immediately. If an AED is immediately available, use it; if not, perform CPR until the AED is available, as discussed in the later section on cardiac arrest. Reassess your interventions to see whether they are helping and whether the patient's condition is improving. Reassessment will also determine whether further interventions are indicated or contraindicated.

Transport the patient. Early, prompt transport to the ED or specialty center is critical so that treatments such as clot-busting medications or angioplasty can be initiated. To be most effective, these treatments must be started as soon as possible after the onset of the attack. If the patient does not have prescribed nitroglycerin and you do not have permission from medical control to administer nitroglycerin, complete your patient assessment and prepare to transport. Be sure that this process does not consume too much time. Do not delay transport to assist with administration of nitroglycerin. The drug can be given en route.

Alert the ED staff about the status of your patient's condition and your estimated time of arrival. Follow the instructions of medical control. Describe the patient's condition to the ED staff on arrival.

It is important to document your assessment and treatment of the patient. All interventions should be initiated according to protocol. If the intervention required an order from medical control, document the intervention and/or medication requested and that prior approval was granted. It must be clear in your documentation that the patient was reassessed appropriately following any intervention. The patient's response to the intervention and the time of each intervention must also be recorded. On completing your documentation, obtain the medical control physician's signature (if required by local protocol) showing approval of medication administration.

Emergency Medical Care for Chest Pain or Discomfort

Your treatment of the patient begins with proper positioning. As mentioned before, some patients will not tolerate being positioned supine, so they should be allowed to sit up (leaning back on the stretcher). Also loosen tight clothing, trying to make the patient as comfortable as possible.

If it is indicated, you should be giving the patient oxygen by this time, but continually reassess the oxygen saturation and patient's respiratory status. For patients with mild dyspnea, a nasal cannula may be all that is needed, whereas patients with more serious respiratory difficulty may require a nonrebreathing mask. Remember to titrate the oxygen to obtain an oxygen saturation between 95% and 99%. A patient who is unconscious or in obvious respiratory distress may need assistance with breathing. Use a BVM or another positive-pressure ventilation device if available and if you have been approved to use it in your service. Alternatively, consider CPAP depending on local protocol. Be aware that ALS may be required to support the use of positive end-expiratory pressure, CPAP, bilevel positive airway pressure, and transport ventilators.

Depending on local protocol, prepare to administer low-dose (sometimes called baby or children's) aspirin and assist with prescribed nitroglycerin. Aspirin (acetylsalicylic acid) prevents clots from forming or getting bigger. Administer low-dose aspirin according to local protocol. Low-dose aspirin comes in 81-mg chewable tablets. The recommended dose is 162 mg (two tablets) to 324 mg (four tablets). Be sure you have verified that the patient is not allergic to aspirin before you give it, because many people are. Also, ask the patient if he or she has any history of internal bleeding such as stomach ulcers, and, if so, contact medical control before giving the patient aspirin.

Nitroglycerin may help to relieve the pain of angina. Nitroglycerin comes in several forms—as a small white tablet, placed sublingually (under the tongue); as a spray, also taken sublingually; and as a skin patch applied to the chest. In any form, the effect is the same. Nitroglycerin relaxes the muscle of blood vessel walls, dilates coronary arteries, increases blood flow and the supply of oxygen to the heart muscle, and decreases the workload of the heart. Nitroglycerin also dilates blood vessels in other parts of the body and can sometimes cause low blood pressure and/or a severe headache. Other side effects include changes in the patient's pulse rate, including tachycardia or bradycardia. You should therefore take the patient's blood pressure within 5 minutes after each dose. If the systolic blood pressure is less than 100 mm Hg, do not give more medication. Other contraindications include the presence of a head injury, use of erectile dysfunction drugs within the previous 24 to 48 hours, and the maximum prescribed dose of nitroglycerin has already been given (usually three doses). Drugs used for erectile dysfunction include sildenafil (Viagra), tadalafil (Cialis), avanafil (Stendra), and vardenafil (Levitra, Staxyn).

Administering Nitroglycerin

Check the condition of the medication and its expiration date, and do not administer contaminated or expired medications. Also make sure the medication is prescribed for your patient. Occasionally, patients will try to take medications prescribed for their spouse or a friend if they think it will help them. Be sure to wear gloves when handling nitroglycerin tablets or spray because it is easily absorbed through the skin. If you handle tablets with bare fingers or get the spray on your fingers, it may be absorbed into your body, causing you to experience a very painful headache. If the patient has on a nitroglycerin patch when you arrive, be sure to carefully remove it if the patient is hypotensive or in cardiac arrest (before use of AED).

After you obtain permission from medical control, if required, help the patient administer prescribed nitroglycerin. Nitroglycerin works in most patients within 5 minutes. Most patients who have been prescribed nitroglycerin carry a supply with them. Nitrostat is one trade name for nitroglycerin. Patients take one dose of nitroglycerin under the tongue whenever they have an episode of angina that does not immediately go away with rest. If the pain is still present after 5 minutes, patients are typically instructed by their physicians to take a second dose. If the second dose does not work, most patients are told to take a third dose and then call for EMS. If the patient has not taken all three doses, you can help to administer the medication, if you are allowed to do so by local protocol.

Be aware that nitroglycerin will lose its potency over time, especially if exposed to light. Patients who take it only rarely may keep a bottle in their pocket for months. It may lose its potency even before its expiration date. When the nitroglycerin tablet loses its potency, patients may not feel the fizzing sensation when the tablet is placed under their tongue, and they may not experience the normal burning sensation and headache that often accompany nitroglycerin administration. Note that the fizzing only occurs with a potent tablet, not with the spray form. To safely assist the patient with nitroglycerin, follow the steps listed in Skill Drill 16-1:

1. Obtain an order from medical control—online or through off-line protocol.

2. Take the patient's blood pressure. Administer nitroglycerin only if the systolic blood pressure is greater than 100 mm Hg **Step 1**.
3. Check that you have the right medication, the right patient, and the right delivery route. Check the expiration date. Make sure the patient has no contraindications, such as having taken medication for erectile dysfunction in the past 24 hours.
4. Ask the patient about the last dose he or she took and its effects. Make sure that the patient understands the route of administration. Be prepared to have the patient lie down to prevent fainting if the nitroglycerin substantially lowers the patient's blood pressure (the patient gets dizzy or feels faint) **Step 2**.
5. Ask the patient to lift his or her tongue. Place the tablet or spray the dose under the tongue (while wearing gloves), or have the patient do so. Have the patient lower the tongue and keep his or her mouth closed with the tablet or spray under the tongue until it is dissolved and absorbed. Caution the patient against chewing or swallowing the tablet **Step 3**.
6. Recheck the blood pressure within 5 minutes. Record the medication and the time of administration. Reevaluate the chest pain, and note the response to the medication. If the chest pain persists and the patient still has a systolic blood pressure greater than 100 mm Hg, repeat the dose every 5 minutes as authorized by medical control. In general, a maximum of three doses of nitroglycerin is given for any one episode of chest pain **Step 4**.

Skill Drill 16-1 Administration of Nitroglycerin

Step 1

Obtain an order from medical control. Take the patient's blood pressure. Administer nitroglycerin only if the systolic blood pressure is greater than 100 mm Hg.

Step 2

Check the medication and expiration date. Ask the patient about the last dose he or she took and its effects. Make sure that the patient understands the route of administration. Prepare to have the patient lie down to prevent fainting.

Step 3

Ask the patient to lift his or her tongue. Place the tablet or spray the dose under the tongue (while wearing gloves), or have the patient do so. Have the patient keep his or her mouth closed with the tablet or spray under the tongue until it is dissolved and absorbed. Caution the patient against chewing or swallowing the tablet.

Step 4

Recheck the blood pressure within 5 minutes. Record each medication and the time of administration. Reevaluate the chest pain and blood pressure, and repeat treatment if necessary.

Cardiac Monitoring

Some EMS systems will allow EMTs to place electrodes, attach the leads, and obtain an electrocardiogram (ECG) tracing prior to transport. If your service allows you to perform this skill, the following information will guide you.

For an ECG to be reliable and useful, the electrodes must be placed in consistent positions on each patient. Figure 16-10

shows placement of limb lead electrodes, which are used to obtain a 3-lead ECG. **Figure 16-11** shows placement of limb lead electrodes and 12-lead ECG electrodes, both of which are used when obtaining a 12-lead ECG. To maintain consistency in monitoring and obtaining a useful ECG, there are predetermined locations for each electrode. Electrodes used in the prehospital setting are generally adhesive and have a gel center to aid in skin contact. Whichever type is used, certain basic principles should be followed to achieve the best skin contact and minimize **artifact** in the signal. Artifact refers to an ECG tracing that is the result of interference, such as patient movement, rather than the heart's electrical activity. Guiding principles are as follows:

- To maintain the correct lead placement, it may occasionally be necessary to shave body hair from the electrode site. Do not be fooled by a hairy chest. It may initially appear that you have good skin contact, but the electrode will rise off the skin and stick to the hair. If you must shave the site, be very careful to avoid nicking the skin. If one is available, it is best to use an electric razor to remove hair, because single-blade manual razors irritate the skin and can easily cut a patient.
- To remove oils and dead tissues from the surface of the skin, rub the electrode site briskly with an alcohol swab before application. Wait for the alcohol to dry before applying electrodes or dry it with a quick wipe of a 4-inch × 4-inch gauze pad. This step may have to be repeated if the patient is very sweaty as many cardiac patients are.
- Attach the electrodes to the ECG cables before placement. Confirm that the appropriate electrode now attached to the cable is placed at the correct location on the patient's chest or limbs (each cable is marked and color coded as to the correct location for placement).
- Once all electrodes are in place, switch on the monitor, and print a sample rhythm strip.

If the strip shows any interference (artifact), verify that the electrodes are firmly applied to the skin and the monitor cable is plugged in correctly.

Artifact on the monitor can be tricky. Patient movement, including deep breathing or muscle tremor, may cause a wavy baseline or small up-and-down squiggles on the baseline. These will prevent the ECG from being usable. Make sure that the patient is supine if possible or in the semi-Fowler position if he or she is having difficulty breathing. Also make sure that the patient's arms are relaxed by his or her side and his or her feet are uncrossed.

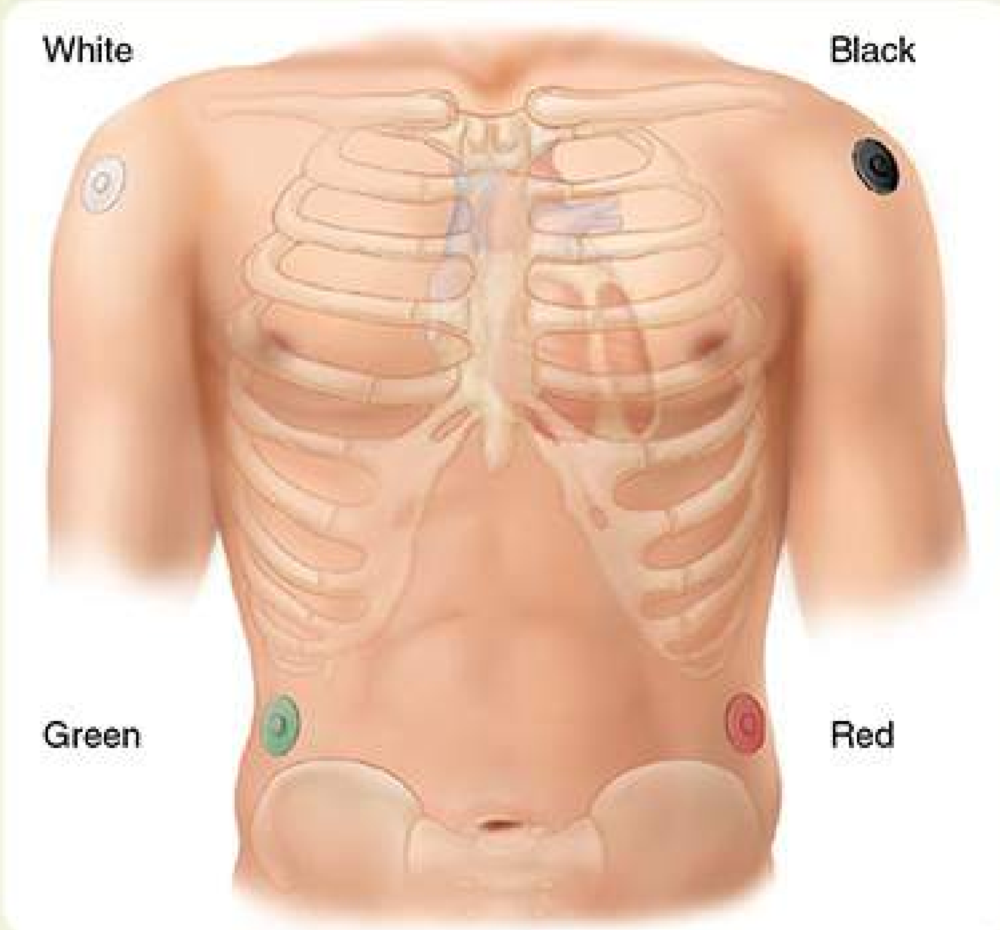
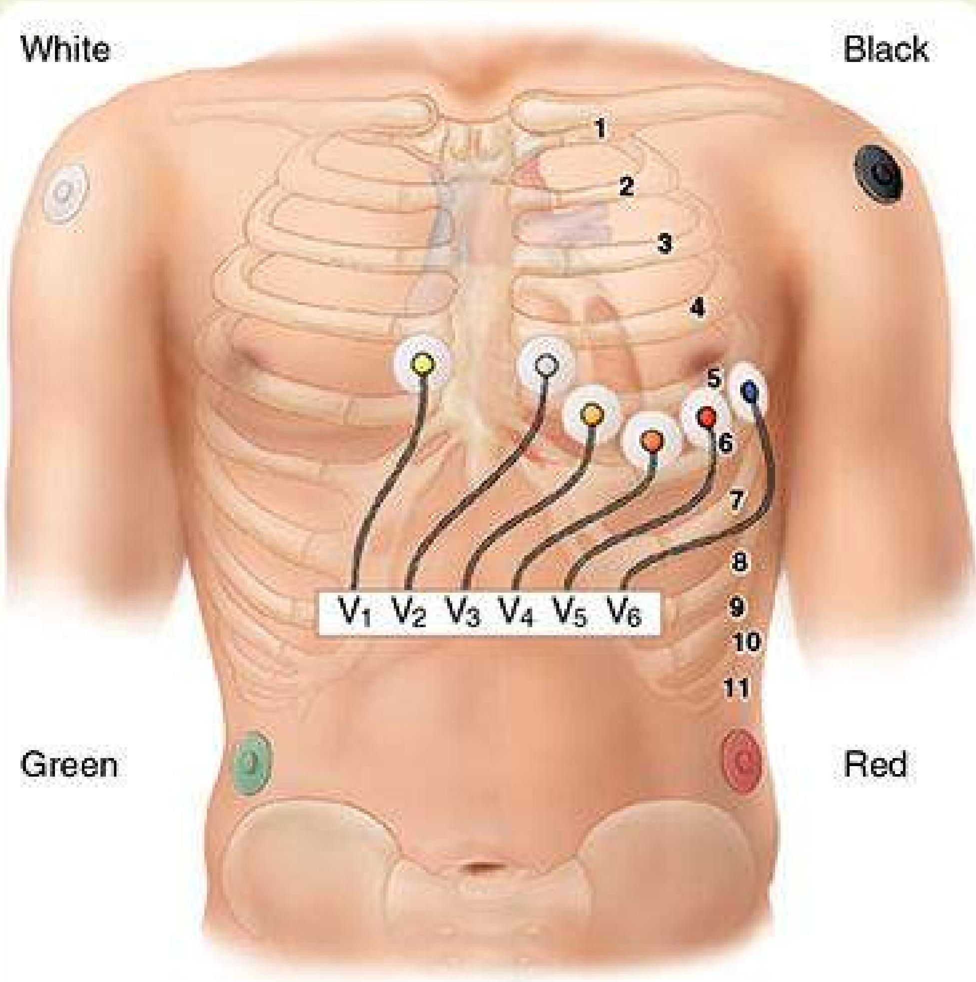


Figure 16-10 Limb electrode placement for cardiac monitoring.



Lead	Location	View
V_1	4th intercostal space, right sternal border	Ventricular septum
V_2	4th intercostal space, left sternal border	Ventricular septum
V_3	Between V_2 and V_4	Anterior wall of left ventricle
V_4	5th intercostal space, midclavicular line	Anterior wall of left ventricle
V_5	Lateral to V_4 at the anterior axillary line	Lateral wall of left ventricle
V_6	Lateral to V_5 at the midaxillary line	Lateral wall of left ventricle

Figure 16-11 12-lead ECG electrode placement.

Skill Drill 16-2 shows the steps for performing cardiac monitoring:

1. Take standard precautions **Step 1**.
2. Explain the procedure to the patient. Prepare the skin for electrode placement **Step 2**.
3. Attach the electrodes to the leads before placing them on the patient **Step 3**.
4. Position the limb electrodes on the patient, on the torso if performing continuous monitoring, on the limbs if you will be acquiring a 12-lead ECG. The RA electrode goes on the right arm distal to the shoulder or on the wrist (avoid placing it directly over a bone). The LA electrode goes on the left arm at the same location as you placed the RA electrode on the right arm. The LL electrode is placed on the left leg on the thigh or ankle, although if you do not plan to obtain a 12-lead ECG tracing, this electrode is often placed on the lower left side of the abdomen (slightly lower

than an AED pad would be placed). Place the RL electrode at the same location on the right side of the body as the LL electrode on the left **Step 4**.

5. If you plan to obtain a 12-lead ECG tracing, place the chest leads on the chest as shown. The V_1 electrode is placed on the right side of the sternum between the fourth and fifth ribs. The V_2 electrode is placed on the left side of the sternum directly across from V_1. The V_4 is placed next, between the fifth and sixth ribs in a straight line down from the middle of the clavicle. The V_3 is then placed halfway between V_2 and V_4. The V_6 is placed next and is located horizontally even with V_4 in a straight line down from the middle of the armpit. Finally, V_5 is placed halfway between V_4 and V_6 **Step 5**.
6. Turn on the monitor **Step 6**.
7. Record tracings. As soon as a rhythm is visible on the screen, press the print button on the monitor and print a strip while counting slowly to six or seven. Then press the print button again to stop the printout. If the time is not printed correctly on the strip, write it on the edge of the strip. If you are obtaining a 12-lead ECG tracing, ask the patient to hold his or her breath or to take very shallow breaths. Press the 12-lead button and wait for the machine to acquire, analyze, and print or transmit the 12-lead ECG tracing. Gently tear off the tracing when the printer automatically stops **Step 7**.
8. Label each strip **Step 8**.

Skill Drill 16-2 Performing Cardiac Monitoring

Step 1

Take standard precautions.

Step 2

Explain the procedure to the patient. Prepare the skin for electrode placement.

Step 3

Attach the electrodes to the leads before placing them on the patient.

Step 4

Position the limb electrodes on the patient. Place the leads on the torso if performing continuous monitoring, on the limbs if you will be acquiring a 12-lead ECG.

Step 5

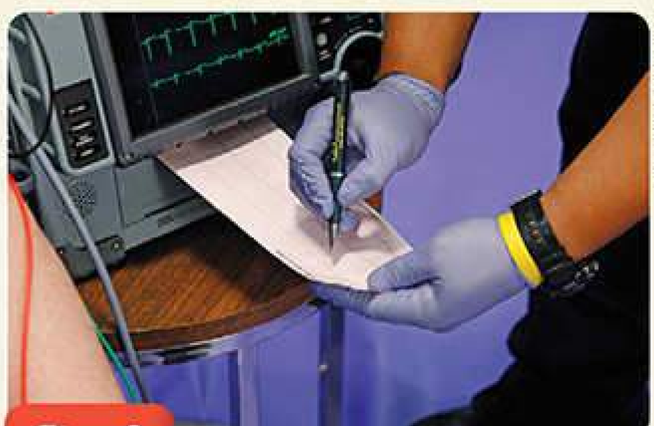
If you plan to obtain a 12-lead ECG tracing, place the chest leads on the chest.

Step 6

Turn on the monitor.

Step 7

Record tracings.



Step 8

Label each strip.

Heart Surgeries and Cardiac Assistive Devices

During the last 30 years, hundreds of thousands of open-heart surgeries have been performed to bypass damaged segments of coronary arteries in the heart. In a coronary artery bypass graft, a blood vessel from the chest or leg is sewn directly from the aorta to a coronary artery beyond the point of the obstruction. Another procedure is the percutaneous transluminal coronary angioplasty, which aims to dilate, rather than bypass, the coronary artery. In this procedure, usually called an angioplasty or balloon angioplasty, a tiny balloon is attached to the end of a long, thin tube. The tube is introduced through the skin into a large artery, usually in the groin, and then threaded into the narrowed coronary artery, with radiographs serving as a guide. Once the balloon is in position inside the coronary artery, it is inflated. The balloon is then deflated, and the tube is removed from the body. Sometimes, a metal mesh cylinder called a stent is placed inside the artery instead of or after the balloon. The stent is left in place permanently to help keep the artery from narrowing again.

A patient who has had an AMI or angina in the past will possibly have had one of these procedures. Patients who have had a bypass graft will have a long surgical scar on the chest from the operation. Patients who have had an angioplasty or a coronary artery stent usually will not. However, newer "keyhole" surgical techniques for bypass surgery may not produce a large scar. You should not assume that a patient who has a small scar has not had bypass surgery. Chest pain in a patient who has had any of these procedures should be treated in the same manner as chest pain in patients who have not had any heart surgery. Carry out all the described tasks, and transport the patient promptly to the ED of the hospital. If CPR is required, perform it in the usual way, regardless of the scar on the patient's chest. Likewise, if indicated, an AED should be used as well.

In the United States many people with heart disease have cardiac pacemakers to maintain a regular cardiac rhythm and rate. Pacemakers are inserted when the electrical control system of the heart is so damaged that it cannot function properly. These battery-powered devices deliver an electrical impulse through wires that are in direct contact with the myocardium. The generating unit is generally placed under a heavy muscle or a fold of skin. It typically resembles a small silver dollar under the skin in the left upper portion of the chest **Figure 16-12**.

Figure 16-12 A pacemaker, which is typically inserted under the skin in the left upper portion of the chest, delivers an electrical impulse to regulate the heartbeat.

Normally, you do not need to be concerned about problems with pacemakers. Thanks to modern technology, an implanted unit will not require replacement for years. Wires are well protected and rarely broken. In the past, pacemakers sometimes malfunctioned when a patient got too close to an electrical radiation source, such as a microwave oven. This is no longer the case; however, patients with pacemakers should avoid exposure to strong magnets. Every patient with a pacemaker should be aware of the precautions, if any, that must be taken to maintain its proper functioning.

If a pacemaker does not function properly, as when the battery wears out, the patient may experience syncope, dizziness, or weakness because of an excessively slow heart rate. The pulse ordinarily will be less than 60 beats/min because the heart is beating without the stimulus of the pacemaker and without the regulation of its own electrical system, which may be damaged. In these circumstances, the heart tends to assume a fixed slow rate that is not fast enough to allow the patient to function normally. A patient with a malfunctioning pacemaker should be promptly transported to the ED; repair of the problem may require surgery. When an AED is used, the patches should not be placed directly over the pacemaker. This will ensure a better flow of electricity through the patient’s body.

â–¶ Automatic Implantable Cardiac Defibrillators

More and more patients who survive cardiac arrest due to ventricular fibrillation have a small automatic implantable cardiac defibrillator implanted **Figure 16-13**. Some patients who are at particularly high risk for a cardiac arrest have them as well. These devices are attached directly to the heart and can prolong the lives of certain patients. They continuously monitor the heart rhythm, delivering shocks as needed. Regardless of whether a patient having an AMI has an automatic implantable cardiac defibrillator, he or she should be treated like all other patients having an AMI. Treatment should include performing CPR and using an AED if the patient goes into cardiac arrest. Generally, the electricity from an automatic implantable cardiac defibrillator is so low that it will not have an effect on rescuers and, therefore, should not be of concern to you.

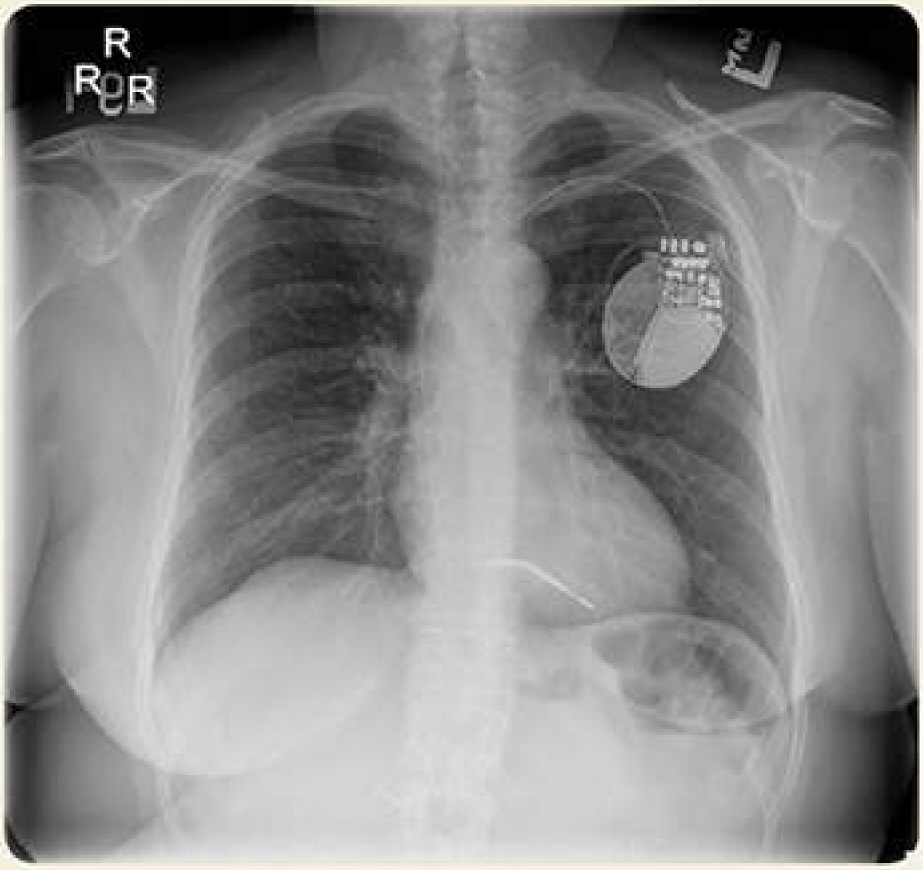


Figure 16-13 An automatic implantable cardiac defibrillator is attached directly to the heart and continuously monitors heart rhythm, delivering shocks as needed. The electricity from the defibrillator is so low that it has no effect on rescuers.

External Defibrillator Vest

An alternative to the implantable cardiac defibrillator is the external defibrillator vest. This device is a vest with built-in monitoring electrodes and defibrillation pads, which is worn by the patient under his or her clothing. The vest is attached to a monitor worn on a belt or hung from a shoulder strap. The monitor provides alerts and voice prompts when it recognizes a dangerous rhythm and before a shock is delivered. Unlike the implantable defibrillator, this device uses high-energy shocks similar to an AED, so you should avoid contact with the patient if the device warns that it is about to deliver a shock. Blue gel under the large defibrillation pads indicates that the device has already delivered at least one shock.

If the patient is in cardiac arrest, the vest should remain in place while CPR is being performed unless it interferes with compressions. If it is necessary to remove the vest, simply remove the battery from the monitor and then remove the vest. You can then use your own AED on the patient. Any patient who is wearing a device that has already delivered a shock should be transported to the hospital for further evaluation.

Left Ventricular Assist Devices

Left ventricular assist devices (LVADs) are used to enhance the pumping of the left ventricle in patients with severe heart failure or in patients who need a temporary boost due to an MI. There are several types of LVADs; the most common ones have an internal pump unit and an external battery pack. These pumps may be pulsatile, meaning they pump the blood in pulsations just like the natural heart, or they may be continuous, in which case the patient will not have any palpable pulses. If you encounter a patient with a LVAD, he or she (or his or her family members) may be able to tell you about the unit. Unless it malfunctions you should not need to deal with it. If you are unsure of what to do, contact medical control for assistance. Also, LVADs provide a number to call for assistance. Transport all LVAD supplies and battery packs to the hospital with the patient.

Cardiac Arrest

Cardiac arrest is the complete cessation of cardiac activity—electrical, mechanical, or both. It is indicated in the field by the absence of a carotid pulse. Until the advent of CPR and external defibrillation in the 1960s, cardiac arrest was virtually always a terminal event. Although it is still infrequent for a patient to survive a cardiac arrest without neurologic damage, great strides have been made in resuscitation science during the last 50 years.

When you arrive to find a patient who appears to be in cardiac arrest, you should automatically follow your CPR training. CPR is covered in Chapter 13, *BLS Resuscitation*.

Automated External Defibrillation

In the late 1970s and early 1980s, scientists developed a small computer that could analyze electrical signals from the heart and determine when ventricular fibrillation was taking place. This development, along with improved battery technology, made the automated portable defibrillator—a device that can automatically administer an electrical shock to the heart when needed—possible.

AED machines come in different models with different features **Figure 16-14**. All of them require a certain degree of operator interaction, beginning with turning on the machine and applying the pads. The operator also has to push a button to deliver an electrical shock, regardless of the model. Many AEDs use a computer voice synthesizer to advise the operator which steps to take on the basis of the AED's analysis. Some have a button that tells the computer to analyze the heart's electrical rhythm; other models start doing this as soon as they are turned on. Even though most defibrillators are now semiautomated, we still use the term automated external defibrillator (AED) to describe all of these machines. There are few fully automatic AEDs (which would deliver a shock without the operator pressing a button) left. All manufacturers are now producing only semiautomated external defibrillators.

Figure 16-14 Automated external defibrillators vary in their design, features, and operation.

A: Photographee.eu/Shutterstock; B: Jones & Bartlett Learning.

AEDs deliver electrical energy from one pad to the other (and then back to the first pad) to electrically stun the heart and allow it to resume normal function. The amount of electricity delivered by the machine varies among the manufacturers but each one has shown that the energy they deliver is adequate to defibrillate the heart. The factors involved in the defibrillation include voltage, current, and impedance. Most AEDs are set up to adjust the voltage based on the impedance (or resistance of the body to the flow of electricity) to deliver the proper amount of current, which is what actually causes the cells to defibrillate.

Special Populations

A pediatric patient with chest pain is not a common call. It is usually associated with a child who has a preexisting heart condition, usually congenital (present since birth). In pediatric situations, it is vital to see family members or caregivers as a valuable source of information.

Cardiac arrest in infants and children is usually the result of respiratory failure, not a primary cardiac event. However, the American Heart Association has determined that AEDs are safe to use in infants and children. If the patient is age 8 or less, pediatric-sized pads and a dose-attenuating system (energy reducer) are preferred. However, if these are unavailable, a regular adult AED can be used. If the child is between 1 month and 1 year of age (an infant), a manual defibrillator is preferred to an AED. If a manual defibrillator is not available, an AED equipped with a pediatric dose attenuator is preferred. If neither is available, an AED without a pediatric dose attenuator may be used.

The computer inside the AED is specially programmed to recognize rhythms that require defibrillation to correct, most commonly ventricular fibrillation. AEDs are extremely accurate. It would be rare for an AED to recommend a shock when a shock is not required, and an AED rarely fails to recommend one when it would be helpful. Therefore, if the AED recommends a shock, you can believe that it is indicated.

Automated external defibrillation offers a number of advantages. First, the machine is fast, and it delivers the most important treatment for a patient in ventricular fibrillation: an electrical shock. It can be delivered within 1 minute of your arrival at the patient's side. Second, AEDs are easy to operate. ALS providers do not have to be on the scene to provide this definitive care.

Current AEDs offer two other advantages. The shock can be given through remote, adhesive defibrillator pads, which are safe to use. Also, the pad area is larger than manual paddles, which means that the transmission of electricity is more efficient. Usually, there are pictures on the pads to remind you where they go on the patient's chest. As a safety measure, make sure the patient is not lying on wet ground or touching metal objects when he or she is being shocked.

Not all patients in cardiac arrest require an electrical shock. Although the cardiac rhythm of all patients in cardiac arrest should be analyzed with an AED, some do not have shockable rhythms (eg, pulseless electrical activity and asystole). Asystole (flatline) indicates that no electrical activity remains. Pulseless electrical activity refers to a state of cardiac arrest that exists despite an organized electrical complex. In both cases, CPR should be initiated as soon as possible beginning with chest compressions.

Rationale for Early Defibrillation

Few patients who experience sudden cardiac arrest outside a hospital survive unless a rapid sequence of events takes place. The chain of survival is a way of describing the ideal sequence of events that can take place when such an arrest occurs.

The five links in the chain of survival are as follows **Figure 16-15**:

- Recognition of early warning signs and immediate activation of EMS
- Immediate CPR with emphasis on high-quality chest compressions
- Rapid defibrillation

Figure 16-15 The five links of the chain of survival.

YOU are the Provider PART 4

After completing the remainder of your assessment and initial treatment, you place the patient onto the stretcher, load her into the ambulance, and proceed to a hospital located 20 miles away. You ask your partner to notify the hospital to alert the staff as you reassess the patient.

Recording Time: 10 Minutes	
Level of consciousness	Conscious and alert; still anxious
Respirations	18 breaths/min; adequate depth
Pulse	84 beats/min; strong and irregular
Skin	Pale and cool; less diaphoretic
Blood pressure	136/84 mm Hg
Spo_2	96% (on oxygen)

9. Why is early notification of the receiving facility so important for patients with an acute coronary event?
10. Should you apply the AED to determine if she is experiencing a cardiac dysrhythmia? Why or why not?

- Basic and advanced EMS
- ALS and postarrest care

If any one of the links in the chain is absent, the patient is more likely to die. For example, few patients benefit from defibrillation when more than 10 minutes elapse before administration of the first shock or if CPR is not performed in the first 2 to 3 minutes. If all links in the chain are strong, the patient has the best possible chance of survival. The link that is the most common determinant for survival is the third link—rapid defibrillation. This link and those for immediate high-quality CPR and basic and advanced EMS are where EMTs are most involved.

CPR helps patients in cardiac arrest because it prolongs the period during which defibrillation can be effective. Rapid defibrillation has successfully resuscitated many patients with cardiac arrest due to ventricular fibrillation. However, defibrillation works best if it takes place within 2 minutes of the onset of the cardiac arrest. To try to achieve better survival rates among cardiac arrest victims, many communities are exploring the idea that nontraditional first responders should be trained to administer rapid defibrillation. These responders would include police officers, security personnel, lifeguards, maintenance workers, and flight attendants. As an EMT, you should support these efforts to shorten the interval until defibrillation. Remember, seconds really matter when a patient is in cardiac arrest.

The final step in the chain of survival is ALS and postarrest care. This refers to continuing ventilation at less than 12 breaths/min to achieve an $ETCO_2$ of 35 to 40 mm Hg; maintaining oxygen saturation between 94% and 99%; assuring blood pressure is above 90 mm Hg; and maintaining glucose levels in the patient who is hypoglycemic. It also includes cardiopulmonary and neurologic support at the hospital as well as other advanced assessment techniques and interventions when indicated.

Integrating the Automated External Defibrillator and Cardiopulmonary Resuscitation

Because most cardiac arrests occur in the home, a bystander at the scene may already have started CPR before you arrive. For this reason, you must know how to work the AED into the CPR sequence. Remember that the AED is not very complex, but it may not be able to distinguish other movements from ventricular fibrillation. To avoid this problem, apply the AED only to pulseless, unresponsive patients and stay clear of the patient (do not touch the patient) while the AED is analyzing the heart rhythm and delivering shocks. Stop CPR, and let the AED do its job.

Automated External Defibrillator Maintenance

One of your primary missions as an EMT is to deliver an electrical shock to a patient in ventricular fibrillation. To accomplish this mission, you need to have a functioning AED. You must become familiar with the maintenance procedures required for the brand of AED your system uses. Read the operator's manual. If your defibrillator does not work on the scene, someone will want to know what went wrong. That person may be your system's administrator, your medical director, the local newspaper reporter, or the family's attorney. You will be asked to show proof that you maintained the defibrillator properly and attended any mandatory in-service sessions.

The main legal risk in using the AED is failing to deliver a shock when one was needed. The three most common errors in using certain AEDs are failure of the machine to shock fine V fib; applying the AED to a patient who is moving, squirming, or being transported; and turning off the AED before analysis or shock is complete. Operator errors include failing to apply the AED to a patient in cardiac arrest, not pushing the analyze or shock buttons when the machine advises you to do so, or pushing the power button instead of pushing the shock button when a shock is advised. Like any other manufactured item, the AED can fail, although this is rare. Ideally, you will encounter any such failure while doing routine maintenance, not while caring for a patient in cardiac arrest.

Another reason includes failure due to a battery that did not work, usually because it was not properly maintained. To avoid a battery that is not charged, many defibrillator companies have built smarter machines that will warn the operator that the battery is unlikely to work. However, some of the older models do not have this feature. Check your equipment, including your AED, daily at the beginning of each shift and exercise the battery as often as the manufacturer recommends. Ask the manufacturer for a checklist of items that should be checked daily, weekly, or less often **Figure 16-16**.

An error can also occur when the AED is applied to a responsive patient with a rapid heart rate. Most AEDs identify a regular rhythm faster than 150 or 180 beats/min as ventricular tachycardia, which should be shocked. Sometimes, however, a patient has another heart rhythm that should not be shocked but that is fast enough to confuse the computer. Again, to avoid this problem, you should apply the AED only to unresponsive patients with no pulse.

AUTOMATED EXTERNAL DEFIBRILLATOR
Inspection Checklist

Serial # ______________________ **Date** ______________________ **Time** ______________

Model # ______________________ **Inspected by** ______________________________________

Item	**Pass**	**Fail**
Exterior/Cables		
Nothing stored on top of unit		
Carry case intact and clean		
Exterior/LCD/cables connectors clean and undamaged		
Cables securely attached to unit		
Batteries		
All chargers plugged in and operational (if applicable)		
All batteries fully charged (battery in unit, spare battery)		
Valid expiration date on both batteries		
Supplies		
Two sets of electrodes in sealed packages with valid expiration dates		
Razor		
Hand towel		
Alcohol wipes		
Memory/voice recording device—module, card, microcassette		
Manual override—module, key (if applicable)		
Printer paper (if applicable)		
Operation		
Unit self-test per manufacturer's recommendation/instructions		
Display (if applicable)		
Visual indicators		
Verbal prompts		
Printer (if applicable)		
Attach AED to simulator/tester		
Recognizes shockable rhythm		
Charges to correct energy level within manufacturer's specifications		
Delivers charge		
Recognizes nonshockable rhythm		
Manual override system in working order (if applicable)		

Signature:

Figure 16-16 A sample checklist for the automated external defibrillator (AED).

Special Populations

Like the other body systems, the cardiovascular system undergoes changes as we get older. The heart, like other major organs, will show the effects of aging. As the heart's muscle mass and tone decrease, the amount of blood pumped out of the heart per beat decreases. The residual (reserve) capacity of the heart is also reduced; therefore, when the vital organs of the body need additional blood flow, the heart cannot meet the need. When blood flow to the tissues is decreased, the organs suffer. If blood flow to the brain is inadequate, the patient may report weakness, fatigue, or dizziness and may experience syncope (fainting).

The heart muscle is stimulated by electricity and has its own electrical system. Under normal conditions, electrical impulses travel throughout the heart, resulting in the contraction of the heart muscle and the pumping of blood from the heart's chambers. With aging, the electrical system can deteriorate, causing the heart's contraction to weaken or, if blood flow to the heart muscle is affected, extra beats to form. With decreased strength of contraction, the heartbeat is weaker and blood flow to the tissues is reduced. If extra beats are produced, the patient's heart rhythm will be irregular. Although some irregular heart rhythms are not harmful, others can be lethal.

The arteries are also affected by aging. Arteriosclerosis (hardening of the arteries) can develop, affecting perfusion of the tissues. There is an increased chance of heart attack or stroke due to decreased blood flow or plaque formation (atherosclerosis) in the narrowed arteries.

Patients with diabetes can experience reduced circulation to the hands and feet, which makes peripheral pulses harder to detect. It also puts the hands and feet at particular risk for infection and ulceration.

In some older patients with angina or AMI, particularly people with diabetes, chest pain is absent, and the clinical picture can be confused with other, noncardiac conditions. These patients may present with a chief complaint of syncope (fainting), fatigue, or shortness of breath.

The cardiovascular system is affected by aging. You should be aware of the changes, seeking to determine what is normal versus what is chronic versus what is an acute condition for the individual patient. Sometimes, the weakening of the heart muscle, the deterioration of its electrical system, and the hardening of the arteries make the task of assessing and caring for older patients more difficult.

If the AED fails while you are caring for a patient, you must report the problem to the manufacturer and the US Food and Drug Administration. Be sure to follow the appropriate EMS procedures for notifying these organizations.

Medical Direction

Defibrillation of the heart is a medical procedure. Although AEDs have made the process of delivering electricity much simpler, there is still a benefit in having a physician's involvement. The medical director of your service should approve the written protocol that you will follow in caring for patients in cardiac arrest.

There should be a review of each incident in which the AED is used. After returning from the hospital or the scene, discuss with the rest of the team what happened. This discussion will help all members of the team learn from the incident. Review such events by using the written report and the device's recordings, if applicable.

There should also be a review of the incident by your service's medical director or quality improvement officer. Quality improvement involves people using AEDs and the responsible EMS system managers. This review should focus on speed of defibrillation, that is, the time from the call to the shock. Few systems will achieve the ultimate goal: shocking 100% of patients within 1 minute of the call. However, all systems continuously work on improving patient care. Mandatory continuing education with skill competency review is generally required for EMS providers.

Emergency Medical Care for Cardiac Arrest

Preparation

When dispatch reports an unresponsive patient with CPR being performed, the AED is probably one of the first pieces of equipment you will obtain from the ambulance. As the operator of the AED, you are responsible for making sure the electricity does not injure anyone, including yourself. Remote defibrillation using pads allows you to distance yourself safely from the patient. As long as you place the pads in the correct position and make sure no one is touching the patient, you should be safe. Do not defibrillate a patient who is in pooled water. Although there is some danger to you if you are also in the water, there is another problem. Electricity follows the path of least resistance; instead of traveling between the pads and through the patient's heart, it will diffuse into the water. Therefore, the heart will not receive enough electricity to cause defibrillation. You can defibrillate a soaking wet patient, but try first to dry the patient's chest. Do not defibrillate someone who is touching metal that others are touching, and carefully remove a nitroglycerin patch from a patient's chest and wipe the area with a dry towel before defibrillation to prevent ignition of the patch. It is often helpful to shave a hairy patient's chest before pad placement to increase conductivity. Be sure to consult local protocols for issues such as pad placement and preparation of the pad site.

Determine the nature of illness and/or mechanism of injury. If the incident involves trauma, consider spinal immobilization as you begin the primary assessment. Is there only one patient? If you are in a tiered system and the patient is in cardiac arrest, call for ALS assistance. If you suspect that the patient may be in cardiac arrest, discuss who will perform which resuscitation responsibilities prior to arrival on the scene. Preparation tasks should be done concurrently, so that time to defibrillation is minimized. For example, one provider begins compressions while another prepares for ventilation and another prepares the AED. Working as a well-organized team will improve the chances for a successful resuscitation.

Performing Defibrillation

If you witness a patient's cardiac arrest, begin CPR starting with chest compressions and attach the AED as soon as it is available. As soon as the AED is turned on and attached, follow the instructions to analyze and deliver shocks to the patient. Make sure to minimize the time when you are not performing chest compressions; research has shown the best survival rates for patients in whom compressions were interrupted for the least amount of time. At each defibrillation, the person performing compressions should switch places with the person providing ventilations so that neither gets overtired. Immediately after each defibrillation, resume CPR with compressions first. The steps for using the AED are listed here and shown in **Skill Drill 16-3**:

1. If bystander CPR is in progress, assess the effectiveness of chest compressions by palpating for a carotid or femoral pulse. If compressions are effective, you should be able to feel a pulse. If you do, leave your fingers in that position and stop compressions. If you lose the pulse when compressions stop, immediately resume compressions. It is important to limit the amount of time compressions are interrupted. If the patient is responsive, do not apply the AED.
2. If the patient is unresponsive and CPR has not been started yet, begin providing chest compressions and rescue breaths at a ratio of 30 compressions to 2 breaths and a rate of 100 to 120 compressions per minute, continuing until an AED arrives and is ready for use **Step 1**. It is important to start chest compressions and use the AED as soon as possible. Compressions provide vital blood flow to the heart and brain, improving the patient's chance of survival. High quality compressions (ie, performed at the appropriate rate and depth, with no leaning on the chest during recoil, and interruptions minimized) provide the best cardiac output.
3. Turn on the AED **Step 2**. Remove clothing from the patient's chest area. Apply the pads to the chest: one just to the right of the breastbone (sternum) just below the collarbone (clavicle), the other on the left lower chest area with the top of the pad 2 inches to 3 inches below the armpit. Do not place the pads on top of breast tissue in women. If necessary, move the breast out of the way with the back of your hand and place the pad underneath. Ensure that the pads are attached to the patient cables (and that they are attached to the AED in some models). Plug in the pads connector to the AED.
4. Stop CPR when the AED instructs you to.
5. State aloud, "Clear the patient," and ensure that no one is touching the patient.
6. Push the Analyze button, if there is one, and wait for the AED to determine whether a shockable rhythm is present. If a shock is advised, perform chest compressions while the AED is charging.
7. If a shock is not advised, perform five cycles (about 2 minutes) of CPR, beginning with chest compressions, and then reanalyze the cardiac rhythm. If a shock is advised, reconfirm that no one is touching the patient and push the Shock button. If at any time the AED advises to check the patient, quickly assess for a carotid or femoral pulse. This should not take longer than 5 to 10 seconds. If you feel a pulse, the patient has experienced **return of spontaneous circulation (ROSC)**. ROSC is defined as the return of a pulse and effective blood flow to the body in a patient who previously was in cardiac arrest. Continue to monitor the patient.
8. After the shock is delivered, immediately resume CPR, beginning with chest compressions. Remember to change to a different person for chest compressions each time CPR is paused to prevent rescuer fatigue **Step 3**.
9. After five cycles (about 2 minutes) of CPR, reanalyze the patient's cardiac rhythm **Step 4**. Do not interrupt chest compressions for more than 10 seconds.
10. If the AED advises a shock, clear the patient, push the Shock button, and immediately resume CPR compressions. If no shock is advised, immediately resume CPR, beginning with chest compressions and remembering to change the person providing compressions.
11. Gather additional information about the arrest event.
12. After five cycles (2 minutes) of CPR, reassess the patient.
13. Repeat the cycle of 2 minutes of CPR, one shock (if indicated), and 2 minutes of CPR.
14. Transport, and contact medical control as needed **Step 5**.

If the AED advises no shock and the patient has a pulse, check the patient's breathing. If the patient is breathing adequately, give oxygen via nonrebreathing mask, adjusting the flow as soon as pulse oximetry gives a reading, and transport. If the patient is not breathing adequately, provide artificial ventilation with a BVM or pocket mask device attached to 100% oxygen and transport. Ensure that proper airway techniques are used at all times.

If the patient has no pulse, perform five cycles (approximately 2 minutes) of CPR beginning with chest compressions. After 2 minutes of CPR, reanalyze the patient's cardiac rhythm. If the AED advises to shock, deliver one shock followed immediately by CPR, beginning with chest compressions. Repeat these steps if needed.

If the patient has no pulse and the AED advises no shock, perform five cycles (approximately 2 minutes) of CPR, beginning with chest compressions. After five cycles (2 minutes) of CPR, reanalyze the patient's cardiac rhythm. If no shock is advised, continue CPR. Transport the patient, and contact medical control as needed.

After Automated External Device Shocks

The care of the patient after the AED delivers a shock depends on your location and EMS system; therefore, you should follow your local protocols. After the AED protocol is completed, one of the following is likely:

YOU are the Provider PART 2

The patient is still conscious and alert and appears less anxious. She tells you that her chest pain has decreased in severity and is now a 3 on a 0 to 10 scale. After reassessing her, you contact the receiving facility and give the staff a patient update.

Recording Time: 17 Minutes	
Level of consciousness	Conscious and alert; less anxious
Respirations	16 breaths/min; adequate depth
Pulse	80 beats/min; strong and irregular
Skin	Pink, cool, and dry
Blood pressure	128/78 mm Hg
Spo_2	98% (on oxygen)

You deliver the patient to the emergency department (ED), where the cardiac team greets you and assumes care of the patient. The physician obtains a 12-lead electrocardiogram and determines that she is experiencing an acute myocardial infarction. Within 15 minutes, she is taken to the cardiac catheterization laboratory, where two coronary stents are successfully placed.

11. What is the difference between angina pectoris and an acute myocardial infarction?
12. As an EMT, how can you distinguish angina pectoris from an acute myocardial infarction?

Skill Drill 16-3 AED and CPR

Step 1

Take standard precautions. Determine scene safety. Question bystanders. Determine responsiveness.

Assess compression effectiveness if CPR is already in progress. If the patient is unresponsive and CPR has not been started yet, begin providing chest compressions and rescue breaths at a ratio of 30 compressions to two breaths and a rate of 100 to 120 compressions per minute, continuing until an AED arrives and is ready for use.

Step 2

Turn on the AED. Apply the AED pads to the chest and attach the pads to the AED. Stop CPR. If a shock is not advised, perform five cycles (about 2 minutes) of CPR, beginning with chest compressions, and then reanalyze the cardiac rhythm. If a shock is advised, reconfirm that no one is touching the patient and push the Shock button. If at any time the AED advises to check the patient, quickly assess for a carotid or femoral pulse. This should not take longer than 5 to 10 seconds. If you feel a pulse, the patient has experienced ROSC (return of spontaneous circulation). Continue to monitor the patient.

Step 3

Verbally and visually clear the patient. Push the Analyze button, if there is one. Wait for the AED to analyze the cardiac rhythm. If no shock is advised, perform five cycles (2 minutes) of CPR and then reanalyze the cardiac rhythm. If a shock is advised, recheck that all are clear, and push the Shock button. After the shock is delivered, immediately resume CPR beginning with chest compressions and remember to switch rescuers.

Step 4

After five cycles (2 minutes) of CPR, reanalyze the cardiac rhythm. Do not interrupt chest compressions for more than 10 seconds.

Step 5

If shock is advised, clear the patient, push the Shock button, and immediately resume CPR compressions. If no shock is advised, immediately resume CPR compressions and be sure to switch rescuers. After five cycles (2 minutes) of CPR, reanalyze the cardiac rhythm. Repeat the cycle of five cycles (2 minutes) of CPR, one shock (if indicated), and 2 minutes of CPR. Transport, and contact medical control as needed.

- Pulse is regained (ROSC).
- No pulse, and the AED indicates that no shock is advised.
- No pulse, and the AED indicates that a shock is advised.

Patients who do not regain a pulse on the scene of the cardiac arrest usually do not survive. What you do with these patients, again, depends on your EMS system. Whether you should transport the patient or wait for ALS to arrive should be in the local protocols established by medical control. If paramedics or another ALS service is responding to the scene, the best option usually is to stay where you are and continue the sequence of shocks and CPR. Administering CPR while patients are being moved or transported is usually not very effective. The best chance for patient survival occurs when the patient is resuscitated where found, unless the location is unsafe.

If an ALS service is not responding to the scene and your local protocols agree, you should begin transport when one of the following occurs:

- The patient regains a pulse.
- Six to nine shocks have been delivered (or as directed by local protocol).
- The machine gives three consecutive messages (separated by 2 minutes of CPR) that no shock is advised (or as directed by local protocol).

If you transport a patient while performing CPR, you need a plan for managing the patient in the ambulance. Ideally, you will have two EMTs in the patient compartment while a third drives. You may deliver additional shocks at the scene or en route with the approval of medical control. Keep in mind that AEDs cannot analyze the rhythm while the vehicle is in motion; nor is it as safe to defibrillate in a moving ambulance. Therefore, you should come to a complete stop if more shocks are needed. Be sure to memorize the protocol of your EMS system **Figure 16-17**.

Cardiac Arrest During Transport

If you are traveling to the hospital with an unconscious patient, check the pulse at least every 30 seconds. If a pulse is not present, take the following steps:

1. Stop the vehicle.
2. If the AED is not immediately ready, perform CPR, beginning with chest compressions, until it is available.
3. Call for help in the form of ALS support or any other available resources as appropriate based on circumstances and local protocol.

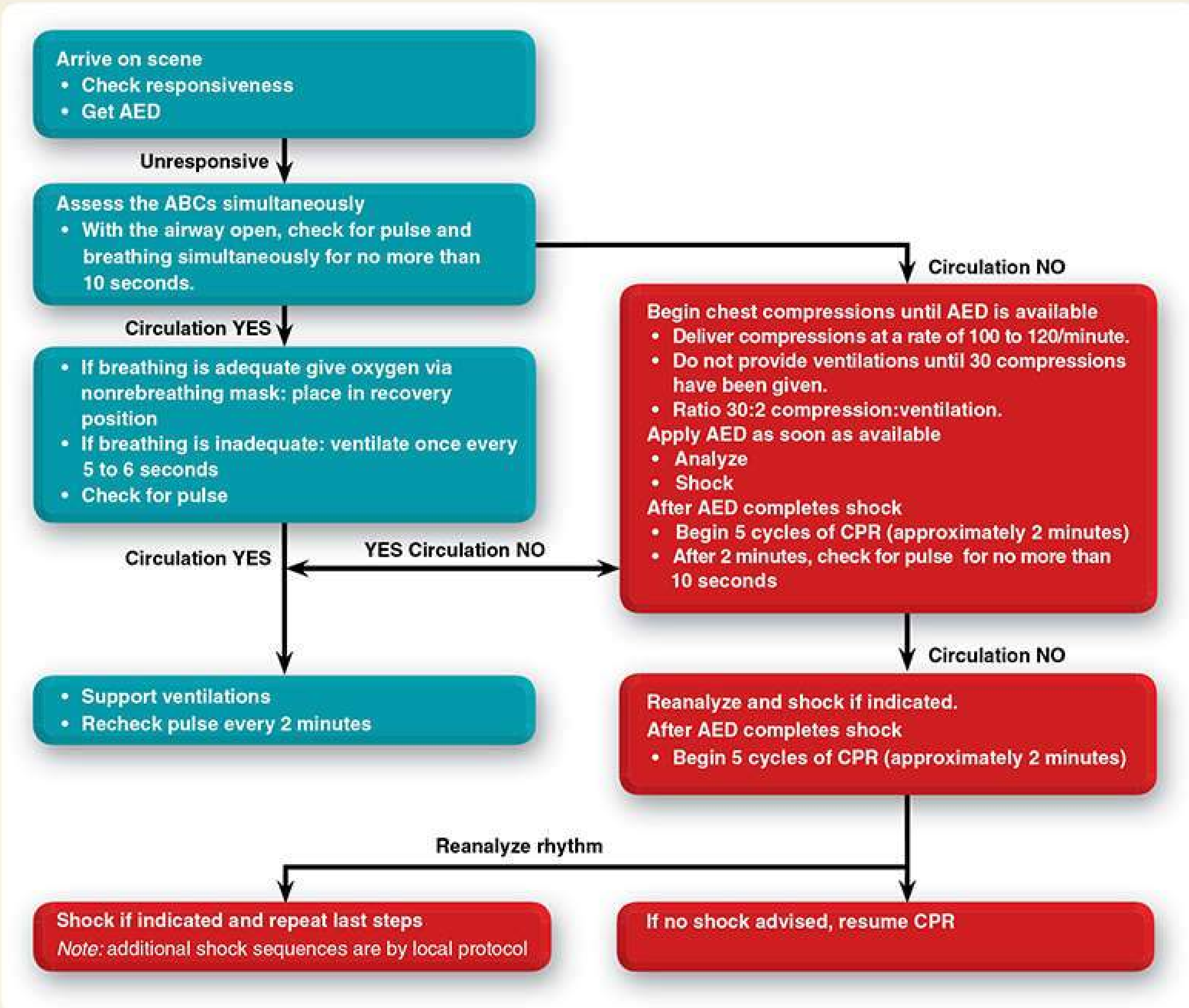


Figure 16-17 Automated external defibrillator (AED) algorithm. CPR indicates cardiopulmonary resuscitation.

4. Analyze the rhythm.
5. Deliver one shock, if indicated, and immediately resume CPR.
6. Continue resuscitation according to your local protocol.

If you are en route with a conscious adult patient who is having chest pain and becomes unconscious, take the following steps:

1. Check for a pulse.
2. Stop the vehicle.

3. If the AED is not immediately ready, perform CPR, beginning with chest compressions, until it is ready.
4. Analyze the rhythm.
5. Deliver one shock, if indicated, and immediately resume CPR.
6. Begin compressions, and continue resuscitation according to your local protocol, including transporting the patient.

Coordination With Advanced Life Support Personnel

The time to defibrillation is critical to survival after cardiac arrest. As an EMT equipped with an AED, you have the one tool that a dying patient in ventricular fibrillation needs most. Furthermore, it is impossible to hurt someone in cardiac arrest with an AED. Therefore, if you have an AED available, do not wait for the paramedics to arrive to administer a shock to a patient in ventricular fibrillation. Waiting might seem like a good idea. It is not. It is throwing away the patient's best chance for survival.

If the patient is unresponsive and does not have a pulse, apply the AED, and push the Analyze button (if there is one) as quickly as you can. Notify the ALS personnel as soon as possible after you recognize a cardiac arrest, but do not delay defibrillation. After the paramedics arrive at the scene, inform them of your actions to that point and then interact with them according to your local protocols.

Management of Return of Spontaneous Circulation

If you are able to restore a heartbeat through the use of an AED (also known as ROSC), what is done next can be critical to the patient's survival. Monitor for spontaneous respirations, provide oxygen via BVM at 10 to 12 breaths/min, and maintain an oxygen saturation between 95% and 99%. Assess the patient's blood pressure and see if he or she can follow simple commands such as "Squeeze my fingers." If ALS is not on scene or en route, immediately begin transport to the closest appropriate hospital depending on local protocol.

Safety Tips

Always remember, when using an AED there are several safety items to review.

1. Be aware of the surface the patient is lying on. Wet and metal surfaces may conduct electricity, making defibrillation of the patient dangerous to EMTs.
2. What is the age of the patient? Use pediatric AED pads when appropriate.
3. Does the patient have a medication patch in the area the AED pads will be placed? If so, remove the medication patch, wipe the area clean, and then attach the AED pad.
4. Does the patient have an implanted pacemaker or internal defibrillator in the same area the AED pads will be placed? If so, place the AED pad below the pacemaker or defibrillator, or place the pads in anterior and posterior positions.

YOU are the Provider — SUMMARY

1. What is the function of the heart?

The heart receives deoxygenated blood from the body, sends it to the lungs to be reoxygenated, and then pumps highly oxygenated blood throughout the body. The heart must pump effectively to ensure that the body's tissues and cells receive an uninterrupted supply of oxygen and that metabolic waste (eg, carbon dioxide) is removed from the tissues and cells and returned, through the heart, for elimination from the body by the respiratory system.

2. What does the heart require to function effectively?

Like any other critical organ or muscle, the heart requires a constant supply of oxygen, which it receives from the coronary arteries. It also relies on electricity to stimulate the contraction of the muscular layer of the heart (myocardium). Adequate blood volume is also required for effective cardiac function. As blood returns to the heart, it enters the chambers, stretches their walls, and causes them to contract with greater force. If blood volume is low, the heart will stretch less, and its contractile force will decrease.

3. What should you include in your primary assessment of a patient with cardiac problems?

Your primary assessment of a patient with cardiac problems should be no different from any other patient: to find and immediately correct problems with airway, breathing, and circulation. Look for signs of impaired cardiac function, such as an irregular heartbeat, a fast or slow heart rate, a weak (thready) pulse, and poor skin condition (eg, pallor, diaphoresis).

4. Why is aspirin given to patients with an acute cardiac event?

Aspirin has clearly been shown to reduce mortality and morbidity from acute myocardial infarction (AMI). Unless the patient is allergic to aspirin, it should be given as soon as possible if an acute cardiac event is suspected. An AMI occurs when an atherosclerotic plaque ruptures and occludes a coronary artery. When this occurs, platelets rush to the area and aggregate (clump together), which further occludes the coronary artery. Aspirin makes the platelets less "sticky," which makes them less likely to aggregate. Although aspirin will not dissolve the existing clot that is occluding the coronary artery, it may help prevent it from getting larger by reducing the amount of platelet aggregation.

5. What type of medication is nitroglycerin? How may it help relieve chest pain, pressure, or discomfort?

Nitroglycerin is a vasodilator. It works by relaxing the smooth muscle that regulates the diameter of the blood vessels, causing them to dilate (open). Nitroglycerin is used by patients with coronary artery disease who are experiencing chest pain, pressure, or discomfort. It dilates the coronary arteries and increases blood flow to the heart. As a result, the myocardial oxygen supply and demand are rebalanced, and the pain subsides or resolves completely. In some cases, however, nitroglycerin does not relieve the patient's chest pain. In a patient with a cardiac history, this should make you more suspicious that he or she is experiencing an AMI.

6. When is nitroglycerin indicated for a patient? What is the typical dose?

Nitroglycerin is indicated for patients with coronary artery disease who experience chest pain, pressure, or discomfort. Many patients with coronary artery disease have prescribed nitroglycerin, which they self-administer. If the patient has not taken any of his or her prescribed nitroglycerin, you may assist the patient in doing so after ensuring that his or her systolic blood pressure is at least 100 mm Hg and that approval from medical control has been obtained. Because nitroglycerin is a vasodilator, it can cause hypotension. Therefore, it is important to reassess the patient's blood pressure within a few minutes after administering nitroglycerin to ensure that it is at least 100 mm Hg. Nitroglycerin is contraindicated in patients with a systolic blood pressure of less than 100 mm Hg and in patients who have taken drugs for erectile dysfunction (eg, sildenafil [Viagra], tadalafil [Cialis], avanafil [Stendra], and vardenafil [Levitra, Staxyn]) within the past 24 to 36 hours. Drugs for erectile dysfunction are also vasodilators; if given together with nitroglycerin, significant hypotension may occur.

7. What is significant about the patient's vital signs?

Pale, cool, clammy (diaphoretic) skin is not exclusive to a cardiac problem. However, in the context of the patient's chief complaint and history of heart problems, it is highly suggestive that her chest pain is of a cardiac origin. An irregular heartbeat indicates a disturbance in the cardiac electrical conduction system (dysrhythmia). Again, in the context of her chief complaint and cardiac history, this should further increase your index of suspicion that she is experiencing a cardiac event. An irregular heartbeat in a patient with a cardiac problem could indicate an impending life-threatening dysrhythmia. The patient's rapid heart rate (tachycardia) and relatively elevated blood pressure (150/90 mm Hg) are also clinically significant; they indicate that her heart is working harder than normal. As the heart rate and blood pressure increase, the heart consumes and requires more oxygen. If the heart is already deprived of oxygen, the patient's condition could worsen.

8. Should you give her additional nitroglycerin? Why or why not?

Despite taking two of her prescribed nitroglycerin doses before your arrival, the patient is still experiencing significant chest pain (7 on a 0 to 10 scale). Because her systolic blood pressure is well above 100 mm Hg, you should contact medical control and request permission to assist her with one more nitroglycerin dose. Remember to reassess her blood pressure within a few minutes after administering the medication.

9. Why is early notification of the receiving facility so important for patients with an acute coronary event?

The longer it takes to reestablish blood flow distal to an occluded artery, the greater the amount of cardiac muscle damage (hence the phrase, "time is muscle"). Early reperfusion—with fibrinolytic medications (clot busters) or cardiac catheterization and stent placement—has clearly been shown to minimize the amount of cardiac damage and improve the patient's outcome. The earlier you notify the receiving facility that you are transporting a patient with a possible AMI, the more time the staff will have to allocate the resources needed to facilitate rapid cardiac reperfusion. The physician determines the reperfusion strategy. Your job is to recognize that the patient may be experiencing an AMI, provide immediate lifesaving care, promptly notify the appropriate receiving facility, and transport without delay.

10. Should you apply the AED to determine if she is experiencing a cardiac dysrhythmia? Why or why not?

No. The automated external defibrillator (AED) is applied only to patients who are apneic and pulseless (eg, in cardiac arrest). At present, your patient is breathing and has a pulse. Even if you did apply the AED, it would not analyze her cardiac rhythm. An AED will not analyze the cardiac rhythm if it detects patient movement. You should have the AED readily available in case she experiences cardiac arrest, but its application is not indicated at this point.

11. What is the difference between angina pectoris and an acute myocardial infarction?

Angina pectoris occurs when the heart’s demand for oxygen exceeds its available supply (ischemia), resulting in chest pain or discomfort. Angina is typically triggered by exertion, which increases myocardial oxygen consumption and demand. When the patient ceases exertion, oxygen supply and demand are rebalanced and the pain resolves, usually in less than 15 minutes. In more severe cases, a combination of rest and nitroglycerin are required for resolution of the patient’s chest pain or discomfort.

An AMI occurs when a portion of the heart muscle is completely deprived of oxygen because of complete occlusion of one or more coronary arteries. Unlike angina, the chest pain, pressure, or discomfort associated with an AMI typically does not resolve with rest or nitroglycerin and persists for greater than 15 minutes. The patient experiencing an AMI needs prompt treatment in the hospital, which is aimed at removing the clot in the coronary artery and reestablishing distal blood flow.

12. As an EMT, how can you distinguish angina pectoris from an acute myocardial infarction?

The signs and symptoms of angina and an AMI are essentially the same and usually cannot be distinguished without advanced diagnostic procedures. In both conditions, the chest pain or discomfort may be described as a feeling of pressure or heaviness. The patient requires physician evaluation, blood analysis, and other tests to diagnose an AMI. You should assume that any patient with nontraumatic chest pain or discomfort is experiencing an AMI until ruled out by a physician.

EMS Patient Care Report (PCR)

Date: 3-10-16	**Incident No.:** 130209	**Nature of Call:** Cardiac		**Location:** 1152 Blanco Road	
Dispatched: 0942	**En Route:** 0942	**At Scene:** 0950	**Transport:** 1000	**At Hospital:** 1017	**In Service:** 1029

Patient Information

Age: 60 **Sex:** F **Weight (in kg [lb]):** 55 kg (121 lb)	**Allergies:** No known drug allergies **Medications:** Vasotec, aspirin (ASA), nitroglycerin (NTG) **Past Medical History:** Heart attack, hypertension **Chief Complaint:** Chest pain

Vital Signs

Time: 0952	**BP:** 150/90	**Pulse:** 118	**Respirations:** 20	**Spo_2:** 98%
Time: 1002	**BP:** 136/84	**Pulse:** 84	**Respirations:** 18	**Spo_2:** 96%
Time: 1012	**BP:** 128/78	**Pulse:** 80	**Respirations:** 16	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ 4 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** 324 mg ASA

Narrative

Dispatched for a 60-year-old woman with chest pain. Upon arrival at the scene, found the patient sitting up in her bed with her fist clenched against her chest. She was conscious and alert, although anxious. Her airway was patent, and her breathing was adequate. She was markedly diaphoretic; had pale, cool skin; and had a rapid, irregular pulse. Patient states that she had a heart attack 3 years ago and has hypertension. She is presently taking Vasotec, NTG, and one (1) ASA per day and states that she has been compliant with her medications. Patient took two doses of her prescribed NTG before EMS arrival; however, she states that the medication had no effect; she presently describes her pain as a "7" on a scale of 0 to 10. Administered 324 mg ASA (patient stated she had no known drug allergies), applied oxygen at 4 L/min via nasal cannula to raise the oxygen saturation from 91% to just above 95%, and obtained vital signs. Contacted medical control, who authorized the administration of one more NTG dose. NTG was administered per medical control orders, the patient was placed onto the stretcher, loaded into the ambulance, and transported to the hospital. Contacted hospital shortly after departing the scene and advised that we were transporting patient with possible AMI. En route to the hospital, allowed patient to assume position of comfort and reassessed her vital signs. She was still reporting chest pain (3/10); however, her pulse rate, although still irregular, was notably slower. Reassessment of her skin revealed that it was pink, cool, and dry, and she was noted to be less anxious. Continued to monitor patient's condition throughout transport; there was no gross evidence of deterioration, and she remained conscious and alert. Delivered her to emergency department staff w/o incident. Upon arrival at the hospital, we were greeted by the cardiac team, who assumed patient care. Gave verbal report to charge nurse and returned to service.**End of report**

Prep Kit

Ready for Review

- The heart is divided down the middle into two sides, right and left, each with an upper chamber called the atrium and a lower chamber called the ventricle.
- The heart valve that keeps blood moving through the circulatory system in the proper direction is the aortic valve, which lies between the left ventricle and the aorta, the body's main artery.
- The heart's electrical system controls heart rate and helps the atria and ventricles work together to pump the blood.
- During periods of exertion or stress, the myocardium requires more oxygen. The oxygen is supplied by dilation of the coronary arteries, which increases blood flow.
- Common places to feel for a pulse include the carotid, femoral, brachial, radial, posterior tibial, and dorsalis pedis arteries.
- Low blood flow to the heart is usually caused by coronary artery atherosclerosis, a disease in which cholesterol plaques build up inside blood vessels, eventually occluding them.
- Occasionally a brittle plaque in an artery will crack, causing a blood clot to form. Heart tissue downstream suffers from a lack of oxygen and, within 30 minutes, will begin to die. This condition is called an acute myocardial infarction (AMI), or heart attack.
- Heart tissues that are not getting enough oxygen but are not yet dying can cause pain called angina. The pain of an AMI is different from the pain of angina in that it can come at any time, not just with exertion; it lasts up to several hours, rather than just a few moments; and it is not relieved by rest or nitroglycerin.
- In addition to crushing chest pain, signs of AMI include sudden onset of weakness, nausea, and sweating; sudden dysrhythmia; pulmonary edema; and even sudden death.
- Heart attacks can have three serious consequences. One is sudden death, usually the result of cardiac arrest caused by abnormal heart rhythms called dysrhythmias. These include tachycardia, bradycardia, ventricular tachycardia, and, most commonly, ventricular fibrillation.
- The second consequence is cardiogenic shock. Symptoms include restlessness; anxiety; pale, clammy skin; pulse rate higher than normal; and blood pressure lower than normal. Patients with these symptoms should receive oxygen, assisted ventilations as needed, and immediate transport.
- The third consequence of AMI is congestive heart failure, in which damaged heart muscle can no longer contract effectively enough to pump blood through the system. The lungs become congested with fluid, breathing becomes difficult, the heart rate increases, and the left ventricle enlarges.
- Signs include swollen ankles from dependent edema, high blood pressure, rapid heart rate and respirations, crackles (rales), and, sometimes, the pink sputum and dyspnea of pulmonary edema.
- Treat a patient with congestive heart failure as you would a patient with chest pain. Monitor the patient's vital signs. Give the patient oxygen via nonrebreathing face mask. Apply CPAP if it is available and you are authorized to use it. Allow the patient to remain sitting up.
- When treating patients with chest pain or discomfort, obtain a SAMPLE history, following the OPQRST mnemonic to assess the pain; measure and record vital signs; ensure the patient is in a comfortable position, usually semireclining or half sitting up; administer prescribed nitroglycerin and oxygen; and transport the patient, reporting to medical control as you do.
- If a patient is not responsive, is not breathing, and does not have a pulse, you may perform the following, depending on the patient's age and your local protocol:
  - Unresponsive adult or child older than 8 years, perform automated external defibrillation.
  - Unresponsive child younger than 8 years, perform automated external defibrillation with pediatric pads and dose attenuator; if neither is available, an adult AED may be used.
  - Unresponsive infant between the ages of 1 month and 1 year should be manually defibrillated (an ALS skill). If ALS is not available, use an AED equipped with pediatric pads and a dose attenuator. If neither is available, adult AED pads may be used.
- The AED requires the operator to apply the pads, power on the unit, follow the AED prompts, and press the shock button as indicated. The computer inside the AED recognizes rhythms that require shocking and will not mislead you.
- The three most common errors in using certain AEDs are failure of the machine to shock fine V fib, applying the AED to a patient who is moving, squirming, or being transported, and turning off the AED before analysis or shock is complete.
- Do not touch the patient while the AED is analyzing the heart rhythm or delivering shocks.
- Effective CPR and early defibrillation with an AED are critical interventions to the survival of a patient in cardiac arrest. Begin CPR starting with high-quality chest compressions and apply the AED as soon as it is available.

- If an advanced life support (ALS) service is responding to the scene, stay where you are and continue CPR and defibrillation as needed. If ALS is not responding, begin transport if the patient regains a pulse, if you have delivered six to nine shocks, or if the AED gives three consecutive messages (separated by 2 minutes of CPR) that no shock is advised. Follow your local protocols regarding when it is appropriate to transport the patient.
- If an unconscious patient has no pulse during transport, stop the vehicle, reanalyze the rhythm, and defibrillate again or begin CPR, as appropriate.
- The chain of survival, which is the sequence of events that must happen for a patient with cardiac arrest to have the best chance of survival, includes recognition of early warning signs and immediate activation of EMS, immediate high-quality CPR, rapid defibrillation, basic and advanced EMS, and ALS and postarrest care. Seconds count at every stage.

Vital Vocabulary

acute coronary syndrome A group of symptoms caused by myocardial ischemia; includes angina and myocardial infarction.

acute myocardial infarction (AMI) A heart attack; death of heart muscle following obstruction of blood flow to it. Acute in this context means "new" or "happening right now."

angina pectoris Transient (short-lived) chest discomfort caused by partial or temporary blockage of blood flow to the heart muscle; also called *angina*.

anterior The front surface of the body; the side facing you in the standard anatomic position.

aorta The main artery, which receives blood from the left ventricle and delivers it to all the other arteries that carry blood to the tissues of the body.

aortic aneurysm A weakness in the wall of the aorta that makes it susceptible to rupture.

aortic valve The one-way valve that lies between the left ventricle and the aorta and keeps blood from flowing back into the left ventricle after the left ventricle ejects its blood into the aorta; one of four heart valves.

artifact A tracing on an ECG that is the result of interference, such as patient movement, rather than the heart's electrical activity.

asystole The complete absence of all heart electrical activity.

atherosclerosis A disorder in which cholesterol and calcium build up inside the walls of blood vessels, eventually leading to partial or complete blockage of blood flow.

atrium One of two (right and left) upper chambers of the heart. The right atrium receives blood from the vena cava and delivers it to the right ventricle. The left atrium receives blood from pulmonary veins and delivers it to the left ventricle.

automaticity The ability of cardiac muscle cells to contract without stimulation from the nervous system.

autonomic nervous system The part of the nervous system that controls the involuntary activities of the body such as the heart rate, blood pressure, and digestion of food.

bradycardia A slow heart rate, less than 60 beats/ min.

cardiac arrest When the heart fails to generate effective and detectable blood flow; pulses are not palpable in cardiac arrest, even if muscular and electrical activity continues in the heart.

cardiac output A measure of the volume of blood circulated by the heart in 1 minute, calculated by multiplying the stroke volume by the heart rate.

cardiogenic shock A state in which not enough oxygen is delivered to the tissues of the body, caused by low output of blood from the heart. It can be a severe complication of a large acute myocardial infarction, as well as other conditions.

congestive heart failure (CHF) A disorder in which the heart loses part of its ability to effectively pump blood, usually as a result of damage to the heart muscle and usually resulting in a backup of fluid into the lungs.

coronary arteries The blood vessels that carry blood and nutrients to the heart muscle.

defibrillate To shock a fibrillating (chaotically beating) heart with specialized electric current in an attempt to restore a normal, rhythmic beat.

dependent edema Swelling in the part of the body closest to the ground, caused by collection of fluid in the tissues; a possible sign of congestive heart failure.

dilation Widening of a tubular structure such as a coronary artery.

dissecting aneurysm A condition in which the inner layers of an artery, such as the aorta, become separated, allowing blood (at high pressures) to flow between the layers.

dysrhythmia An irregular or abnormal heart rhythm.

hypertensive emergency An emergency situation created by excessively high blood pressure, which can lead to serious complications such as stroke or aneurysm.

infarction Death of a body tissue, usually caused by interruption of its blood supply.

inferior The part of the body or any body part nearer to the feet.

ischemia A lack of oxygen that deprives tissues of necessary nutrients, resulting from partial or complete blockage of blood flow; potentially reversible because permanent injury has not yet occurred.

lumen The inside diameter of an artery or other hollow structure.

myocardium The heart muscle.

occlusion A blockage, usually of a tubular structure such as a blood vessel.

parasympathetic nervous system The part of the autonomic nervous system that controls vegetative functions such as digestion of food and relaxation.

perfusion The flow of blood through body tissues and vessels.

posterior The back surface of the body; the side away from you in the standard anatomic position.

return of spontaneous circulation (ROSC) The return of a pulse and effective blood flow to the body in a patient who previously was in cardiac arrest.

stroke volume The volume of blood ejected with each ventricular contraction.

superior The part of the body or any body part nearer to the head.

sympathetic nervous system The part of the autonomic nervous system that controls active functions such as responding to fear (also known as the “fight-or-flight” system).

syncope A fainting spell or transient loss of consciousness.

tachycardia A rapid heart rate, more than 100 beats/min.

thromboembolism A blood clot that has formed within a blood vessel and is floating within the bloodstream.

ventricle One of two (right and left) lower chambers of the heart. The left ventricle receives blood from the left atrium (upper chamber) and delivers blood to the aorta. The right ventricle receives blood from the right atrium and pumps it into the pulmonary artery.

ventricular fibrillation Disorganized, ineffective quivering of the ventricles, resulting in no blood flow and a state of cardiac arrest.

ventricular tachycardia A rapid heart rhythm in which the electrical impulse begins in the ventricle (instead of the atrium), which may result in inadequate blood flow and eventually deteriorate into cardiac arrest.

Assessment *in Action*

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You are dispatched to a person reporting chest pain and shortness of breath. You arrive at the residence to find a 56-year-old man sitting in the kitchen. His skin is ashen, and he is diaphoretic. The patient describes the pain as substernal and crushing. On a scale of 0 to 10, he states his pain is an 8. The patient had a myocardial infarction 2 years ago, and he has angina, hypertension, and high cholesterol. His medications include nitroglycerin, furosemide, and atorvastatin. His vital signs are as follows: pulse, 140 beats/min and irregular; respiratory rate, 28 breaths/min; and blood pressure, 90/50 mm Hg. You hear crackles when listening to his breath sounds.

1. The patient's difficulty breathing and crackles are due to blood backing up in which part of the body?

   A. The heart
   B. The lungs
   C. The vessels
   D. The arteries

2. On the basis of the information given, the patient is most likely experiencing which type of shock?

   A. Neurogenic
   B. Vasogenic
   C. Cardiogenic
   D. Hypovolemic

3. Treatment of this patient includes which of the following?

   A. Oxygen, furosemide, and nitroglycerin
   B. Oxygen and transport in a position of comfort
   C. Oxygen and nitroglycerin
   D. Oxygen and transport with legs raised

4. What combination of vital signs and history gives the best clue about the patient's condition?

   A. The respiratory rate of 28 breaths/min with a history of angina

B. The pulse of 140 beats/min with a history of high cholesterol
C. The pulse of 140 beats/min with a history of angina
D. The blood pressure of 90/50 mm Hg with a history of hypertension

5. What other information would be most helpful in determining the treatment of this patient?

A. A pulse oximetry measurement and a list of medication allergies
B. A description of his prior heart attack and how it was treated
C. Whether or not he has an implanted pacemaker or an internal defibrillator
D. Who is his doctor and which hospital would he prefer

6. Why would nitroglycerin be contraindicated for this patient?

A. He may have already taken it three times.
B. His blood pressure is too low.
C. He may be allergic to it.
D. He may have taken Viagra in the last 24 hours.

7. What would be your most important initial treatment of this patient?

A. Apply the AED in case he goes into cardiac arrest.
B. Give him nitroglycerin if he denies using Viagra.
C. Transport to the hospital because all other treatment is contraindicated.
D. Administer aspirin if he is not allergic to it.

8. The patient has a loss of consciousness on the way to the hospital. When you check, you cannot feel a pulse. What should you do?

A. Tell your partner to drive faster as you begin CPR on the patient.
B. Immediately apply the AED and wait for it to analyze the rhythm before taking any other action.
C. Have your partner pull over the ambulance and come back to help you with CPR and the AED.
D. Begin CPR and after 2 minutes stop to apply the AED while your partner continues driving to the hospital.

9. Describe the path of blood through the heart and lungs.

10. What is cardiogenic shock?

CHAPTER

17

Neurologic Emergencies

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Neurology

Anatomy, presentations, and management of

› Decreased level of responsiveness (pp 675–676, 685–686, 697)
› Seizure (pp 675–676, 681–685, 696–697)
› Stroke (pp 675–676, 678–681, 694–696)

Anatomy, physiology, pathophysiology, assessment, and management of

› Stroke/transient ischemic attack (pp 675–681, 686–696)
› Seizure (pp 675–676, 681–690, 693–697)
› Status epilepticus (pp 675–676, 682–690, 693–697)
› Headache (pp 675–678, 686–690, 693–695)

Knowledge Objectives

1. Describe the anatomy and physiology and functions of the brain and spinal cord. (pp 675–676)
2. Discuss the different types of headaches, the possible causes of each, and how to distinguish a harmless headache from a potentially life-threatening condition. (pp 676–678)
3. Explain the various ways blood flow to the brain may be interrupted and cause a cerebrovascular accident. (p 678)
4. Discuss the causes, similarities, and differences of an ischemic stroke, hemorrhagic stroke, and transient ischemic attack. (pp 678–680)
5. List the general signs and symptoms of stroke and how those symptoms manifest if the left hemisphere of the brain is affected and if the right hemisphere of the brain is affected. (pp 680–681)

6. List three conditions with symptoms that mimic stroke and the assessment techniques EMTs may use to identify them. (p 681)
7. Define a generalized seizure, partial seizure, and status epilepticus; include how they differ from each other and their effects on patients. (pp 681–682)
8. Describe how the different stages of a seizure are characterized. (p 682)
9. Discuss the importance for EMTs to recognize when a seizure is occurring or whether one has already occurred in a patient. (p 684)
10. Explain the postictal state and the specific patient care interventions that may be necessary. (pp 684–685)
11. Define altered mental status; include possible causes and the patient assessment considerations that apply to each. (pp 685–686)
12. Discuss scene safety considerations when responding to a patient with a neurologic emergency. (pp 686–687)
13. Explain the special considerations required for pediatric patients who exhibit altered mental status. (p 687)
14. Explain the primary assessment of a patient who is experiencing a neurologic emergency and the necessary interventions that may be required to address all life threats. (pp 687–689)
15. Describe the process of history taking for a patient who is experiencing a neurologic emergency and how this process varies depending on the nature of the patient's illness. (pp 689–690)
16. Explain the secondary assessment of a patient who is experiencing a neurologic emergency. (pp 690–692)
17. Explain how to use stroke assessment tools to rapidly identify a stroke patient; include two commonly used tools. (pp 690–693)
18. Explain the concept of a stroke alert and the important timeframe for the most successful treatment outcome for a patient who is suspected of having a stroke. (pp 690, 694)
19. List the key information EMTs must obtain and document for a stroke patient during assessment and reassessment. (pp 693–694)
20. Explain the care, treatment, and transport of patients who are experiencing headaches, stroke, seizure, and altered mental status. (pp 694–697)
21. Explain the special considerations required for geriatric patientsgeriatric patients who are experiencing a neurologic emergency. (p 696)

Skills Objective

1. Demonstrate how to use a stroke assessment tool such as the Cincinnati Prehospital Stroke Scale, 3-Item Stroke Severity Scale (LAG), or FAST mnemonic to test a patient for aphasia, facial weakness, and motor weakness. (pp 691–693)

Introduction

Stroke is the fifth leading cause of death and the leading cause of adult disability in the United States, according to the American Stroke Association. While stroke is common in geriatric patients, it may happen to anyone. Contributing factors for stroke include family history and race and ethnicity; African Americans, Hispanics, and Asians have an increased risk of stroke. Fortunately, treatments are available for stroke, and many hospitals are certified stroke centers. Some patients can avoid the devastating consequences of an acute stroke if they reach a hospital in time for treatment.

Seizures and altered mental status may occur in patients with brain disorders. Seizures may occur as a result of a recent or a prior head injury, a brain tumor, a metabolic disease, fever, or a genetic disposition. Your ability to recognize when a seizure has occurred or is occurring is a critical step because you can then provide the appropriate management.

Altered mental status is common in patients with a wide variety of medical conditions. However, avoid making assumptions about the cause of a patient's altered mental status. Many causes are possible, some obvious, some not: intoxication, head injury, hypoxia, stroke, metabolic disturbances, and many more. Obviously, treatment varies widely as well. Patients with altered mental status present a particular challenge in that they may be difficult to handle and frustrating to treat. This chapter will help you better understand, communicate with, and care for patients experiencing neurologic emergencies. Remember, your professionalism is paramount in these situations.

This chapter describes the structure and function of the brain and the most common causes of brain disorders, including stroke, transient ischemic attacks (TIA), seizures, headaches, and altered mental status. The signs and symptoms of each condition are explained, as well as how to approach and assess a patient with a neurologic emergency, and why prompt transport to an appropriate medical facility is so important.

Anatomy and Physiology

The brain is the body's computer. It controls breathing, speech, and all other body functions. All thoughts, memories, needs, and desires reside in the brain. Different parts of the brain perform different functions. For example, some parts of the brain receive input from the senses, including sight, hearing, taste, smell, and touch; some control the muscles and movement; and some control the formation of speech.

The brain is divided into three major parts: the brain stem, the cerebellum, and the cerebrum, which is the largest part **Figure 17-1**. The brain stem controls the most basic functions of the body, such as breathing, blood pressure, swallowing, and pupil constriction. Located just behind the brain stem is the cerebellum, which controls muscle and body coordination. The cerebellum is responsible for coordinating complex tasks that involve many muscles, such as standing on one foot without falling, walking, writing, picking up a coin, and playing the piano.

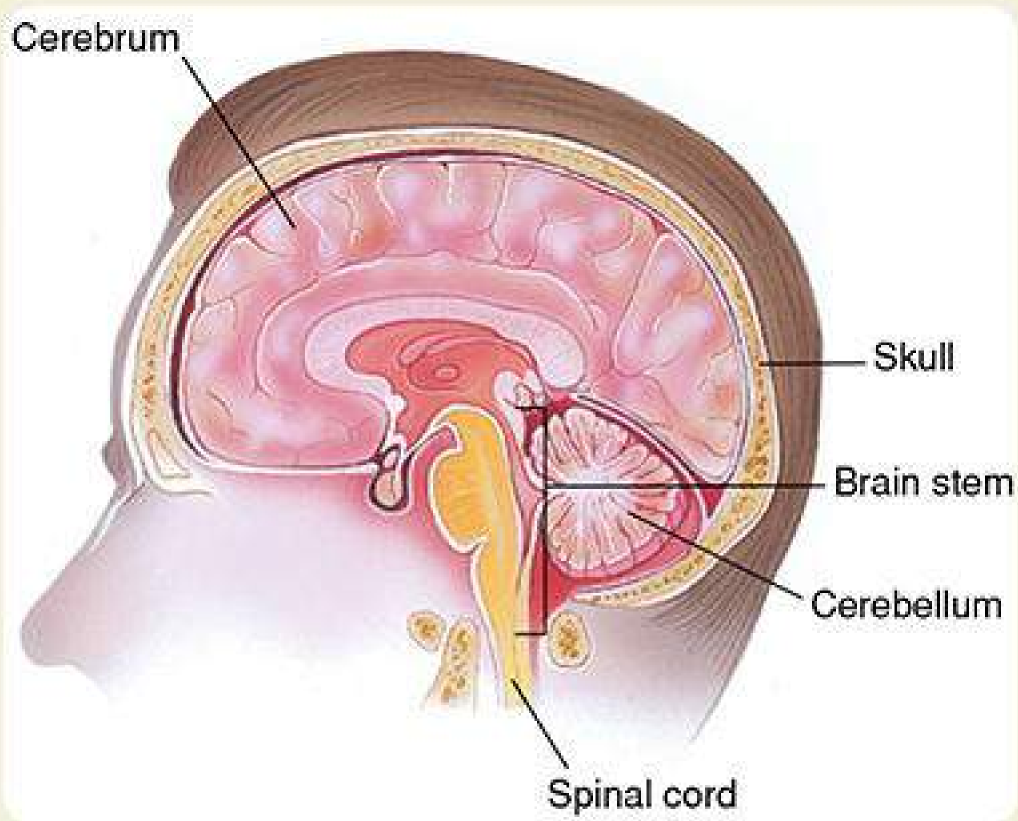

Figure 17-1 The brain is well protected within the skull. The brain's major parts are the cerebrum, the cerebellum, and the brain stem.

YOU are the Provider — PART 1

At 1823 hours, your unit is dispatched to 106 Scottie Drive. The dispatcher states that a 58-year-old woman is believed to be having a seizure. Bystanders report the patient is unresponsive, with shaking of her extremities and torso. You respond to the scene, which is located approximately 4 miles from your station. The weather is cloudy, the traffic is moderate, and the temperature is 87°F (30.6°C). While en route, you and your partner discuss the different types of seizures.

1. On the basis of the dispatch information, what type of seizure is the patient most likely experiencing?

2. What are some common causes of seizures in this patient's age group?

The cerebrum, located above the cerebellum, is divided down the middle into the right and left cerebral hemispheres. Each hemisphere controls activities on the opposite side of the body. The front part of the cerebrum controls emotion and thought, and the middle part controls sensation and movement. The back part of the cerebrum processes sight. In most people, speech is controlled on the left side of the brain, near the middle of the cerebrum.

Messages sent to and from the brain travel through nerves. Twelve cranial nerves run directly from the brain to various parts of the head, such as the eyes, ears, nose, and face. The remaining nerves join in the spinal cord and exit the brain through a large opening in the base of the skull called the foramen magnum **Figure 17-2**. At each vertebra in the neck and back, two nerves, called spinal nerves, branch out from the spinal cord and carry signals to and from the body.

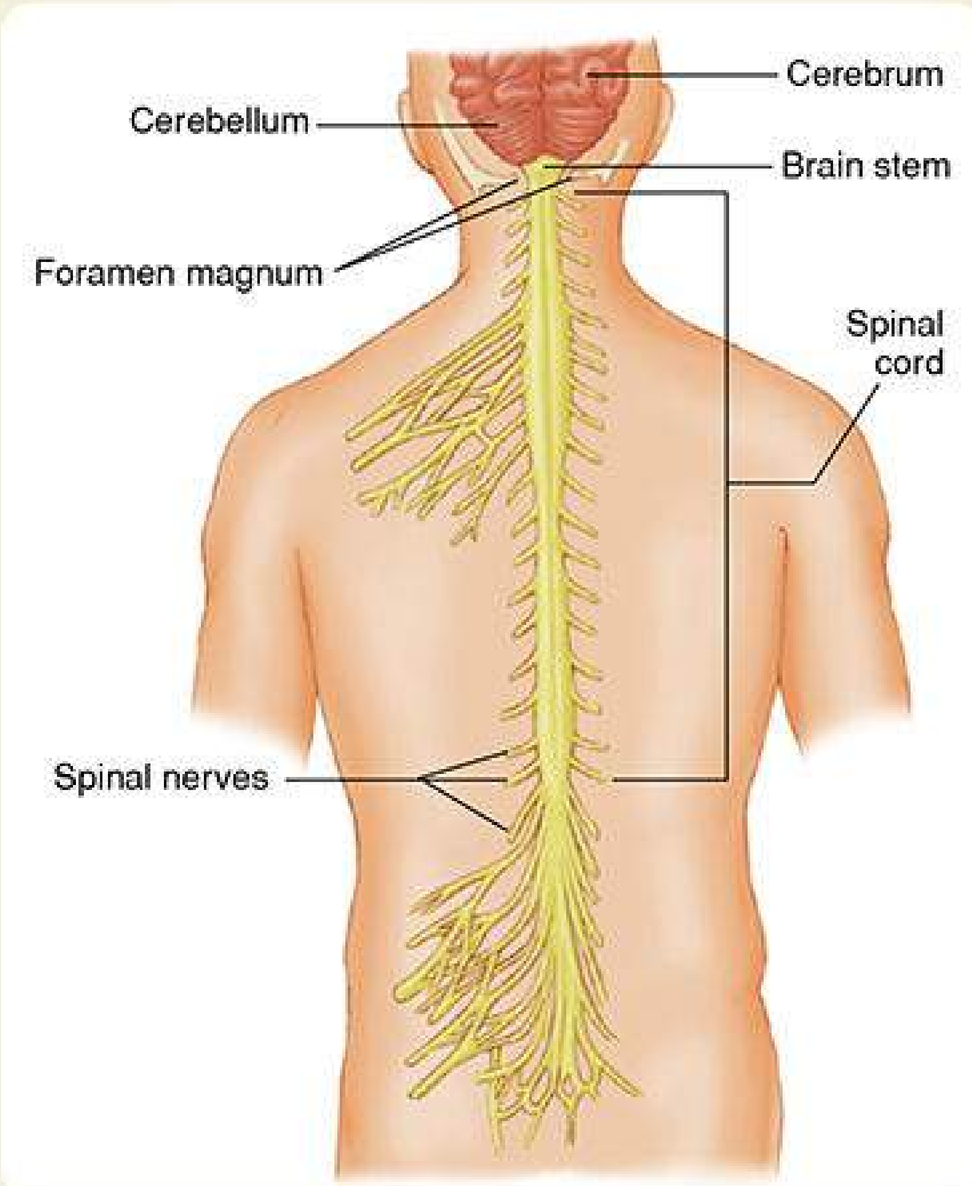

Figure 17-2 The spinal cord is the continuation of the brain stem. It exits the skull at the foramen magnum and extends down to the level of the second lumbar vertebra.

Pathophysiology

Many different disorders may cause brain dysfunction or other neurologic symptoms and may affect the patient's level of consciousness, speech, and voluntary muscle control. The brain is most sensitive to changes in oxygen, glucose, and temperature levels. A significant change in any one of these three levels will result in a neurologic change. As a general rule, if the problem is caused primarily by disorders in the heart and lungs, the entire brain will be affected. For example, when blood flow is stopped (cardiac arrest), the patient will go into a **coma**, a state of profound unconsciousness, and permanent brain damage can result within minutes. However, if the primary problem is in the brain, such as a poor blood supply to one side of the brain, the patient may have signs and symptoms affecting only one side of the body. A low oxygen level in the bloodstream will affect the entire brain, often causing anxiety, restlessness, and confusion. Very low blood glucose levels (hypoglycemia) can cause a wide spectrum of symptoms ranging from mild confusion to symptoms that mimic stroke.

Headache

One of the most common complaints of pain you will hear from your patients is headache. Because a headache is subjective, it may be a symptom of another condition or it may be considered a neurologic condition on its own. Millions of people experience a headache every year, but only a small percentage of these are caused by a serious medical condition. The brain and skull do not actually sense pain because neither contains pain receptors. The pain associated with a headache is felt from the surrounding areas of the face; scalp, meninges (membranes that cover the brain and spinal cord); larger blood vessels; and the muscles of the head, neck, and face.

Tension headaches, migraines, and sinus headaches are the most common types of headaches. These types of headaches are not considered life threatening, although they may be debilitating for the patient. Tension headaches are caused by muscle contractions in the head and neck and are attributed to stress. Patients usually describe the pain as squeezing, dull, or an ache. This type of headache typically does not have any associated symptoms and usually does not require medical attention.

Migraine headaches are thought to be caused by changes in blood vessel size in the base of the brain. Both adults and children can experience migraine headaches. Women are three times as likely as men to experience migraines. Frequently, the patient will have a history of migraines and will tell you that this episode is similar to one in the past. Pain from a migraine headache is usually described as pounding, throbbing, or pulsating. Migraines are often associated with nausea and vomiting and may be preceded by visual warning signs such as flashing lights or partial vision loss. These headaches can last for several hours to days.

Sinus headaches are caused by pressure that is the result of fluid accumulation in the sinus cavities. Patients may also have cold-like signs and symptoms of nasal congestion, cough, and fever if they have a sinus infection. Patients may report increased pain when they bend over or when their heads are moved forward. This type of headache is usually self-limiting, and prehospital emergency care is not required.

Although most headaches are not life threatening, some patients with a chief complaint of headache will require medical attention. Hemorrhagic stroke (bleeding in the brain), brain tumor, and meningitis are serious neurologic conditions that include headache as a symptom. Be concerned if the patient reports a sudden-onset, severe headache or a sudden-onset headache that has associated symptoms. Headaches accompanied by fever, stiff neck, seizures, or altered mental status or following a head trauma are potentially life threatening and require a complete assessment and transport to the hospital **Table 17-1**. An incident with multiple patients reporting a headache may indicate carbon monoxide poisoning.

A sudden, severe headache, often described as the worst pain the patient has ever had, could be a sign of a hemorrhagic stroke. The blood from a ruptured blood vessel irritates the tissues of the brain and can cause increased intracranial pressure, resulting in severe headache pain. This type of pain may initially be localized and then become more diffuse as the irritation in the meninges spreads. You should suspect a hemorrhagic stroke in patients with a severe headache, seizures, and altered mental status. Early signs of increased intracranial pressure include headache, vomiting, altered mental status, and seizures. Increasing intracranial pressure may also be caused by a hemorrhagic stroke (a blood vessel swells and ruptures), a tumor, or head trauma that may have occurred hours or days before this event. During your patient assessment ask if the patient has experienced any recent head trauma.

Table 17-1 Headache Red Flags

A patient who has a headache associated with any of the following should be evaluated for a potentially life-threatening condition:

- Sudden onset of symptoms
- Explosive/thunderclap pain
- Altered mental status
- Age >50
- Depressed immune system (known to be at higher risk for infection)
- Neurologic deficits
- Neck stiffness/pain
- Fever
- Changes in vision
- One-sided paralysis or weakness

YOU are the Provider PART 2

You arrive at the scene, and you are greeted by the patient's sister. She tells you they were having a conversation when the patient suddenly grabbed both sides of her head and then began "shaking all over." The patient is lying on the floor in her living room with a pillow under her head. She is conscious but confused and reports a severe headache. You perform an assessment as your partner opens the jump bag.

Recording Time: 0 Minutes	
Appearance	Slightly pale; skin is dry
Level of consciousness	Conscious, but confused
Airway	Open; clear of secretions and foreign bodies
Breathing	Rapid rate; adequate depth
Circulation	Radial pulse, rapid and bounding

Your partner administers oxygen and prepares to take the patient's vital signs. The patient's sister tells you her sister has never had seizures before. The patient is wearing a medical alert bracelet, which identifies her medical history of high blood pressure, heart disease, and type 2 diabetes.

3. What additional questions should you ask the patient's sister?
4. What prehospital assessments can you perform to determine the possible cause of the patient's seizure?
5. Other than oxygen, what additional treatment is indicated at this point?

Bacterial meningitis, an inflammation of the meninges caused by a bacterial infection, is a central nervous system infection in which the patient may complain of a headache, stiff neck, fever, and sensitivity to light. This is a serious condition requiring prompt medical attention. Use standard precautions, and provide supportive care of the ABCs. Provide a quiet, darkened environment when possible and consider not using lights and siren.

Stroke

A **cerebrovascular accident (CVA)**, or **stroke**, is an interruption of blood flow to an area within the brain that results in the loss of brain function. In the context of a total lack of oxygen, brain cells stop functioning and begin to die within minutes. Medical science currently has little to offer in the way of treatment once brain cells are dead. However, when oxygen levels are decreased, but not absent, because an insufficient amount of blood is getting through, brain cells may be damaged more slowly. It may take several hours or more for brain cells to die in this situation. When brain cells die or are injured, severe disability may result. For example, if cells that are responsible for controlling the left arm are starved for oxygen, the patient will not be able to move that arm. The brain cells will develop **ischemia**, a reduction in blood supply that results in inadequate oxygen being supplied to the brain cells. This causes those cells to stop functioning properly. If normal blood flow is restored to that area of the brain in time, the cells will not die and the patient may regain full use and control of the arm.

Unfortunately, many patients having a stroke deny or ignore their symptoms and delay seeking medical attention. The delay in seeking care can result in devastating consequences, because "time is brain."

> **Words of Wisdom**
>
> Stroke patients who receive treatment within the first few hours of the onset of stroke symptoms have a much greater chance of surviving and avoiding long-term brain damage. Patients with ischemic strokes, the most common type of stroke, may be candidates for treatment with tissue plasminogen activator (tPA), but this drug must be given within the first few hours after a stroke; ideally within the first hour of arrival in the ED to have the best chance of reversing the symptoms. Note the time of symptom onset and transport to a stroke center.

Types of Stroke

The two main types of stroke are ischemic and hemorrhagic. An ischemic stroke occurs when blood flow through the cerebral arteries is blocked. In hemorrhagic stroke, a blood vessel ruptures and the accumulated blood causes increased pressure in the brain.

Ischemic Stroke

According to the American Stroke Association, **ischemic stroke** is the most common type of stroke, accounting for more than 80% of all strokes. When blood flow to a particular part of the brain is stopped by a blockage (blood clot) inside a blood vessel, the result is an ischemic stroke. This blockage may be due to **thrombosis**, where a clot forms at the site of blockage, or an **embolus**, where the blood clot forms in a remote area (such as a diseased heart) and then travels to the site of the blockage. As with coronary artery disease, atherosclerosis in the blood vessels is often the cause of ischemic stroke. Patients who experience an ischemic stroke may have dramatic symptoms, including loss of movement on the side of the body opposite the side where the occlusion has occurred.

Atherosclerosis is a disorder in which calcium and cholesterol build up, forming plaque inside the walls of the blood vessels. This plaque may obstruct blood flow and interfere with the vessels' ability to dilate. Eventually, atherosclerosis may cause complete occlusion of an artery **Figure 17-3**. In other cases, an atherosclerotic plaque in the carotid artery in the neck ruptures. A blood clot forms over the crack in the plaque. Sometimes, it grows large enough to completely block all blood flow through that artery. The parts of the brain supplied by the artery are deprived of oxygen and stop functioning.

Even if the blockage in the carotid artery is not complete, smaller pieces of the blood clot may embolize (break off and be carried by the normal flow of blood) deep into the brain, where they may become lodged in a smaller branch of a blood vessel. This cerebral embolism then blocks blood flow **Figure 17-4**. Depending on the location of the lodged blood clot, the patient's symptoms can vary widely, from nothing at all to complete paralysis.

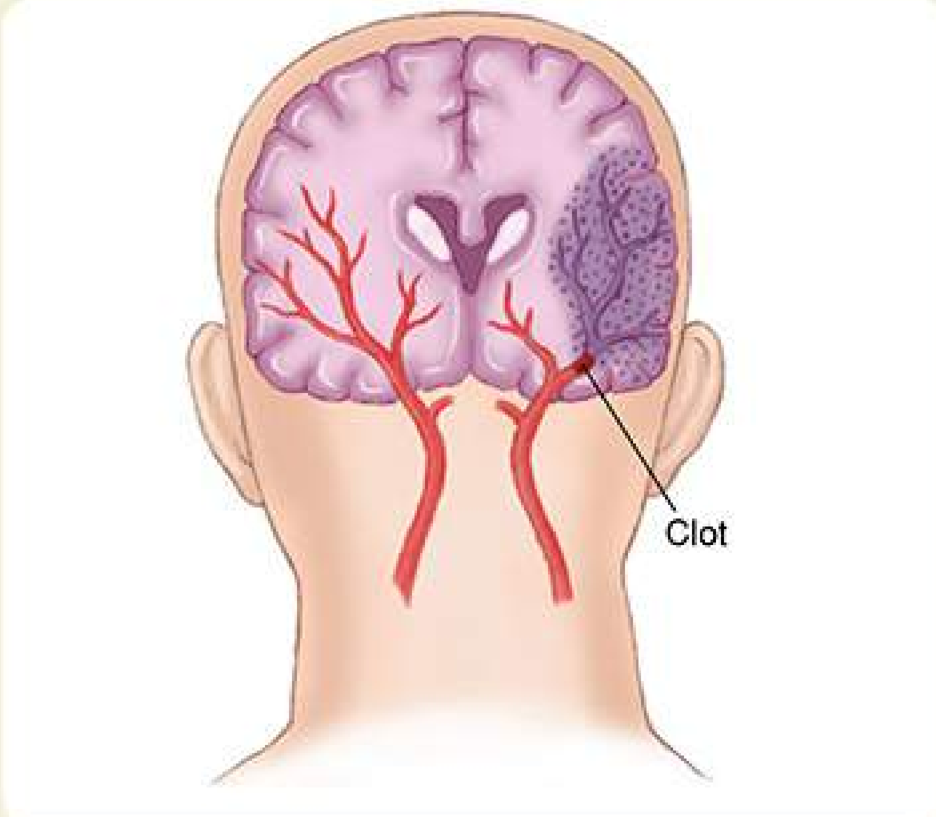

Figure 17-3 Atherosclerosis can damage the wall of a cerebral artery, producing narrowing and/or a blood clot. When a vessel is narrowed or completely blocked, blood flow to part of the brain may be blocked, causing brain cells to die because of the lack of adequate oxygenation.

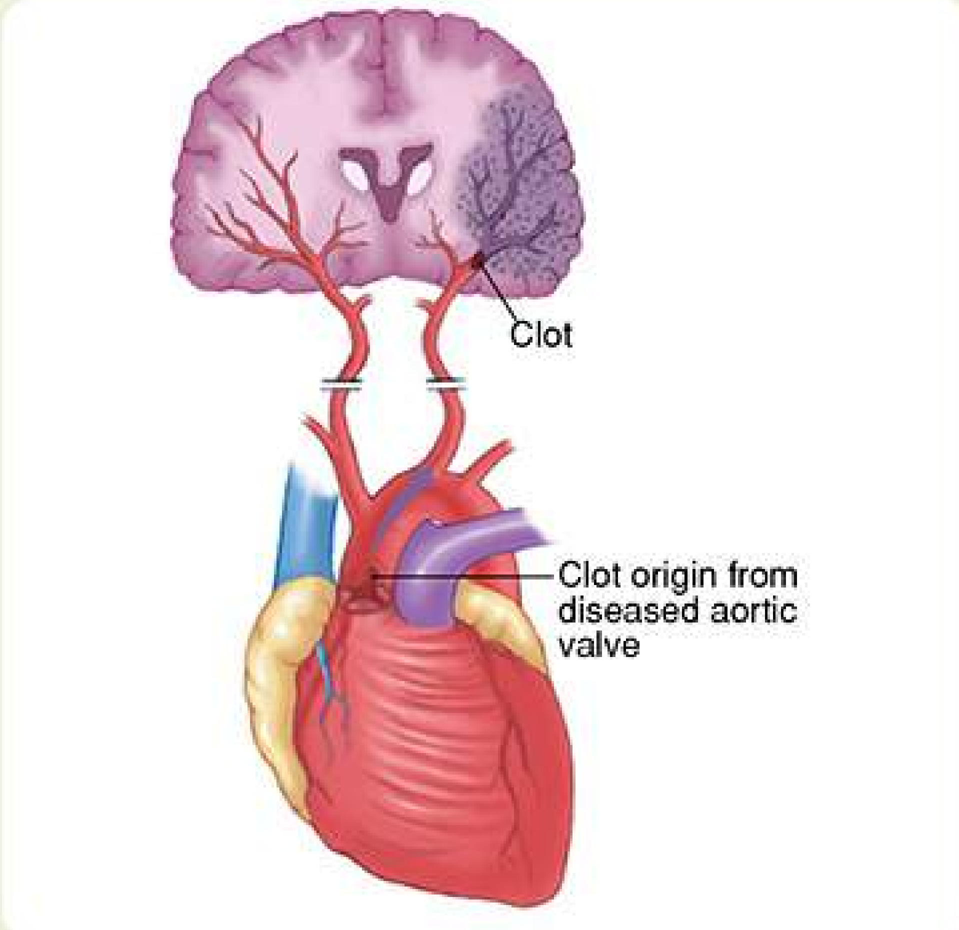

Figure 17-4 An embolus, a blood clot formed elsewhere in the body (for example, on a diseased heart valve), can travel through the body's vascular system, lodge in a cerebral artery, and cause a stroke.

Hemorrhagic Stroke

Hemorrhagic stroke occurs as a result of bleeding inside the brain. According to the American Stroke Association, hemorrhagic strokes account for 13% of all strokes. In hemorrhagic stroke, a blood vessel ruptures and the accumulated blood then forms a blood clot, which compresses the brain tissue next to it. The compression prevents oxygenated blood from getting into the area, and the brain cells begin to die. Cerebral hemorrhages are often fatal.

Hemorrhagic stroke commonly occurs in people experiencing stress or exertion. The people at highest risk for hemorrhagic stroke are those with very high blood pressure or long-term untreated elevated blood pressure. Many years of high blood pressure weaken the blood vessels in the brain. If a vessel ruptures, the bleeding in the brain will increase the pressure inside the cranium. Proper treatment of high blood pressure can help prevent this long-term damage to the blood vessels, decreasing the risk of this devastating complication.

Some people are born with a weakness in the walls of an artery. An **aneurysm**, a swelling or enlargement of the wall of an artery resulting from a defect or weakening of the arterial wall, may then develop. Figure 17-5 is an angiogram showing a cerebral aneurysm. The most notable symptom of a ruptured aneurysm is often a sudden onset, severe headache, typically described by the patient as the worst headache he or she has ever had. The headache is caused by the irritation of blood on the brain tissue after the artery swells and ruptures. A hemorrhagic stroke in an otherwise healthy young person is often caused by a weakness in a blood vessel called a *berry aneurysm*. This type of aneurysm resembles a tiny balloon (or berry) that juts out from the artery. When the aneurysm is overstretched and ruptures, blood spurts into an area between two of the coverings of the brain called the subarachnoid space. These types of strokes are called subarachnoid hemorrhages. If the patient gets to the hospital quickly, surgical repair of the aneurysm may be possible. However, like other brain bleeding and cerebral hemorrhage, this condition is often fatal.

Figure 17-5 An angiogram showing a cerebral aneurysm.

Transient Ischemic Attack

In a patient with coronary artery disease, blood flow to the heart muscle may be obstructed, causing chest pain (angina), which is considered a warning sign of a potential myocardial infarction. Similarly, when blood flow to the brain is obstructed due to atherosclerosis or a small blood clot, the patient may exhibit signs of a stroke. When these stroke-like symptoms resolve on their own in less than 24 hours, the event is called a **transient ischemic attack (TIA)**. Some people call these *mini strokes*. As with angina, no actual death of tissue (infarction) occurs with a TIA. However, since symptoms of a TIA can last up to 24 hours, you may not be able to differentiate between a stroke and a TIA.

Although most patients with TIAs do well, every TIA is an emergency. It may be a warning sign that a more significant stroke may occur in the future. Approximately one-third of patients who have a TIA will experience a stroke soon after the TIA. For this reason, all patients with a TIA should be evaluated by a physician to determine whether preventive action should be taken.

Signs and Symptoms of Stroke

The general signs and symptoms of stroke include the following:

- Facial drooping
- Sudden weakness or numbness in the face, arm, leg, or one side of the body

- Decreased or absent movement and sensation on one side of the body
- Lack of muscle coordination (ataxia) or loss of balance
- Sudden vision loss in one eye; blurred or double vision
- Difficulty swallowing (a primary reason for good airway management in a patient with a stroke)
- Decreased level of responsiveness
- Speech disorders
- Aphasia; difficulty expressing thoughts or inability to use the right words (expressive aphasia) or difficulty understanding spoken words (receptive aphasia)
- Slurred speech (**dysarthria**)
- Sudden and severe headache
- Confusion
- Dizziness
- Weakness
- Combativeness
- Restlessness
- Tongue deviation
- Coma

Left Hemisphere

If the left cerebral hemisphere has been affected by a stroke, the patient may exhibit a speech disorder called **aphasia**, the inability to produce or understand speech. Speech problems can vary widely. Some patients will have trouble understanding speech but will be able speak clearly. You can detect this problem by asking the patient a question such as "What day is today?" The patient may respond with an inappropriate answer such as, "Green." The speech is clear, but it does not make sense. Other patients will be able to understand the question but cannot produce the right sounds to provide an answer. Strokes that affect the left side of the brain can also cause paralysis of the right side of the body.

Right Hemisphere

If the right cerebral hemisphere of the brain is not getting enough blood, the patient will have trouble moving the muscles on the left side of the body. Usually, the patient will understand language and be able to speak, but the words may be slurred and hard to understand.

Interestingly, patients with right hemisphere strokes may be completely oblivious to their problems. If you ask these patients to lift their left arms and they cannot, they will lift their right arms instead. Patients will seem to have forgotten that their left arms even exist. This symptom is called neglect. Patients with conditions affecting the back part of the cerebrum may neglect certain parts of their vision. Generally, this is hard to detect in the field because patients compensate without conscious effort. Nevertheless, be aware of the possibility. Sit or stand on the patient's "good" side because he or she may be unable to see things on the "bad" side.

Neglect and lack of pain causes many patients who have had strokes to delay seeking help. A patient may be unaware that he or she has a problem until someone points out that some part of the patient's body is not functioning properly.

Bleeding in the Brain

Patients with bleeding in the brain (cerebral hemorrhage) may have very high blood pressure. High blood pressure can either cause the bleeding or be a compensatory response to the bleeding. Blood pressure increases as the body attempts to force more oxygen to the area of the brain where the damage is occurring. Remember, the brain is located inside a box (skull) with only a few openings. When bleeding occurs inside the brain, the pressure inside the skull increases. The body must increase the blood pressure to get blood to the brain's tissues, increasing the pressure even further. A trend of increasing blood pressure is an important sign. Blood pressure may then taper off and return to normal. Significant drops in blood pressure may also occur as the patient's condition worsens. Therefore, it is important to monitor the blood pressure for changes in these patients.

Conditions That May Mimic Stroke

The following conditions may appear to be a stroke:

- Hypoglycemia
- A **postictal state** (period following a seizure that lasts between 5 and 30 minutes, characterized by labored respirations and some degree of altered mental status)
- Subdural or epidural bleeding (a collection of blood near the skull that presses on the brain)

Because oxygen and glucose are needed for brain metabolism, a patient with hypoglycemia may present like a patient who is having a stroke. Good patient assessment includes finding out whether the patient's medical history includes diabetes. Always check the blood glucose level in patients with altered mental status if allowed by your local protocol.

A patient in a postictal state may look like a patient who is having a stroke. However, in most cases, a patient who has had a seizure will recover rapidly, within several minutes.

Subdural and epidural bleeding usually occur as a result of trauma. The dura is the leathery covering of the brain that lies next to the skull. A fracture near the temples may cause an artery to bleed on top of the dura, resulting in pressure on the brain **Figure 17-6A**. The onset of epidural bleeding is usually very rapid after injury. When the veins just below the dura bleed, this is referred to as subdural bleeding **Figure 17-6B**. Subdural bleeding is slower than epidural bleeding, sometimes occurring over a period of several days.

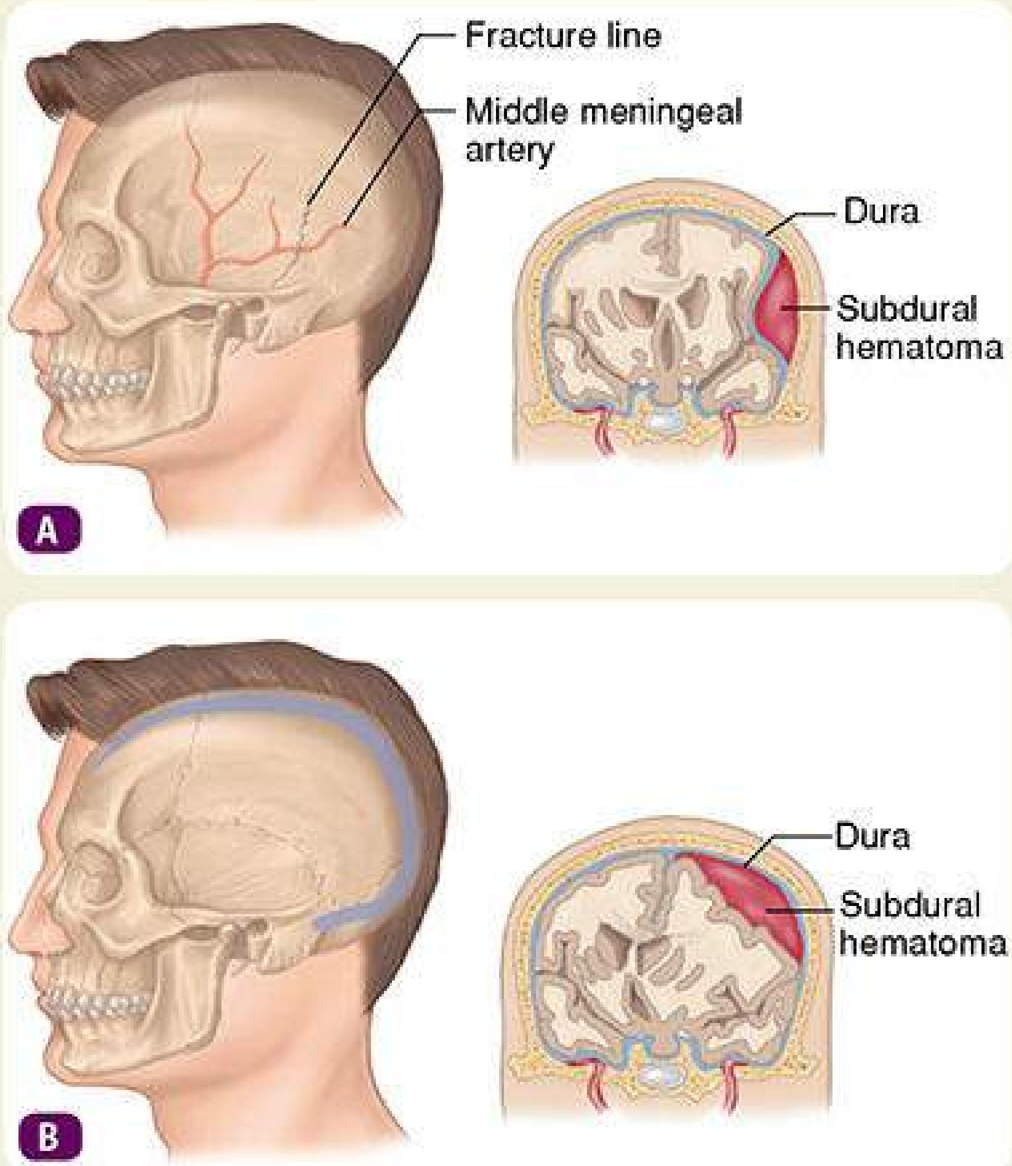

Figure 17-6 Trauma to the head may result in intracranial bleeding. **A.** Bleeding outside the dura and under the skull is called epidural bleeding. **B.** Bleeding beneath the dura but outside the brain is called subdural bleeding.

With subdural and epidural bleeding, the onset of stroke-like signs and symptoms may be subtle. The patient or family may not even remember the original injury that is causing the bleeding.

Words of Wisdom

With epidural hemorrhage after a head injury, the patient may have normal mental status for a period of time (usually minutes to hours), only to deteriorate markedly. This period between injury and deterioration is called a lucid interval.

Seizures

EMS calls frequently involve seizures. A **seizure** is a neurologic episode caused by a surge of electrical activity in the brain. It can take the form of a convulsion, characterized by generalized, uncoordinated muscle activity, and/or can be associated with a temporary alteration in consciousness. An estimated 2 to 3 million people in the United States have **epilepsy**, which is a common cause of seizures. Seizures are classified into two basic groups, generalized and partial (focal).

A **generalized (tonic-clonic) seizure** results from abnormal electrical discharges from large areas of the brain, usually involving both hemispheres. It is typically characterized by unconsciousness and a generalized severe twitching of the body's muscles that lasts several minutes or longer. In other cases, the seizure may simply be characterized by a brief lapse of consciousness in which the patient seems to stare and not to respond to anyone. This type of seizure does not involve any changes in motor activity and is called a petit mal or absence seizure.

A **partial (focal) seizure** begins in one part of the brain. Partial seizures are classified as simple or complex.

In a simple partial seizure, no change occurs in the patient's level of consciousness. Patients may report numbness, weakness, or dizziness. The senses may also be involved; the patient may report visual changes and unusual smells or tastes. A simple partial seizure may also cause twitching of the muscles and the extremities that spreads slowly from one part of the body to another, but it is not characterized by the dramatic severe twitching and muscle movements seen in a generalized seizure. The patient may also experience brief paralysis.

In a complex partial seizure, the patient has an altered mental status and does not interact normally with his or her environment. This type of seizure results from abnormal discharges from the temporal lobe of the brain. Other signs may include lip smacking, eye blinking, and isolated convulsions or jerking of the body or one part of the body such as an arm. The patient may experience unpleasant smells and visual hallucinations, exhibit uncontrollable fear, or exhibit repetitive physical behavior such as constant sitting and standing.

Some seizures occur on only one side of the body. Others begin on one side and gradually progress to a generalized seizure that affects the entire body. Depending on the type of seizure, the patient may have no loss of consciousness but still experience body shaking or muscle tremors. Most people with lifelong or chronic seizures tolerate these events reasonably well without complications, but in some patients, seizures may signal life-threatening conditions.

Often, a patient may experience a warning sign prior to the event. This is referred to as an **aura**. An aura can include visual changes (flashing lights or blind spots in the field of vision) or hallucinations (seeing, hearing, or smelling things that are not actually present). People with a history of seizures recognize their auras and usually take steps to minimize injury, such as sitting or lying down, knowing what is about to happen. However, be aware that auras do not occur prior to every seizure, and not all patients with a seizure disorder experience an aura.

A generalized seizure is characterized by sudden loss of consciousness followed by chaotic muscle movement and tone, and apnea. The patient may experience a tonic phase, usually lasting only seconds, in which there is a period of constant muscle contraction and trembling, tongue biting, bladder incontinence, or bowel incontinence. During a generalized seizure, the patient may exhibit bilateral movement characterized by a cycle of muscle rigidity and relaxation usually lasting 1 to 3 minutes. Throughout a generalized seizure, the patient exhibits tachycardia, hyperventilation, sweating, and intense salivation.

Generalized seizures last 3 to 5 minutes and are followed by a lengthy period (5 to 30 minutes or more) called a postictal state, in which a patient is unresponsive at first and gradually regains consciousness. The postictal state is over when the patient regains a complete return of his or her normal level of consciousness. In most cases, the patient will gradually begin to recover and awaken but appear dazed, confused, and fatigued. In contrast, an absence (formerly called petit mal) seizure may last for just seconds, after which the patient fully recovers with only a brief lapse of memory of the event.

Seizures lasting more than 5 minutes are likely to progress to **status epilepticus**, which describes seizures that continue every few minutes without the person regaining consciousness or last longer than 30 minutes.

Recurring or prolonged seizures should be considered potentially life-threatening situations in which patients need emergency medical care. If the patient does not regain consciousness or the seizure continues, protect the patient from self-harm, and call for advanced life support (ALS) backup. These patients need advanced airway management and medication to stop the seizure.

Causes of Seizures

Some seizure disorders, such as epilepsy, are congenital. Other types of seizures may be caused by high fevers, structural problems in the brain, or metabolic or chemical problems in the body Table 17-2. In addition, a percentage of the population will experience a seizure for which the cause cannot be determined (idiopathic). Epileptic seizures can usually be controlled with medications. Medications used most often to treat seizures include the following:

- Levetiracetam (Keppra)
- Phenytoin (Dilantin)
- Phenobarbital
- Carbamazepine (Tegretol)
- Valproate (Depakote)
- Topiramate (Topamax)
- Clonazepam (Klonopin)

Patients with epilepsy will often have seizures if they stop taking their medications or if they do not take the prescribed dose on a regular basis.

Seizures may also be caused by abnormalities in the brain, such as a benign or cancerous tumor, an infection (brain abscess, meningitis), or scar tissue from some type of injury. These seizures are said to have a structural cause. Seizures from a metabolic cause may result from abnormal levels of certain blood chemicals (eg, extremely low sodium level), **hypoglycemia** (low blood glucose level), poisons, drug overdoses, or sudden withdrawal from routine heavy alcohol or sedative drug use or even from prescribed medications. Phenytoin, a drug that is used to control seizures, may itself cause seizures if the person takes too much.

Table 17-2 Common Causes of Seizures

Type	Cause
Epileptic	Congenital origin
Structural	Tumor (benign or cancerous) Infection (brain abscess) Scar tissue from injury Head trauma Stroke
Metabolic	Hypoxia Abnormal blood chemical values Hypoglycemia Poisoning Drug overdose Sudden withdrawal from alcohol or medications
Febrile	Sudden high fever

YOU are the Provider — PART 3

Your partner reports the patient's vital signs. The patient tells you she is nauseated and her headache, which is still severe, is located on both sides of her head. She further tells you the last thing she remembers was the sudden, severe headache. When she woke up, she was lying on the floor with a pillow under her head. Her sister tells you she caught the patient before she struck the ground.

Recording Time: 4 Minutes	
Respirations	14 breaths/min; adequate depth
Pulse	100 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	200/112 mm Hg
Oxygen saturation (Spo_2)	96% (on oxygen)

The patient's blood glucose level is assessed and noted to be 97 mg/dL. Her sister hands you the patient's medication list, which includes benazepril, clopidogrel (Plavix), and metformin. The patient says she is noncompliant with her medication regimen.

6. What is your field impression of this patient? Why?
7. On the basis of your last assessment, what is the patient's Glasgow Coma Scale score?

Seizures may also result from sudden high fevers, particularly in children. These **febrile seizures** are frightening for parents but are generally well tolerated by the child. Nevertheless, you must transport a child who has had a febrile seizure because this condition needs to be evaluated in the hospital. It is possible a second seizure may occur. If it does, the patient requires rapid transport to the hospital so possible causes can be identified.

The Importance of Recognizing Seizures

Regardless of the type or the cause of a seizure, it is important for you to recognize when a seizure is occurring or whether one has already occurred. You must also determine whether this episode differs from any previous ones. For example, if the previous seizure occurred on only one side of the body and this seizure occurs over the entire body, an additional or new problem may be involved. In addition to recognizing that seizure activity has occurred and/or that something different may now be occurring, you must also recognize the postictal state and the complications of seizures.

Because most seizures involve a vigorous twitching of the muscles, the muscles use a lot of oxygen. This excessive demand consumes oxygen that is needed for the vital functions of the body. As a result, there is a buildup of acids in the bloodstream, and the patient may turn cyanotic (bluish lips, tongue, and skin) from the lack of oxygen. Often, the seizures themselves prevent the patient from breathing normally, making the problem worse. In a patient with diabetes, the blood glucose level may decrease because of the excessive muscular contraction of a seizure. If your local protocol allows, closely monitor the blood glucose level after a patient with diabetes has a seizure.

Safety Tips

Be aware that a patient may behave violently during the postictal state. Although most patients who have had a seizure pose no threat to EMS personnel, signs of alcohol or other drug abuse should heighten your awareness of the potential for dangerous behavior.

Recognizing seizure activity also means looking at other problems associated with the seizure. For example, the patient may have fallen during the seizure episode and been injured; head injury is the most serious possibility. Some patients may experience **incontinence** during a generalized seizure, meaning that they may have a loss of bowel or bladder control. Therefore, one clue that unresponsive or confused patients may have had a seizure is to find that they were incontinent. Although incontinence can occur with other medical conditions, sudden incontinence is very likely a sign of a seizure. When the patient regains consciousness, he or she is likely to be embarrassed by this temporary loss of control. Minimize the patient's discomfort by covering the patient and assuring him or her that incontinence is part of the loss of control that accompanies a seizure.

Words of Wisdom

The physician's examination of a patient who has had a seizure will be aided greatly by information you provide about the seizure pattern and changes in that pattern. Record all pertinent information about the seizure in terms of duration, areas of body movement, and possible triggering factors. This requires effective interviewing of available witnesses, family members, and/or caregivers.

The Postictal State

Once a seizure has stopped, the patient's muscles relax, becoming almost flaccid, or floppy, and the breathing becomes labored (fast and deep) in an attempt to compensate for the buildup of acids in the bloodstream. By breathing faster and more deeply, the body can balance the acidity in the bloodstream. With normal circulation and liver function, the acids clear away within minutes, and the patient will begin to breathe more normally. The longer and more intense the seizures, the longer it will take for this imbalance to correct itself. Likewise, longer and more severe seizures will result in longer postictal unresponsiveness and confusion. Once the patient regains a normal level of consciousness, the postictal state is over.

Words of Wisdom

Interventions during the postictal state are very important. Patients may be unable to maintain an open airway because of their relaxed and exhausted state; therefore, patient positioning, clearing the airway of secretions, and preventing aspiration are critical steps for achieving the best patient outcomes.

In some situations, the postictal state may be characterized by **hemiparesis**, or weakness on one side of the body, resembling a stroke. Unlike a stroke, however, hypoxic hemiparesis soon resolves. Most commonly, the postictal state is characterized by lethargy and confusion to the point that the patient may be combative. Be prepared for these circumstances in your approach to scene control and in your treatment of the patient's symptoms. If the patient's condition does not improve, consider other possible underlying conditions such as hypoglycemia or infection.

Special Populations

Status epilepticus is harmful at any age, but because of physical changes caused by the normal aging process, geriatric patients are at greater risk of hypoxia, hypotension, and/or cardiac dysrhythmias.

Syncope

Seizures are often mistaken for **syncope** (fainting); however, fainting typically occurs while the patient is standing, whereas seizures may occur in any position. Fainting is not associated with a postictal state.

Altered Mental Status

Aside from stroke and seizures, the most common type of neurologic emergency you will encounter is a patient with altered mental status. Simply put, **altered mental status** means the patient is not thinking clearly or is incapable of being aroused. In some cases, the patient will be unconscious; other times, the patient may be alert but confused **Figure 17-7**. The range of problems is wide and the causes are many, including hypoglycemia, hypoxemia, intoxication, delirium, drug overdose, unrecognized head injury, brain infection, body temperature abnormalities, brain tumors, and overdoses and/or poisonings.

Causes of Altered Mental Status

Hypoglycemia

The clinical picture of patients with altered mental status caused by hypoglycemia is very complex. Because oxygen and glucose are needed for brain function, hypoglycemia can mimic conditions in the brain associated with stroke. In these cases, the patient may have hemiparesis similar to that seen with a stroke. The principal difference is that a patient who has had a stroke may be alert and attempting to communicate normally, whereas a patient with hypoglycemia almost always has an altered or decreased level of consciousness **Figure 17-8**.

Patients with hypoglycemia commonly, but not always, take medications that lower their blood glucose level. Thus, if the patient appears to have signs and symptoms of stroke and altered mental status, report your findings to medical control and treat the patient accordingly. Remember, patients with a decreased level of consciousness should not be given anything by mouth.

Figure 17-7 Some patients with altered mental status may be unconscious; others may be alert but confused.

Figure 17-8 During your assessment of a patient with an altered or decreased level of consciousness, consider the possibility of hypoglycemia.

Patients with hypoglycemia may also experience seizures, and you may arrive at the scene to find a patient in a postictal state: confused and disoriented or unresponsive. The mental status of a patient who has had a typical seizure is likely to improve soon after the seizure stops. In a patient with hypoglycemia, on the other hand, mental status is not likely to improve, even after several minutes. Consider the possibility of hypoglycemia in a patient who has had a seizure, especially if the patient has a history of diabetes.

Likewise, consider hypoglycemia in a patient who has altered mental status after an injury such as a motor vehicle crash, even when there is the possibility of an accompanying head injury. As with any other patient, look for medical identification jewelry or medications that might confirm your suspicions.

Words of Wisdom

Always remember that altered mental status is a symptom, not a disease.

Words of Wisdom

A helpful mnemonic to use when reviewing the possible causes of altered mental status is AEIOU TIPS:

A Alcohol

E Epilepsy, endocrine, electrolytes

I Insulin

O Opiates and other drugs

U Uremia (kidney failure)

T Trauma, temperature

I Infection

P Poisoning, psychogenic causes

S Shock, stroke, seizure, syncope, space-occupying lesion, subarachnoid hemorrhage

Delirium

Delirium is a symptom, not a disease. It presents as a new complaint, rather than a long-standing alteration in behavior. It is a temporary state that often has a physical or mental cause (eg, infection, changes in medications, hypoxia) and may be reversed with proper treatment.

Signs and symptoms include confusion and disorientation, disorganized thoughts, inattention, memory loss, striking changes in personality and affect, hallucinations, delusions, or a decreased level of consciousness. The patient may experience a rapid alteration between mental states such as lethargy and agitation. Symptoms of delirium may mimic intoxication, drug abuse, or severe psychological disorders such as schizophrenia. Delirium is discussed in detail in Chapter 35, *Geriatric Emergencies*.

Other Causes of Altered Mental Status

Other causes of altered mental status include unrecognized head injury and severe alcohol intoxication. Considering other possibilities is important because a patient with altered mental status may be combative and may refuse treatment and transport. Be prepared for difficult patient encounters and follow local protocols for dealing with these situations.

In most cases, a patient who appears intoxicated is just that; however, you must consider other causes as well. A person with chronic alcoholism may have decreased liver function, blood clotting, and immune system abnormalities, causing a predisposition to intracranial bleeding, brain and bloodstream infections, and hypoglycemia.

Psychological disorders and medication complications are also possible causes of altered mental status. A person who appears to have a psychological disorder may also have an underlying medical condition.

Infections, particularly those involving the brain or bloodstream, are another possible cause of altered mental status. Infections in the brain and bloodstream are life threatening and require immediate medical attention. Patients may not demonstrate the typical signs of infection, such as fever, particularly if they are very young or very old or have an impaired immune system. Altered mental status may also be caused by a drug overdose or poisoning.

Patient Assessment

Scene Size-up

Your dispatcher may obtain a lot of information about your patient or very little. In some calls, the description of the patient's signs and symptoms will give you a fairly good idea of what the problem may be (the patient has slurred speech or one-sided paralysis). In other calls, the description may be vague (the patient has a headache). Dispatchers are frequently given information regarding a seizure by the caller. Even if the caller has never seen a seizure before, on the basis of the caller's description of the convulsions, the dispatcher will be able to convey this information to the responding crew.

Special Populations

Children can have altered mental status caused by strokes, seizures, high or low blood glucose levels, infection (eg, meningitis), poisoning, or tumors. Hemorrhagic strokes are usually caused by congenital defects in blood vessels, such as berry aneurysms. Ischemic strokes can be caused by disorders such as sickle cell anemia. Children who have sickle cell anemia are at a particularly high risk for ischemic stroke. Treat stroke and altered mental status in children the same way you do in adults.

Remember, seizures can result from sudden high fevers, particularly in children. Also remember that although febrile seizures are generally well tolerated by children, you must provide rapid transport to the hospital. The possibility of a second seizure makes transport mandatory so that if other problems develop, the child is in the hospital and can receive immediate definitive care.

If you suspect that a patient with altered mental status has hypoglycemia and you are trained and approved to do so, use your glucometer to test the blood glucose level and treat the patient according to local protocols. The patient will require close monitoring, particularly of the airway, en route to the hospital.

Patients with altered mental status may exhibit a wide range of signs and symptoms and behaviors. The most significant difference between a patient with altered mental status and other emergencies is that a patient with altered mental status cannot reliably tell you what is wrong, and there may be more than one cause. Make an early determination whether the call is medical or trauma related because this will help determine the approach of care for the patient.

Do not be distracted by the seriousness of the situation or by frightened family members who want you to rush. Look first for threats to your safety, and follow standard precautions.

Consider the need for spinal immobilization based on dispatch information and your assessment of the scene as you approach the patient. Many calls involving a neurologic emergency require ALS assistance if it is available. Call for additional resources early.

Look for clues to help you determine the nature of the illness. Special considerations for a patient with a suspected neurologic emergency include an evaluation of the patient's environment, assessing for any signs of potential trauma (mechanism of injury), indications of a medical condition, such as diabetic supplies, medical alert tags, and evidence of a seizure. Answers to the following questions may help you determine the nature of the illness: Did anyone witness what happened? When was the last time the patient appeared normal? Is the patient's bed or furniture in disarray? Most patients with a neurologic emergency display a change in their level of consciousness and their ability to interact with their environment and others.

Primary Assessment

Your first priority is to look for and treat any life-threatening conditions. Perform a rapid exam. Patients become unresponsive or have an altered level of consciousness, especially from a neurologic cause, for many reasons. Use a sound approach to assessing the airway, breathing, and circulation to have significant impact on how well these systems respond to your care and treatment.

As you approach the patient, gather information from the scene (is this medical or trauma related?) and note the patient's body position and level of consciousness. This initial impression will help you determine the severity of the situation and help set the pace of your call. A patient lying on the ground in an unnatural position is more likely to have a potentially life-threatening condition than one sitting up in bed. In a call that indicates that a seizure is taking place, you should be able to tell whether the patient is still having a seizure. Unless your arrival time is one minute or less, most seizures will be over by the time you arrive. If the seizure is still occurring, the potentially life-threatening condition of status epilepticus may be present. If the patient is in a postictal state, he or she may be unresponsive or starting to regain awareness of the surroundings. When you treat any patient with altered mental status, first determine the patient's level of consciousness. To assess the patient's level of consciousness, use the AVPU scale.

As with any other situation, focus on the patient's airway and breathing on arrival. Stroke affects how the body functions in many ways. Patients may have difficulty swallowing and are at risk for choking on their own saliva. Evaluate the airway of an unresponsive patient to make sure it is patent and will remain so **Figure 17-9**. If the patient requires assistance maintaining an airway, consider an oropharyngeal or nasopharyngeal airway. Be prepared to provide suction, and position the patient to prevent aspiration. If you determine that the patient cannot protect his or her airway, place the patient in the recovery position to help prevent secretions from entering the airway.

A patient who has had or is having a seizure may have been eating or chewing gum at the time of the seizure, so check for foreign body obstruction. Bystanders may have tried to put objects in the patient's mouth to keep the person from "swallowing the tongue," even though this practice is not advised.

Figure 17-9 Securing and maintaining the airway in a patient who is unconscious is extremely important. Have suction readily available in case the patient vomits.

Assess the patient's breathing. All patients with altered mental status, regardless of the cause, should receive high-flow oxygen. Seizures cause patients to use oxygen quickly, resulting in hypoxia. Again, in the immediate postictal state following a seizure, you should anticipate rapid, deep respirations and an accompanying fast heart rate as a result of the stress of the severe convulsions. However, the respirations and the heart rate should begin to slow to normal rates after several minutes.

It is important to ventilate the patient at the appropriate rate with the proper volume. Deliver each breath during a period of 1 second (just enough to produce visible chest rise) at a rate of 10 to 12 breaths/ min. Do not hyperventilate the patient; doing so may have several negative consequences. Hyperventilation overinflates the lungs, which can impair blood return to the right atrium and cause a decrease in cardiac output. Hyperventilation also increases the risks of regurgitation and aspiration. In addition to the risks already discussed, hyperventilation may cause severe injury in patients with intracerebral bleeding and increased intracranial pressure; it causes cerebral vasoconstriction, which shunts blood (and oxygen) away from the brain. This decrease in cerebral perfusion may cause further injury to the brain.

Circulation should be confirmed as normal or treated as necessary. Your assessment of the patient's circulation should begin with checking the pulse if the patient is unresponsive. If no pulse is found, immediately begin cardiopulmonary resuscitation, and attach an automated external defibrillator. If the patient is responsive, determine whether the pulse is fast or slow, weak or strong. Oxygen administration is helpful for limiting the effects of hypoperfusion of the brain. Evaluate the patient quickly for external bleeding. A patient with a stroke is unlikely to have sustained trauma; it is more likely in a patient who has had a seizure. Consider this possibility and assess appropriately.

YOU are the Provider — PART 4

An engine crew arrives shortly before you load the patient onto the stretcher. Shortly after loading her into the ambulance, you reassess her and note that her condition has deteriorated. One of the engine crew EMTs accompanies you in the back of the ambulance, and you proceed to the hospital.

Recording Time: 10 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	6 breaths/min; snoring, irregular, and shallow
Pulse	60 beats/min; bounding
Skin	Pink, warm, and dry
Blood pressure	198/110 mm Hg
Spo_2	94% (on oxygen)

8. What should be your most immediate action?
9. What additional treatment does this patient require?

Establish your priorities of care based on your assessment of the patient's level of consciousness and the ABCs. How the patient is presenting will guide you as to whether you stay at the scene for further assessment or proceed to immediate transport. If you suspect the patient is experiencing a stroke, provide rapid transport to an appropriate facility. Prompt treatment is a critical action to minimize the disability caused by an ischemic stroke.

History Taking

If the patient is unresponsive, you will need to gather any history of the present illness from family or bystanders. If no one is around, quickly look for explanations for the altered mental status (eg, signs of trauma, medical alert tags, track marks resulting from intravenous drug injections, environmental clues such as empty alcohol or medication containers).

To determine the chief complaint in a responsive patient, begin by asking the patient what happened. Look for signs and symptoms that may indicate a cause for the patient's altered mental status, such as a stroke (eg, hemiparalysis or one-sided weakness), or if there is any evidence of a seizure (eg, incontinence, bitten tongue). Evaluate the patient's speech. Is the patient making sense? Is his or her speech slurred?

If you know that the patient has had a seizure and is now in a postictal state, you will not be able to obtain a history from the patient. Look for any obvious trauma or explanations as to why the patient may have had a seizure.

If the patient is responsive and breathing, obtain a SAMPLE history. Also speak with family or friends who may be able to explain the events leading up to the altered mental status **Figure 17-10**, remembering that time is critically important in a neurologic emergency. Make a special effort to determine the exact time that the patient last appeared to be healthy. In the case of a patient having a stroke, this information will help physicians decide whether it is safe to begin certain treatments that must be given within the first hours after the onset of stroke symptoms. You may be the only person with the opportunity to speak with bystanders to obtain this critical information. Many times, you will be able to find out only that the patient was healthy when he or she went to sleep the night before. In those cases, the time the patient was last seen to be healthy was at bedtime, not when the patient awoke with symptoms. Collect or list all medications the patient has taken. When possible, determine allergies and the patient's last oral intake.

Figure 17-10 Speak with family members or bystanders who may know what happened. They may be able to tell you when the patient last appeared healthy.

Although a patient who has had a stroke may appear to be unconscious and unable to speak, the patient may still be able to hear and understand what is taking place. Therefore, avoid making unnecessary or inappropriate remarks. Communicate with the patient by looking for indications that the patient may understand you, such as a glance, gaze, motion or pressure of the hand, effort to speak, or head nod. Reassure your patient that you understand that communication between the two of you may be difficult at this point but that you will provide him or her with continuous information as to what you and the other team members are doing. Establish effective communication to help you calm the patient and lessen the fear that accompanies an inability to communicate **Figure 17-11**. Keep in mind that the patient has just experienced a potentially life-threatening event and that anxiety, frustration, and embarrassment may inhibit communication with you.

With patients who have had a seizure, your SAMPLE history should reveal if the patient has a history of seizures. If so, it is important to find out how the patient's seizures typically occur and whether this episode differs in some way from previous episodes. Also, ask what medications the patient has been taking, and note medications used to treat a seizure disorder. You might find that the patient ran out of medication or stopped taking the medication for a time. A patient who has a history of seizures *and* diabetes may use up all the glucose in the body to fuel the seizure.

Figure 17-11 Make a special effort to establish communication with a patient who may have had a stroke, seizure, or other neurologic emergency that impairs the patient's ability to communicate. Look for indications that the patient understands you, such as a glance, gaze, squeeze of the hand, efforts to speak, or nodding of the head.

If a patient with no history of seizures suddenly has a seizure, a serious condition should be suspected, such as a brain tumor, intracranial bleeding, or serious infection. This part of the patient assessment process is the time to determine whether the patient takes medications that lower blood glucose, such as insulin or oral hypoglycemic agents. In other situations, you may want to inquire about illicit drug use or exposure to poisons.

Words of Wisdom

When assessing a patient who might have had a stroke, it is important to pinpoint when the symptoms first started. Typically, there is a 3-hour window in which outcomes are greatly improved if the patient receives treatment. During transport, notify the receiving hospital of when the patient's symptoms first began. When appropriate, this will allow hospitals to activate stroke alerts and be ready to immediately start treating these patients as soon as they enter the ED. If the receiving hospital's CT scanner is not available, it may be better to divert to another facility with a functional CT scanner. Follow your local protocols.

Safety Tips

Be aware of the potential for a patient to become violent during a neurologic emergency. When alcohol or drugs are part of a patient's SAMPLE history, the potential for this type of behavior increases.

Secondary Assessment

Your assessment of the patient should continue with a secondary assessment of the entire body, paying particular attention to the system involved. If you suspect your patient is having a stroke, then you should direct particular attention to the neurologic assessment. As always, your secondary assessment should include a complete set of vital signs using the monitoring devices you have available.

Patients with significant intracranial bleeding (hemorrhagic stroke) may have a great deal of pressure in the skull that is compressing the brain, thus slowing the pulse and causing respirations to be erratic. Blood pressure is usually high to compensate for poor perfusion in the brain. Unequal pupil size and reactivity indicate significant bleeding and pressure on the brain. If the patient has altered mental status (regardless of the cause), check the blood glucose level if your local protocol allows. Most commonly, this is done using a portable blood glucose monitor (glucometer), similar to the one your patient may use at home. The portable blood glucose monitor measures the glucose level in whole blood, using capillary or venous samples. Chapter 9, *Patient Assessment,* discusses the use of a glucometer in more detail.

Evaluating vital signs is impossible during most active seizures, and this should not be your priority. In most cases, the vital signs of a patient in a postictal state will be close to normal limits. Obtain pulse rate, rhythm, and quality; respiratory rate, rhythm, and quality; blood pressure; skin color, temperature, and condition; and pupil size and reactivity.

It is recommended that the first blood pressure reading be taken manually, with a sphygmomanometer (blood pressure cuff) and a stethoscope. You may also use noninvasive methods to monitor blood pressure.

Stroke Assessment

A stroke assessment tool should be part of your secondary assessment. Many EMS units use stroke scales to rapidly identify stroke in the field. Stroke scales evaluate the face, arms, and speech. If the patient does not have a normal response to these evaluations, you should strongly suspect a stroke. Rapid transport to a designated stroke center is indicated.

The Cincinnati Prehospital Stroke Scale **Table 17-3** and the Los Angeles Prehospital Stroke Screen **Table 17-4** are commonly used.

To test speech, ask the patient to repeat a simple sentence such as "The sky is blue in Cincinnati." If the patient does this correctly, you know the patient understands and can produce speech. If the patient cannot repeat the phrase, the problem may be with either understanding speech or producing it.

To test facial movement, ask the patient to smile, showing his or her teeth (or gums if the patient does not have teeth). Watch whether both sides of the face around the mouth move equally. If only one side is moving well, you know something is wrong with the control of the muscles on the other side.

Table 17-3 Cincinnati Prehospital Stroke Scale

Test	Normal Response	Abnormal Response
Facial droop (Ask patient to show teeth or smile.)	Both sides of face move equally well.	One side of face does not move as well as other.
Arm drift (Ask patient to close eyes and hold both arms out with palms up.)	Both arms move the same, or neither arm moves. (The latter response requires a retest because it may indicate the patient did not understand the instructions.)	One arm does not move, or one arm drifts down compared with the other side.
Speech (Ask patient to say, "The sky is blue in Cincinnati.")	Patient uses correct words with no slurring.	Patient slurs words, uses inappropriate words, or is unable to speak.

YOU are the Provider PART 5

You continue treatment en route to the hospital. You reassess the patient and note that her condition has deteriorated further. Her pupils are unequal, and she exhibits decorticate posturing (flexion posturing to painful stimulus). You call in your report to the receiving facility, with an estimated time of arrival of 6 minutes.

Recording Time: 17 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	6 breaths/min; irregular and shallow
Pulse	64 beats/min; bounding
Skin	Pink, warm, and dry
Blood pressure	194/104 mm Hg
Spo_2	98% (on oxygen)

You arrive at the hospital and transfer patient care to the emergency department (ED) staff. After further treatment in the ED, a computed tomographic scan of the patient's brain was performed and revealed massive intracerebral hemorrhage. Despite aggressive treatment in the intensive care unit, the patient died the next day.

10. What do unequal pupils indicate?

11. On the basis of your last assessment, what is the patient's Glasgow Coma Scale score?

Table 17-4 Los Angeles Prehospital Stroke Screen

Criterion	Yes	Unknown	No
1. Age >45 y	☐	☐	☐
2. History of seizures or epilepsy absent	☐	☐	☐
3. Symptoms <24 h	☐	☐	☐
4. At baseline, patient is not wheelchair-bound or bedridden	☐	☐	☐
5. Blood glucose between 60 and 400 mg/dL	☐	☐	☐
6. Obvious asymmetry (right versus left) in any of the following three exam categories (must be unilateral):			
	Equal	**Right Weak**	**Left Weak**
Facial smile/grimace	☐	☐ Droop	☐ Droop
Grip	☐	☐ Weak grip ☐ No grip	☐ Weak grip ☐ No grip
Arm strength	☐	☐ Drifts down ☐ Falls rapidly	☐ Drifts down ☐ Falls rapidly

Interpretation: If all criteria 1–6 are marked yes, the probability of a stroke is 97%.

To test arm movement, ask the patient to hold both arms in front of his or her body, palms up toward the sky, with eyes closed and without moving. During the next 10 seconds, watch the patient's hands. If you see one side drift down toward the ground, you know that side is affected. If both arms stay up and do not move, you know both sides of the brain are functioning. If both arms fall to the ground, you have not really learned anything. Perhaps the patient did not understand your instructions. Perform the arm test again, but this time you move the patient's arms into position yourself.

In addition, a newer scoring system called the 3-Item Stroke Severity Scale, sometimes called the LAG scale, looks specifically at three items—***l***evel of consciousness, ***a***rm drift (motor function), and *g*aze. This system may be used to assess the likelihood your patient is having a stroke. Each item is scored from 0 to 2, with zero (0) being "normal" and two (2) being a severe abnormality Table 17-5. Data show that a score of 5 or 6 indicates a high probability the patient is having a stroke. Become familiar with what is used in your local protocol.

The FAST mnemonic can also be used in assessing for a stroke:

- **F**acial droop (ask the patient to smile; look for a droop on either side of the patient's face)
- **A**rm drift (ask the patient to close his or her eyes and hold arms out with palms up, then watch for one to drift down)
- **S**peech (ask the patient to repeat a simple phrase, then listen for slurred speech)
- **T**ime (note the time the patient was last seen acting normally)

Calculate the GCS score Table 17-6 for all patients with altered mental status (stroke, TIA, seizure, of unknown cause).

Table 17-5 3-Item Stroke Severity Scale (LAG)

Item	Criteria	Score
Level of consciousness	Normal Mild dysfunction Severe dysfunction (unconscious)	0 1 2
Arm drift (hemiparesis)	Normal function Mild dysfunction Severe dysfunction (flaccid)	0 1 2
Gaze	Normal gaze (follows pen/finger to left and right sides) Mild dysfunction Severe dysfunction (fixed gaze)	0 1 2
Score (total)		**>4 indicates stroke is likely**

Table 17-6 Glasgow Coma Scale (GCS)

Eye Opening		Best Verbal Response		Best Motor Response	
Spontaneous	4	Oriented conversation	5	Obeys commands	6
In response to speech	3	Confused conversation	4	Localizes pain	5
In response to pain	2	Inappropriate words	3	Withdraws to pain	4
None	1	Incomprehensible sounds	2	Abnormal flexion	3
		None	1	Abnormal extension	2
				None	1

Score: 13–15 may indicate mild dysfunction, although 15 is the score a person without neurologic disabilities would receive.
Score: 9–12 may indicate moderate dysfunction.
Score: 8 or less is indicative of severe dysfunction.

Reassessment

The reassessment should focus on reassessing the ABCs, vital signs, and interventions provided so far. Patients who have had a stroke may have airway loss or stop breathing without warning. Multiple interventions may be necessary. The effectiveness of airway adjuncts, positive-pressure ventilations, and other treatments can be determined only with immediate and continuous observation after providing the intervention. If an intervention is not working, try something else.

You have already established baseline vital signs during your assessment, as well as a GCS score. Now is the time to compare that baseline information with updated information. Any changes may indicate if treatments are effective. Watch carefully for changes in pulse, blood pressure, respirations, and GCS scores.

Words of Wisdom

The following is key information to document for a patient who may have had a stroke:

- Time of onset of the signs and symptoms
- Score on the Glasgow Coma Scale
- Results of a stroke assessment tool (Cincinnati, Los Angeles, LAG, or FAST)
- Changes noted on reassessment

Establishing the time of onset is critical information because it helps determine whether the patient is a candidate for treatment with blood clot-dissolving drugs.

Notify the receiving facility of your patient's chief complaint and your assessment findings. Your local protocol will tell you if the designated stroke centers in your call area want you to call in a "stroke alert" for patients you have assessed and found to be having a stroke. This will alert the stroke team members at the hospital and give them time to assemble their resources to be ready to treat the patient without delay. Report the time the patient last appeared to be healthy, the findings of your neurologic examination, and the time you anticipate arriving at the hospital.

A key piece of information to document is the time of onset of the patient's signs and symptoms. If the diagnosis is an ischemic stroke, time of onset of the signs and symptoms is critical information in determining whether the patient is a candidate for treatment with blood clot-dissolving drugs. It is also important to document your findings from your stroke scale and the score of the GCS, along with any changes you found in your reassessment. Document airway management and interventions performed, including the position in which the patient was placed.

For patients who have had a seizure, give a description of the seizure activity if known. Include bystanders' comments if they witnessed the seizure. Document the onset and duration of the seizure. Did the patient mention noticing an aura? Record any evidence of trauma and interventions performed. Document whether this is the patient's first seizure or whether the patient has a history of seizures. If the patient has a history of seizure activity, determine how often the seizures occur, and if there is any history of status epilepticus. Document your interventions and record the time the intervention was performed, the patient's response to the intervention, and the findings of continued reassessments.

Emergency Medical Care

A patient with stroke, seizure, hypoglycemia, or hypoxia typically shows relatively easily identifiable signs or symptoms, and treatment options are readily available. With other neurologic emergencies, the cause of the patient's symptoms will not always be obvious, and more time and diagnostic testing may be needed at the hospital to determine the cause. This may make it difficult for you to provide definitive treatment in the field. Most of your interventions will be based on your assessment findings. For example, if the blood glucose level is low, you may give oral glucose according to your local protocol; if a patient is unresponsive, you may need to position him or her in the recovery position to protect the airway. Remember, never give anything orally to a patient with altered mental status or to a patient who is unable to swallow normally, as this may result in aspiration. Your best treatment in these situations is to perform a thorough assessment and maintain the ABCs.

In most patients with a suspected stroke, the physicians in the emergency department (ED) will need to determine whether there is bleeding in the brain. If there is no bleeding, the patient may be a candidate for blood clot-dissolving medication that may help brain cells survive. However, if bleeding is present this medication will increase the bleeding, with disastrous consequences. The only reliable way to tell whether there is bleeding in the brain is with a special type of imaging test called a computed tomography (CT) scan of the head. Blood is usually easy to see on the CT scan.

Some EMS systems designate specific hospitals, typically accredited stroke centers, to receive patients who may be having a stroke. These institutions have CT technicians, radiologists, and neurosurgeons on duty 24 hours a day. Most hospitals that are not accredited stroke centers have only one CT scanner and may not have CT technicians available 24 hours a day. It is important that you recognize the signs and symptoms of a stroke and notify the hospital staff as early as possible if you have a "stroke alert" patient. If the ED staff knows you are transporting a possible stroke patient, they can call in the technician if needed or may be able to free up the CT scanner so it is immediately available. Keep in mind that most treatments for stroke must be started as soon as possible after the onset of the event **Table 17-7**. Only a limited number of treatments are available that are effective if started more than 3 hours after the stroke begins. Even if 3 hours have passed, however, prompt action on your part is essential. It is very important to notify the hospital regarding the last time the patient was known to be well (without their current signs and symptoms of stroke).

Table 17-7 Tips on Patient Care

- Patients who experience a transient ischemic attack (TIA) may exhibit most of the same signs and symptoms as patients who are having a stroke. These signs and symptoms may last from minutes up to 24 hours. Therefore, the signs of stroke that you note on arrival may gradually disappear. Patients who appear to have had a TIA should be transported for further evaluation.
- Place the patient's affected or paralyzed extremity in a secure and safe position during patient movement and transport.
- Some patients who have had a stroke may be unable to communicate, but they can often understand what is being said around them. Be aware of this possibility.
- New therapies for stroke are available but must be used as soon as possible after the start of symptoms. Minimize time on the scene, and notify the receiving hospital as soon as possible.

In most situations, patients who have had a seizure require definitive evaluation and treatment in the hospital. Unless the patient has a well-established history of seizures and is completely alert and oriented, supplemental oxygen is strongly advised, both to provide extra oxygen and to prevent the possibility of a recurrent seizure.

Words of Wisdom

Use the same process as with all other patients in determining whether an adequate airway is present and whether the patient is able to sufficiently maintain that airway on his or her own. Do not assume that a patient who has had a seizure is in need of an airway adjunct.

Seizures are usually short-lived. Most seizures will not require a significant amount of intervention on your part because the seizure will have ended by the time you arrive. For patients who are having a seizure, protect them from harm, maintain a clear airway by suctioning as necessary, and administer oxygen as quickly as possible. If head or neck trauma is suspected, provide spinal immobilization. With recurrent seizures, protect the patient from further injury, and manage the airway once the seizure ceases.

For patients who continue to have a seizure, as in status epilepticus, suction the airway, provide positive-pressure ventilations (bag-valve mask [BVM] ventilations), and transport quickly to the hospital. If you have the option to rendezvous with ALS, you should do so. ALS providers have medications that can stop a prolonged seizure.

In all cases, show patience and tolerance because many of the patients are likely to be confused and occasionally frightened. Many patients who experience seizures are frustrated with their condition and may refuse transport. Kindness and professional behavior are required to help convince the patient that transport is necessary for definitive care.

Headache

As discussed earlier, most headaches are harmless and do not require emergency medical care. However, be concerned if the patient complains of a sudden-onset, severe headache or a sudden headache that has associated symptoms. Headaches with fever, seizures or altered mental status, or following head trauma are potentially life threatening. Complete a thorough patient assessment, and transport the patient to the hospital.

Migraine

Treatment of a migraine headache is supportive; however, always assess the patient for other signs and symptoms that might indicate a more serious condition. Applying high-flow oxygen, if tolerated, may help ease the patient's condition. When possible, provide a darkened and quiet environment because patients with migraines are sensitive to light and sound. Do not use lights and siren during transport.

Stroke

Management of a patient having a stroke in the field is based on supporting the ABCs and providing rapid transport to a stroke center. Depending on the location of the stroke in the brain and the signs and symptoms, the patient may require manual airway positioning. Patients may have difficulty swallowing and controlling their own secretions; therefore, use suction as needed. Provide oxygen to maintain a Spo_2 level of at least 94%, and monitor the patient's oxygen saturation with a pulse oximeter. Routine use of oxygen therapy in a stroke patient is not recommended unless the patient is experiencing respiratory distress or is showing signs of hypoxia. If the patient's extremities are paralyzed, they will require protection from injury because the patient may not be able to feel his or her extremities or move them out of harm's way as you prepare and move the patient for transport. Continuously talk to the patient and inform him or her of what is going on. Many patients who are having or who have had a stroke understand what is going on, but they may not be able to communicate with you. The patient may not be able to speak, or when he or she does, inappropriate words may come out. Regardless, the patient will be scared. Reassure the patient, and provide emotional support throughout the call.

Special Populations

The brain gradually deteriorates and shrinks as a part of the normal aging process. These processes increase the risk of brain injury from minor forces because the brain can more readily impact the inside of the skull as a result of the increased space and because the veins that connect the brain to the dura are stretched. A reduced brain mass may also reduce the patient's mental status and capacity. A smaller brain can impair memory function. A geriatric patient with lapses in short-term memory will often ask the same or similar questions repeatedly.

When you are called to care for a geriatric patient with altered mental status, consider the possibility of a stroke or transient ischemic attack (TIA). At the scene of a motor vehicle crash involving an older driver, consider a stroke or TIA as a possible cause in the crash. Be alert for altered mental status and unusual pupil responses (eg, constricted pupils in dim light, unequal pupils).

Take special note of complaints of a headache. Although geriatric patients get tension headaches, they are far less common in the older population. Consider any headache as potentially serious.

As with the general population, older people can experience seizures. Remember, seizures are not necessarily caused by epilepsy. Consider and assess for the possibility of a drug overdose, stroke, head injury, or central nervous system infection. Status epilepticus in a geriatric patient increases the risk of hypoxia, irregular heart rhythm, hypotension, elevated body temperature, low blood glucose level, and, if the patient vomits, aspiration.

Remember, geriatric patients are at a higher risk for central nervous system illnesses and injuries, including brain injury, TIA, stroke, and seizures. Do not be surprised to find a serious head injury from what you might consider a simple bump on the head.

Thrombolytic therapy (blood clot-dissolving drugs) and methods to mechanically remove the blood clot may reverse stroke symptoms and even stop the stroke if given within 3 hours (drugs) or 6 hours (mechanical methods) of the onset of symptoms. These therapies may not work for all patients, and they cannot be given to patients with bleeding-type (hemorrhagic) strokes. Comprehensive stroke centers are able to offer advanced stroke care and in some cases may be able to provide thrombolytic therapy even after the 3- to 6-hour window. Because hospital personnel will ultimately make these treatment decisions, you should proceed under the assumption that the affected area of the brain may be saved. The sooner the treatment is begun, the better the prognosis for the patient.

Spend as little time at the scene as possible. Remember, stroke is an emergency and "time is brain." Treatment may be available for the patient at the hospital, and rapid transport is essential to maximize the possibility of recovery. If you have a choice of hospitals, transport the patient to one that is a designated stroke center.

Seizure

Most patients who have had a seizure will be in a postictal state on your arrival. For those patients who are still having a seizure, continue to assess and treat the ABCs. It may be necessary to maintain the patient's airway with manual airway positioning. Use suction to clear the airway of any excessive secretions or vomitus. Oxygen is rapidly consumed by the body during seizure activity, so you should monitor the patient's oxygen saturation level with a pulse oximeter and apply high-flow oxygen. Administer oxygen even if you are unable to get an accurate pulse oximetry reading because of the patient's seizure activity, shaking, or tremors. Provide emotional support.

It is difficult to safely prepare a patient for transport when he or she is having a seizure. Assess the patient for trauma and immobilize the spine if indicated. Protect the patient from his or her surroundings. Never attempt to restrain a patient having a seizure. Injury could result from tonic-clonic movement. Use soft materials for padding, and move any objects out of the way that may harm your patient.

Not every patient who has had a seizure wants to be transported, but it is usually in the best interest of the patient to be evaluated by a physician in the ED after a seizure. Your goal is to encourage the patient to be seen by a physician. Should the patient refuse transport, be prepared to discuss the situation with the hospital staff on the radio before releasing the patient. Ask yourself the following questions if a patient in a postictal state refuses transport:

- Is the patient awake and completely oriented after the seizure (GCS score of 15)?
- Does your assessment reveal no indication of trauma or complications from the seizure?
- Has the patient ever had a seizure before?
- Was this seizure the "usual" seizure in every way (length, activity, recovery)?
- Is the patient currently being treated with medications and receiving regular evaluations by a physician?

If the answer to all of these questions is "yes," you can consider agreeing to a patient's refusal for transport if the patient can be released to a responsible person and monitored. If the patient responds "no" to any questions, strongly encourage the patient to be transported and evaluated. Follow your local protocols for patients who refuse care and transport.

Altered Mental Status

The signs and symptoms of altered mental status can vary widely, from simple confusion to coma. No matter what the cause, consider altered mental status to be an emergency that requires immediate attention, even when it appears that it may be caused by alcohol intoxication or minor head trauma. Determine the cause (mechanism of injury versus nature of illness) and provide spinal immobilization as indicated, airway and ventilation support, and transport to the appropriate facility.

YOU are the Provider — SUMMARY

1. On the basis of the dispatch information, what type of seizure is the patient most likely experiencing?

Given the patient's age (58 years), loss of consciousness, and the fact that the convulsions affect her extremities and torso, the patient is most likely experiencing a generalized seizure.

2. What are some common causes of seizures in this patient's age group?

Seizures in adults are typically caused by one of three underlying problems: epilepsy, structural brain problems (eg, brain tumors and abscesses, head trauma, and stroke), or metabolic derangements (eg, cerebral hypoxia, hypoglycemia, drug overdose, poisoning, and alcohol withdrawal). Febrile seizures are rare in adults.

3. What additional questions should you ask the patient's sister?

The sister has already stated the patient does not have a history of seizures. She also said she caught her sister as she fell, so the patient did not strike her head. Important questions that need to be answered include: What was the patient doing and what position was she in when the seizure began? Was she sitting or standing? Did the patient describe experiencing an aura? Although neither the patient nor her sister mentioned an aura, this does not rule out a seizure.

How long did the seizure last? Was the patient unconscious following the seizure? If so, how long was she unconscious? Does the patient have a history of recent head trauma?

4. What prehospital assessments can you perform to determine the possible cause of the patient's seizure?

In most cases, you will not be able to determine the underlying cause of the patient's seizure in the prehospital setting.

However, there are a few assessments you can perform and observations you can make that may increase your index of suspicion. Assess the patient's blood glucose level, if trained to do so, to rule out hypoglycemia as the cause of her seizure. If the patient is conscious and able to follow commands, test the patient by using a stroke scale, such as the Cincinnati Prehospital Stroke Scale. You should also assess and closely monitor the patient's vital signs and assess her neurologic status using the Glasgow Coma Scale (GCS).

5. Other than oxygen, what additional treatment is indicated at this point?

Unless the patient was injured during the seizure or you have identified an underlying cause of her seizure that can be treated in the prehospital setting (eg, hypoglycemia), additional treatment is mainly supportive. Maintaining a patent airway and ensuring adequate oxygenation and ventilation are your highest priorities. Provide a calm, quiet environment; reassure and reorient the patient as needed; avoid any loud or bright stimulus, which may cause another seizure; and safely transport her to the hospital. Continuously monitor the patient's ABCs, level of consciousness, and vital signs.

6. What is your field impression of this patient? Why?

From the sister's description, it is likely that the patient experienced a seizure. Her present signs and symptoms (confusion; sudden, severe headache; nausea) and medical history (poorly controlled hypertension) should make you suspicious that she is experiencing a hemorrhagic stroke, which likely caused the seizure. Signs of increased intracranial pressure (ICP) include changes in level of consciousness, nausea and vomiting, seizures, and high blood pressure, among others; your patient is experiencing all of these signs and symptoms.

7. On the basis of your field impression, the patient should be monitored for which additional signs and symptoms?

Your patient's present condition suggests that a cerebral artery is leaking and blood is slowly accumulating in her brain tissue, which will increase the ICP. As the ICP increases, the patient's level of consciousness will deteriorate; therefore, the level of consciousness is the single most important assessment parameter to monitor. Because of the cerebral ischemia caused by the increased ICP, the patient may experience another seizure. As the ICP increases further, the blood pressure often increases and the heart rate commonly decreases. Pressure on the brain stem may cause irregular and ineffective breathing; therefore, assisted ventilation may be necessary. It is very important to continuously monitor your patient's condition and be prepared to intervene if her condition deteriorates.

8. What should be your most immediate action?

Airway, airway, airway! Snoring respirations indicate partial obstruction of the airway by the tongue. Performing the head tilt–chin lift maneuver is the quickest way to correct the problem. The patient is now unconscious and unresponsive; insert an airway adjunct (eg, oral or nasal airway) to help maintain airway patency. Patients with increased ICP often vomit; remain alert to this possibility and have suction readily available. Regardless of the situation, you must ensure the patient's airway remains patent at all times. No airway, no patient—it's that simple!

9. What additional treatment does this patient require?

After establishing a patent airway, your next priority is to assist the patient's breathing. A slow (6 breaths/ min), irregular breathing pattern will not support adequate minute volume; therefore, deliver positive-pressure ventilation, which can be provided with a pocket face mask and one-way valve or a bag-valve mask (BVM). Be sure to attach 100% oxygen to the ventilation device you will be using.

10. What do unequal pupils indicate?

In the context of a traumatic brain injury or hemorrhagic stroke, unequal pupil size is an ominous sign. It indicates significantly increased ICP and compression of one of the oculomotor nerves (the nerves that control the pupillary response). The affected pupil is often fully dilated (blown) and does not constrict when a light source is shone into it.

11. On the basis of your last assessment, what is the patient's Glasgow Coma Scale score?

The GCS assesses three parameters: eye opening, verbal response, and motor response. Your last assessment revealed that the patient was unconscious and unresponsive (she did not open her eyes and was unresponsive to all stimuli) and was exhibiting decorticate (abnormal flexion) posturing. Therefore, she would receive a GCS score of 5, based on the following values (the numeric value for each component is in bold):

Eye opening:

Spontaneous: 4
Responsive to speech: 3
Responsive to pain: 2
None: 1

Best verbal response:

Oriented conversation: 5
Confused conversation: 4
Inappropriate words: 3
Incomprehensible sounds: 2
None: 1

Best motor response:

Obeys commands: 6
Localizes pain: 5
Withdraws from pain: 4
Abnormal flexion: 3
Abnormal extension: 2
None: 1

EMS Patient Care Report (PCR)

Date: 3-16-17	**Incident No.:** 140109	**Nature of Call:** Seizure		**Location:** 106 Scottie Drive	
Dispatched: 1823	**En Route:** 1823	**At Scene:** 1827	**Transport:** 1839	**At Hospital:** 1852	**In Service:** 1909

Patient Information

Age: 58 **Sex:** F **Weight (in kg [lb]):** 77 kg (170 lb)	**Allergies:** Penicillin, codeine **Medications:** Benazepril, Plavix, metformin **Past Medical History:** Hypertension, heart disease, type 2 diabetes mellitus **Chief Complaint:** Severe headache and nausea

Vital Signs

Time: 1831	**BP:** 200/112	**Pulse:** 100	**Respirations:** 14	**Spo_2:** 96% (on oxygen)
Time: 1837	**BP:** 198/110	**Pulse:** 60	**Respirations:** 6	**Spo_2:** 94% (on oxygen)
Time: 1844	**BP:** 194/104	**Pulse:** 64	**Respirations:** 6	**Spo_2:** 98% (on oxygen)

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

Dispatched for a 58-year-old woman experiencing a seizure. On arrival at the scene, found the patient lying supine on her living room floor with a pillow under her head. She was conscious but confused and reported nausea and the "worst headache of my life." The patient's sister witnessed the episode and stated her sister suddenly grabbed both sides of her head and then began "shaking all over." There was no trauma involved; the patient's sister states she caught her before she struck the ground. Per the sister, the patient had never experienced a seizure before today. Past medical history significant for hypertension, heart disease, and type 2 diabetes mellitus. Medications listed above; patient admits to being noncompliant with her prescribed medications. Administered oxygen and obtained vital signs. Blood glucose level was assessed and noted to be 97 mg/dL. Further assessment did not reveal any gross evidence of a seizure (eg, tongue-biting, urinary incontinence). Engine 60 arrived at the scene to provide assistance. As the patient was being loaded into the ambulance, she became unconscious and unresponsive. Reassessment revealed that her respirations were slow, irregular, and shallow. Inserted an oral airway and began assisting the patient's ventilations with a BVM and high-flow oxygen. Requested assistance from engine 60 EMT and began transport to the hospital. Continued to assist the patient's ventilations en route and reassessed her vital signs. Shortly before arriving at the hospital, reassessed the patient and noted her pupils were unequal and she began exhibiting decorticate posturing. Assigned a Glasgow Coma Scale score of 5. Quickly transferred patient to the ED staff and gave verbal report to attending physician.**End of report**

Prep Kit

▶ Ready for Review

- The cerebrum, the largest part of the brain, is divided into right and left cerebral hemispheres, each controlling the opposite side of the body.
- Different areas of the brain control different functions. The front part of the cerebrum controls emotion and thought; the middle part controls touch and movement; and the back part of the cerebrum is involved with vision. In most people, speech is controlled on the left side of the brain, near the middle of the cerebrum.
- Many different disorders can cause brain or other neurologic symptoms. As a general rule, if the problem is primarily in the brain, only part of the brain will be affected. If the problem is in the heart or lungs, the whole brain will be affected.
- Stroke is a common brain disorder and is a leading cause of death. The most effective treatment is time dependent. Seizures and altered mental status are also common brain disorders. You must learn to recognize the signs and symptoms of each condition.
- Other causes of neurologic dysfunction include coma, infections, and tumors.
- Strokes occur when part of the blood flow to the brain is suddenly cut off; within minutes, brain cells begin to die.
- Signs and symptoms of stroke include receptive and/or expressive aphasia, slurred speech, muscle weakness or numbness on one side of the body, facial droop, and sometimes high blood pressure.
- Always perform at least three neurologic tests on patients you suspect of having a stroke: testing speech, facial movement, and arm movement.
- In a transient ischemic attack (TIA), normal body processes break up the blood clot, restoring blood flow and ending symptoms in less than 24 hours. However, patients experiencing a TIA are at a higher risk for a repeat episode or a more serious stroke.
- Because current treatments for stroke must be administered within 3 hours of the onset of symptoms to be most effective, provide prompt transport.
- Always notify the hospital as soon as possible that you are bringing in a patient with a possible stroke, so staff can prepare to test and treat the patient without delay.
- Generalized seizures are characterized by unconsciousness and generalized twitching of all or part of the body.
- Most seizures last 3 to 5 minutes and are followed by a postictal state in which the patient may be unresponsive and have labored breathing or hemiparesis. The patient may have a loss of bladder or bowel control.
- Recognize the signs and symptoms of seizures so you can provide the ED staff with information as you transport the patient.
- Altered mental status is a common neurologic disorder that you will encounter as an EMT. Signs and symptoms vary widely, as do the causes for this condition.
- Among the most common causes of altered mental status are hypoglycemia, intoxication, drug overdose, and poisoning.
- Do not always assume intoxication when you assess a patient with an altered mental status; hypoglycemia is just as likely a cause. Prompt transport with close monitoring of vital signs en route is indicated.

â–¶ Vital Vocabulary

altered mental status Any deviation from alert and oriented to person, place, time, and event, or any deviation from a patient's normal baseline mental status.

aneurysm A swelling or enlargement of the wall of a blood vessel that results from weakening of the vessel wall.

aphasia The inability to understand and/or produce speech.

atherosclerosis A disorder in which calcium and cholesterol build up inside the walls of the blood vessels, forming plaque, potentially leading to a partial or complete blockage of blood flow.

aura A sensation experienced before a seizure; serves as a warning sign that a seizure is about to occur.

cerebrovascular accident (CVA) An interruption of blood flow to the brain that results in the loss of brain function; also called a stroke.

coma A state of profound unconsciousness from which the patient cannot be roused.

delirium A temporary change in mental status characterized by disorganized thoughts, inattention, memory loss, disorientation, striking changes in personality and affect, hallucinations, delusions, or a decreased level of consciousness.

dysarthria Slurred speech.

embolus A blood clot or other substance in the circulatory system that travels to a blood vessel where it causes a blockage.

epilepsy A disorder in which abnormal electrical discharges occur in the brain, causing seizure and possible loss of consciousness.

febrile seizures Seizures that result from sudden high fevers; most often seen in children.

generalized (tonic-clonic) seizure A seizure characterized by severe twitching of all of the body's muscles that may last several minutes or more; formerly known as a grand mal seizure.

hemiparesis Weakness on one side of the body.

hemorrhagic stroke A type of stroke that occurs as a result of bleeding inside the brain.

hypoglycemia An abnormally low blood glucose level.

incontinence Loss of bowel and/or bladder control; may be the result of a generalized seizure.

ischemia A lack of oxygen that deprives tissues of necessary nutrients, resulting from partial or complete blockage of blood flow; potentially reversible because permanent injury has not yet occurred.

ischemic stroke A type of stroke that occurs when blood flow to a particular part of the brain is cut off by a blockage (eg, a blood clot) inside a blood vessel.

partial (focal) seizure A seizure affecting a limited portion of the brain.

postictal state The period following a seizure that lasts 5 to 30 minutes; characterized by labored respirations and some degree of altered mental status.

seizure A neurologic episode caused by a surge of electrical activity in the brain; can be a convulsion characterized by generalized, uncoordinated muscular activity, and can be associated with loss of consciousness.

status epilepticus A condition in which seizures recur every few minutes or last longer than 30 minutes.

stroke An interruption of blood flow to the brain that results in the loss of brain function; also called a cerebrovascular accident (CVA).

syncope A fainting spell or transient loss of consciousness.

thrombosis A blood clot, either in the arterial or venous system. When the clot occurs in a cerebral artery, it may result in the interruption of cerebral blood flow and subsequent stroke.

transient ischemic attack (TIA) A disorder of the brain in which brain cells temporarily stop functioning because of insufficient oxygen, causing stroke-like symptoms that resolve completely within 24 hours of onset.

Assessment *in Action*

You are dispatched to a residence for a patient with a headache. You arrive to find a 68-year-old man sitting up in a recliner in the living room, but he is leaning slightly to the left. His wife reports he had a sudden headache about 1 hour ago. As you assess the patient, you notice that his speech is slurred and he is not moving his left side. You ask the patient to lift his left arm; he lifts his right instead. You also note a left-sided facial droop. A check of his vital signs shows a pulse of 100 beats/min, a blood pressure of 188/110 mm Hg, and respirations of 22 breaths/min. His past medical history includes poorly controlled diabetes and hypertension. He reports a blood glucose level of 70 mg/dL. As you prepare for transport, the patient experiences a generalized seizure.

1. On the basis of the patient's condition, what should you be most concerned with?

   A. Maintaining the ABCs
   B. Determining the type of stroke
   C. Administering oral glucose
   D. Performing further assessment

2. The patient was exhibiting slurred speech, facial droop, and an inability to move his left arm. Which neurologic examination emphasizes these possible stroke signs?

   A. Chicago Prehospital Stroke Scale
   B. Philadelphia Stroke Scale
   C. Cincinnati Prehospital Stroke Scale
   D. Camden Stroke Scale

3. Which of the following occurs when blood flow to a particular part of the brain is cut off by a blockage resulting in tissue damage?

   A. Ischemic stroke
   B. Hemorrhagic stroke
   C. Seizure
   D. Status epilepticus

4. What is the name of the condition when the patient forgets about the injured side after a stroke?

   A. Hemiparesis
   B. Neglect
   C. Aphasia
   D. Ataxia

5. The patient in this scenario experienced a seizure. What criteria must be met for this patient to have status epilepticus?

   A. A seizure lasting greater than 30 minutes
   B. A seizure that was preceded by an aura
   C. The presence of incontinence during the seizure
   D. Multiple seizures with normal consciousness between each event

6. Which of the following is a metabolic cause for a seizure?

   A. Brain tumor
   B. Head trauma
   C. Hypoglycemia
   D. Brain abscess

7. This patient appears to be suffering from a stroke and a seizure. What condition mimics a stroke and also causes a seizure?

   A. Meningitis
   B. Postictal state
   C. Hypoglycemia
   D. Migraine headache

8. Describe how to use the Cincinnati Prehospital Stroke Scale.
9. What is the difference between a stroke and a transient ischemic attack?
10. Explain why it is important to determine the time when the patient was last seen normal.

CHAPTER 18

Gastrointestinal and Urologic Emergencies

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Abdominal and Gastrointestinal Disorders

Anatomy, presentations, and management of shock associated with abdominal emergencies

› Gastrointestinal bleeding (pp 705, 710, 715, 718–719)

Anatomy, physiology, pathophysiology, assessment, and management of

› Acute and chronic gastrointestinal hemorrhage (pp 705–707, 710, 714–719)
› Peritonitis (pp 705–708, 714–719)
› Ulcerative diseases (pp 705–706, 708–709, 714–719)

Genitourinary/Renal

› Blood pressure assessment in hemodialysis patients (p 718)

Anatomy, physiology, pathophysiology, assessment, and management of

› Complications related to
  - Renal dialysis (pp 713, 719)
  - Urinary catheter management (not insertion) (p 719)
› Kidney stones (pp 713–719)

Knowledge Objectives

1. Describe the basic anatomy and physiology of the gastrointestinal, genital, and urinary systems. (pp 705–707)
2. Define the term acute abdomen. (p 707)
3. Describe pathologic conditions of the gastrointestinal, genital, and urinary systems. (pp 707–714)

4. Explain the concept of referred pain. (p 708)
5. Recognize that abdominal pain can arise from other body systems. (pp 708–709, 713–714)
6. Identify the signs and symptoms, and common causes, of an acute abdomen. (pp 708–712)
7. Explain the procedures to follow in the assessment and management of acute and chronic gastrointestinal hemorrhage, peritonitis, and ulcerative diseases. (pp 708–712, 714–719)
8. List the most common abdominal emergencies, with the most common locations of direct and referred pain. (p 709)
9. Explain the procedures to follow for patient assessment of gastrointestinal and urologic emergencies. (pp 714–718)
10. Describe the procedures to follow in managing the patient with shock associated with abdominal emergencies. (p 715)
11. Describe the emergency medical care of the patient with gastrointestinal or urologic emergencies. (pp 718–719)
12. Explain the principles of kidney dialysis. (pp 719)

Skills Objective

1. Demonstrate the assessment of a patient's abdomen. (pp 717–718)

Introduction

Abdominal pain is a common complaint, but the cause is often difficult to identify, even for a physician. As an EMT, you do not need to determine the exact cause of acute abdominal pain, but it is helpful for you to understand the pathophysiology and the signs and symptoms of common illnesses. You need to be able to recognize a life-threatening problem and act swiftly in response. Remember, the patient is in pain and is probably anxious, requiring your skills of rapid assessment and emotional support.

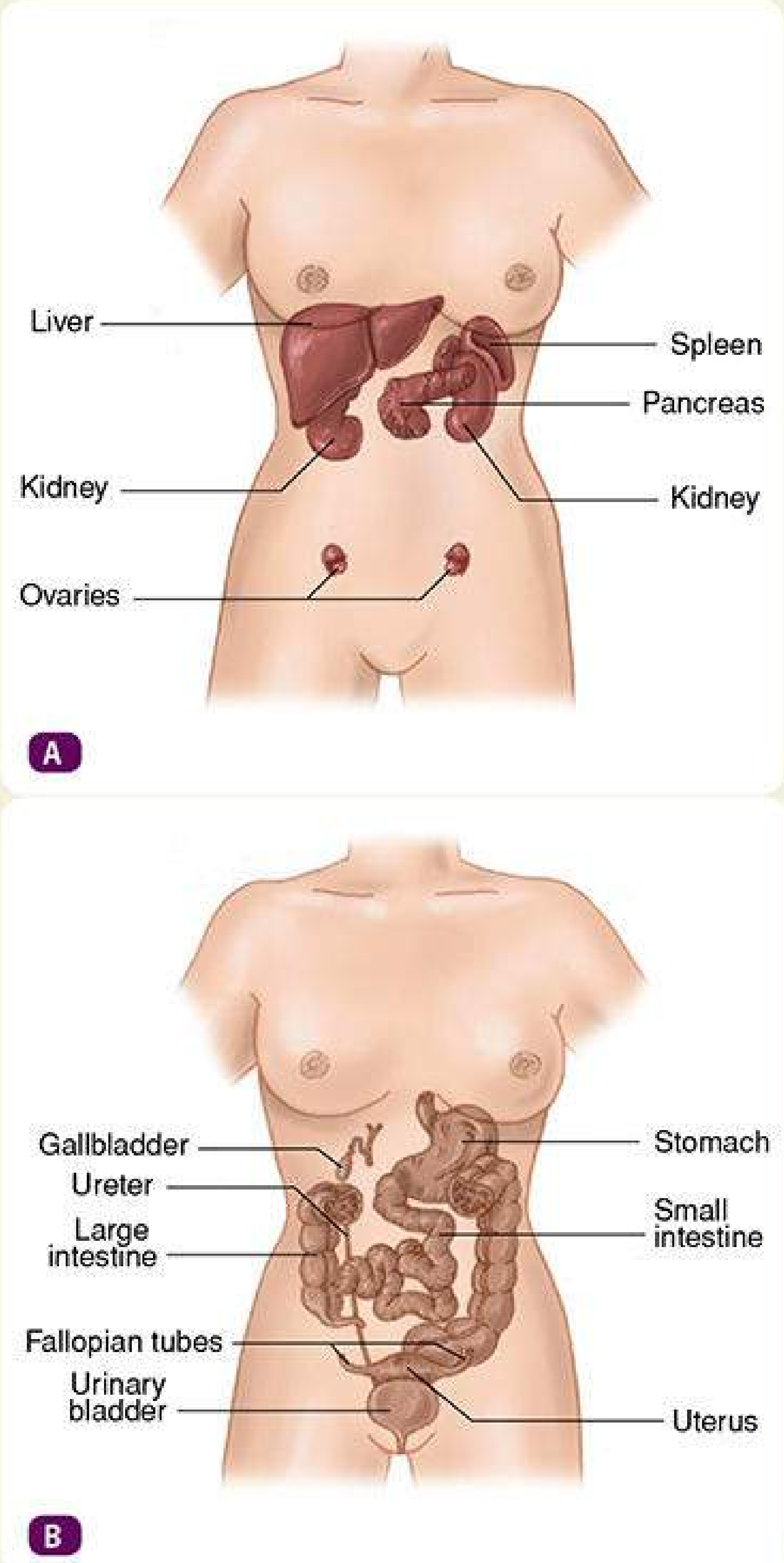

Figure 18-1 The solid and hollow organs of the abdomen. **A.** Solid organs include the liver, spleen, pancreas, kidneys, and ovaries (in women). **B.** Hollow organs include the gallbladder, stomach, small intestine, large intestine, and bladder.

Anatomy and Physiology

The abdominal cavity contains solid and hollow organs that make up the gastrointestinal, genital, and urinary systems **Figure 18-1**. Solid organs include the liver, spleen, pancreas, kidneys, and ovaries (in women). Technically, organs such as the kidneys, ovaries, and the pancreas are retroperitoneal (behind the peritoneum). However, because they lie next to the peritoneum, they can cause abdominal pain. An injury to a solid organ can cause shock and bleeding because of the amount of blood vessels that the organ contains.

Hollow organs include the gallbladder, stomach, small intestine, large intestine, and urinary bladder. If there is a perforation of these hollow organs, the contents of the organ will leak and contaminate the abdominal cavity.

The Gastrointestinal System

The gastrointestinal (GI) system is responsible for the digestion process. Digestion begins when food is put into the mouth and chewed; the salivary glands secrete saliva and begin to break down the food, then it is swallowed. The food travels down the esophagus to the stomach. The stomach is the main organ of the digestive system. Most digestion takes place in the stomach, where gastric juices break down food to a form that can be used by the body.

YOU are the Provider — PART 1

At 0320 hours, you and your partner are dispatched to 1500 East River Road, Apartment 5, for a 79-year-old man with abdominal pain. You proceed to the scene, which is approximately 8 miles from your station. The weather is clear, the temperature is 67°F (19.4°C), and the traffic is light.

1. What is the definition of an acute abdomen?
2. What is your role as an EMT in treating a patient with abdominal pain?

The liver assists in digestion by secreting bile, which aids in the digestion of fats. The liver also filters toxic substances produced by digestion, creates glucose stores, and produces substances necessary for blood clotting and immune function. The gallbladder is a hollow pouch located beneath the liver that acts as a reservoir for bile.

Food then travels down into the small intestine, which consists of three sections: the duodenum, jejunum, and ileum. The duodenum is where digestive juices from the pancreas and liver mix together. The pancreas secretes juice containing enzymes that help break down starches, fats, and proteins. Amylase, which breaks down starches into sugar, is one enzyme the pancreas secretes. The pancreas also produces bicarbonate and insulin. Bicarbonate neutralizes the stomach acid in the duodenum, and insulin helps regulate the levels of glucose in the bloodstream.

The jejunum, the next part of the small intestine, plays a major role in the absorption of digestive products. In fact, the jejunum comprises a large amount of the surface area of the small intestine and does much of the work. The final part of the small intestine is the ileum. The ileum absorbs nutrients that were not absorbed earlier. It also absorbs bile acids so they can be returned to the liver for future use and vitamin B12 for making nerve cells and red blood cells.

The food that was not broken down and used as nutrients then moves into the colon, or large intestine, as waste products. A rhythmic movement called peristalsis moves the waste matter through the intestines. Water is absorbed and stool is formed. The stool passes through the rectum to the anus, where it is defecated.

Additional Abdominal Organs

The spleen is also located in the abdomen but has no digestive system function. The spleen is part of the lymphatic system and plays a significant role in relation to red blood cells and the immune system. It assists in the filtration of blood, aids in the development of red blood cells, and serves as a blood reservoir. The spleen also produces antibodies to help the body fight off disease and infection.

The Genital System

The abdominal space also holds the male and female reproductive organs. The male reproductive system consists of the testicles, epididymis, vasa deferentia, seminal vesicles, prostate gland, and penis. The female reproductive system includes the ovaries, fallopian tubes, uterus, cervix, and vagina.

The Urinary System

The urinary system controls the discharge of certain waste materials filtered from the blood by the kidneys. In the urinary system, the kidneys are solid organs, and the ureters, bladder, and urethra are hollow organs **Figure 18-2**. Ordinarily, the urinary and genital systems are considered together because they share many organs. One system can directly affect the other. For example, if the prostate gland in the male genital system enlarges, then the urethra will narrow, weakening the bladder, and eventually leading to urinary retention.

The body contains two kidneys, one on each side, which lie on the posterior muscular wall of the abdomen behind the peritoneum in the retroperitoneal space. The kidneys play an important role in the regulation of acid-base balance (the body's pH) and blood pressure. Blood pressure regulation is associated with the kidney's ability to remove sodium chloride from the body. Kidney disease is a common cause of hypertension. The kidneys also rid the body of toxic wastes and control the body's balance of fluid and electrolytes. Blood flow in the kidneys is high. Nearly 20% of the output of blood from the heart passes through the kidneys each minute. Large vessels attach the kidneys directly to the aorta and the inferior vena cava. Waste products and water are constantly filtered from the blood to form urine. The kidneys continuously concentrate this filtered urine by reabsorbing the water as it passes through a system of specialized tubes within them. The tubes finally unite to form the renal pelvis, a cone-shaped collecting area that connects the ureter and the kidney.

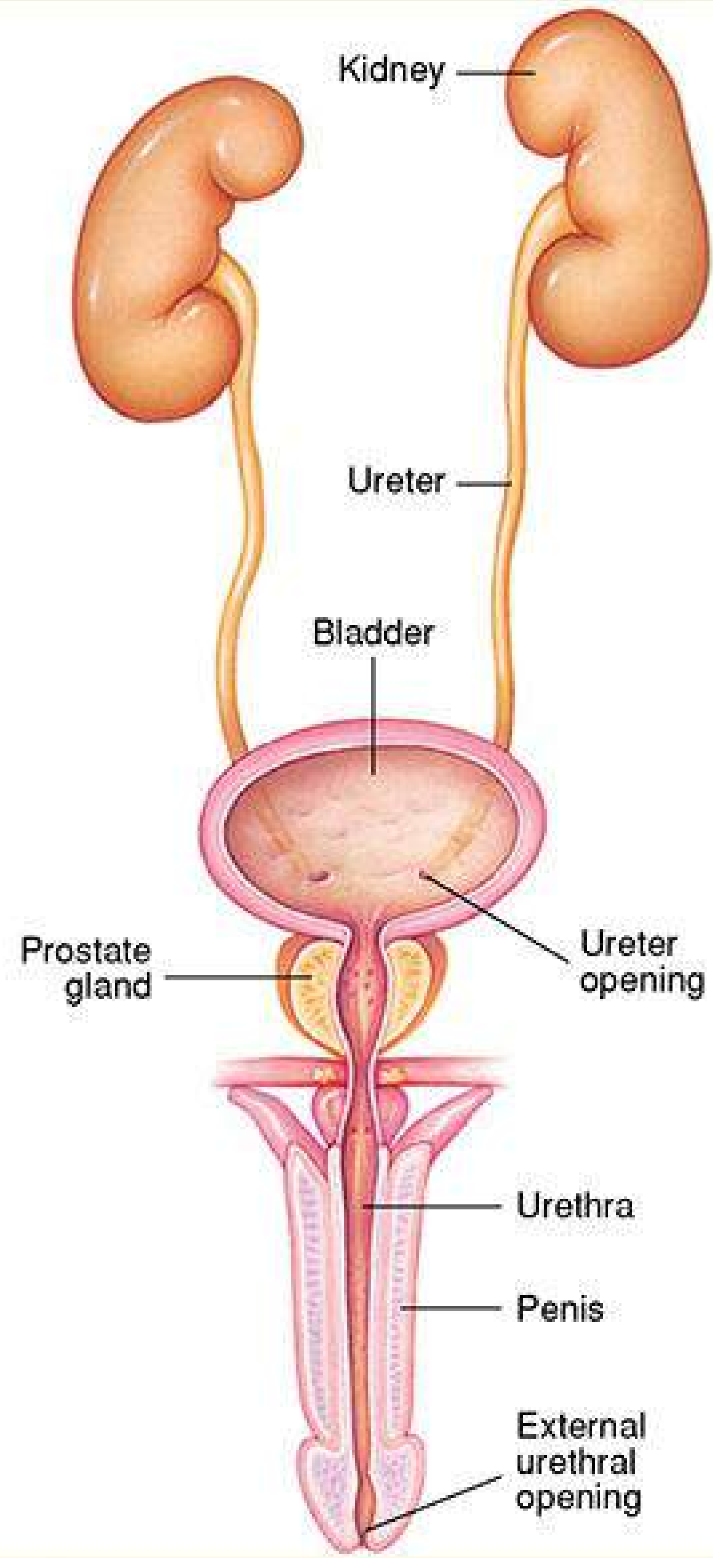

Figure 18-2 The urinary system lies in the retroperitoneal space behind the organs of the digestive system. The urinary system in men and women includes the kidneys, ureters, bladder, and urethra. This diagram shows the male urinary system.

A ureter passes from the renal pelvis of each kidney along the surface of the posterior abdominal wall behind the peritoneum to drain into the urinary bladder. The ureters are small (0.2 inch in diameter), hollow, muscular tubes. Peristalsis, a wavelike contraction of smooth muscle, occurs in these tubes to move the urine to the bladder.

The urinary bladder is located immediately behind the pubic symphysis in the pelvic cavity and is composed of smooth muscle with a specialized lining membrane. The two ureters enter posteriorly at its base on either side. The bladder empties to the outside of the body through the urethra. In the man, the urethra passes from the anterior base of the bladder through the penis. In the woman, the urethra opens at the front of the vagina. The normal adult forms 1.5 to 2 L of urine every day. This waste is extracted and then concentrated in the urine from the 1,500 L of blood that circulate through the kidneys daily.

Pathophysiology

The abdominal cavity is lined by a membrane called the **peritoneum**. The peritoneum also covers the organs of the abdomen. The parietal peritoneum lines the walls of the abdominal cavity, and the visceral peritoneum covers the organs themselves. The abdominal space normally contains a small amount of peritoneal fluid to bathe and lubricate the organs in the abdominal cavity. Any foreign material, such as blood, pus, bile, pancreatic juice, or amniotic fluid, can cause irritation of the peritoneum, called **peritonitis**.

Acute abdomen is a medical term referring to the sudden onset of abdominal pain, often associated with severe, progressive problems that require medical attention. Peritonitis will usually develop if the acute abdomen is not treated, and can be fatal.

Peritonitis typically causes **ileus**, or paralysis of the muscular contractions that normally propel material through the intestine. The retained gas and feces, in turn, cause abdominal distention. Distention usually begins after the muscular contractions cease. In the presence of such paralysis, nothing that is eaten can pass normally out of the stomach or through the bowel. In this situation, the only way the stomach can empty itself is by **emesis**, or vomiting. For this reason, peritonitis is frequently associated with nausea and vomiting. These symptoms do not point to a particular cause because they can accompany almost every type of gastrointestinal disease or injury.

YOU are the Provider — PART 2

When you arrive at the scene and enter the patient's residence, you find him lying on the couch on his side with his knees drawn up to his abdomen. He is markedly diaphoretic (sweaty) and pale and is in obvious severe pain. You introduce yourself and begin your assessment.

Recording Time: 0 Minutes	
Appearance	Lying on his side, diaphoretic, in obvious pain
Level of consciousness	Conscious and alert; restless
Airway	Open; clear of secretions or foreign bodies
Breathing	Rapid, shallow respirations
Circulation	Radial pulse, weak and rapid; skin is pale and diaphoretic

Your partner administers oxygen at 15 L/min via a nonrebreathing mask as you continue your assessment. The patient tells you that his abdominal pain began suddenly and has been severe from the onset. He describes the pain as severe and indicates that it radiates to his lower back. He denies nausea, vomiting, or any other symptoms. As you examine his abdomen, your partner prepares to take his vital signs.

3. What is the proper technique of assessing a patient's abdomen? What should you assess for?
4. What is the difference between radiating pain and referred pain?

Peritonitis is also associated with a loss of body fluid into the abdominal cavity. The loss of fluid usually results from abnormal shifts of fluid from the bloodstream into body tissues. This fluid shift decreases the volume of circulating blood and may lead to decreased blood pressure or even shock. The patient may have normal vital signs or, if the peritonitis has progressed further, the patient may present with tachycardia and hypotension. When peritonitis is accompanied by hemorrhage, the signs of shock are much more apparent.

Fever may or may not be present, depending on the cause of the peritonitis. Patients with **diverticulitis** (inflammation in small pockets at weak areas in the muscle walls) or **cholecystitis** (inflammation of the gallbladder) may have a substantial elevation in temperature. However, patients with acute appendicitis may have a temperature within normal limits until the appendix ruptures and an abscess starts to form.

Abdominal Pain

Abdominal pain can have different qualities because two different types of nerves supply the peritoneum. The nerves from the spinal cord that supply the skin of the abdomen also supply the parietal peritoneum. Therefore, the parietal peritoneum and the skin of the abdomen can perceive much the same sensations: pain, touch, pressure, heat, and cold. These sensory nerves can easily identify and localize a point of irritation. In contrast, the visceral peritoneum is supplied by the autonomic nervous system. These nerves are far less able to localize sensation. This means that your patient will not be able to describe exactly where the pain is located. The visceral peritoneum is stimulated when distention or contraction of the hollow abdominal organs activates the stretch receptors. Patients sometimes describe it as a “deep“ pain. Other painful sensations that occur because of an irritated visceral peritoneum may be perceived at a distant point on the surface of the body, such as the back or shoulder. This phenomenon is called **referred pain**.

Referred pain is the result of connections between the body’s two separate nervous systems. The nerves connecting the somatic nervous system and autonomic nervous system cause the stimulation of the autonomic nerves to be perceived as stimulation of the spinal sensory nerves. For example, acute cholecystitis may cause pain in the right shoulder because the autonomic nerves serving the gallbladder lie near the spinal cord at the same anatomic level as the spinal sensory nerves that supply the skin of the shoulder **Figure 18-3**.

The most common abdominal emergencies, with the most common locations of direct and referred pain, are listed in **Table 18-1**.

Causes of Acute Abdomen

Almost any problem with an abdominal organ can cause an acute abdomen. Some of the more common causes are discussed here. Because the visceral peritoneum is usually irritated first, early abdominal pain tends to be vague and poorly localized. As the parietal peritoneum becomes irritated, pain becomes more severe and may be more specifically located.

Ulcers

The stomach and duodenum are subjected to high levels of acidity. To prevent damage to these organs, protective layers of mucus line both organs. In peptic ulcer disease (PUD), the protective layer is eroded, allowing the acid to eat into the organ itself over the course of weeks, months, or even years.

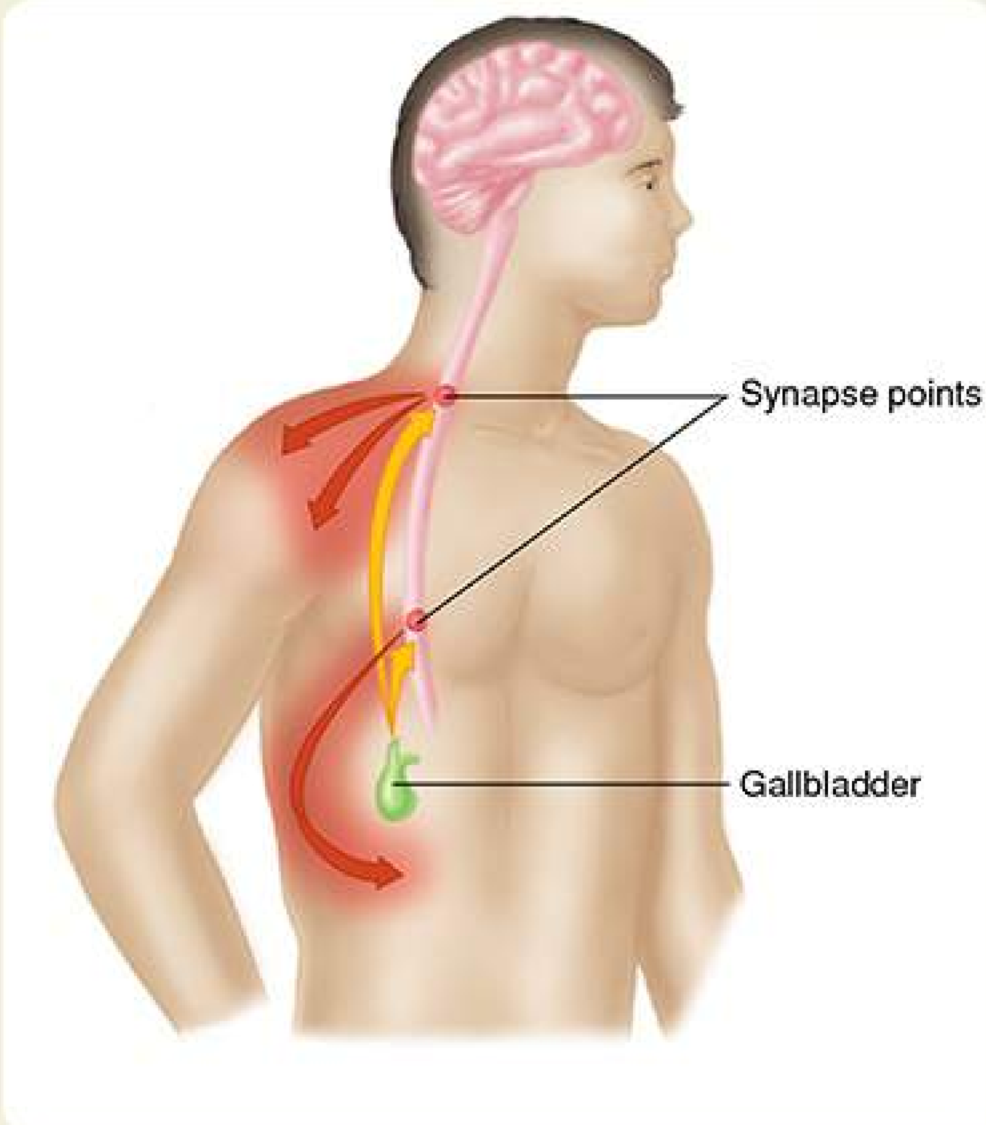

Figure 18-3 Acute cholecystitis causes referred pain in the right shoulder as well as in the abdomen.

Table 18-1 Common Abdominal Conditions	
Condition	**Localization of Pain**
Appendicitis	Right lower quadrant (direct); around navel (referred); rebound tenderness (pain felt on the rebound after palpation)
Cholecystitis	Right upper quadrant (direct); right shoulder (referred)
Ulcer	Upper midabdomen or upper part of back
Diverticulitis	Left lower quadrant
Abdominal aortic aneurysm (ruptured or dissecting)	Low part of back and lower quadrants
Cystitis (inflammation of the bladder)	Lower midabdomen (retropubic)
Kidney infection	Costovertebral angle
Kidney stone	Right or left flank, radiating to genitalia
Pancreatitis	Upper abdomen (both quadrants); back
Pneumonia	Referred pain to the upper abdomen
Hernia	Anywhere in the abdominal area
Peritonitis	Anywhere in the abdominal area

Most peptic ulcers are the result of infection of the stomach with *Helicobacter pylori (H pylori)*. Another major cause is chronic use of nonsteroidal anti-inflammatory drugs (NSAIDs). Alcohol and smoking can also affect the severity of PUD by increasing gastric acidity.

PUD affects both men and women equally, but tends to occur more often in the older population. As people age, the immune system's ability to fight infection decreases, making infection more likely. The geriatric population, in general, also uses NSAIDs frequently for arthritis and other musculoskeletal conditions.

Patients with peptic ulcers experience a classic sequence of burning or gnawing pain in the stomach that subsides or diminishes immediately after eating and then reemerges 2 to 3 hours later. The pain usually presents in the upper abdomen, but sometimes may be found below the sternum. With some patients, the pain occurs immediately after eating. Nausea, vomiting, belching, and heartburn are common symptoms. If the erosion is severe, gastric bleeding can occur, resulting in **hematemesis** (vomiting blood) and **melena** (black, tarry stools containing blood).

Some ulcers will heal without medical intervention, but often complications can occur from bleeding or perforation (a hole through the wall of the stomach). More serious ulcerative conditions can cause severe peritonitis and an acute abdomen.

Gallstones

The gallbladder is a storage pouch for digestive juices and waste from the liver. Gallstones can form and block the outlet from the gallbladder, causing pain. Sometimes the blockage will pass, but if not, it can lead to severe inflammation of the gallbladder, called cholecystitis. This is a condition in which the wall of the gallbladder becomes inflamed. In severe cases, the gallbladder may rupture, causing inflammation to spread and irritate surrounding structures such as the diaphragm and bowel.

This condition presents as a constant, severe pain in the right upper or midabdominal region and may refer to the right upper back, shoulder area, or flank. The pain may steadily increase for hours or may come and go. Cholecystitis commonly produces symptoms about 30 minutes after a particularly fatty meal and usually at night. Other symptoms include general gastrointestinal distress such as nausea and vomiting, indigestion, bloating, gas, and belching. People at a higher risk for developing cholecystitis include women, older adults, obese people, and people of Scandinavian, Native American, and Hispanic descent.

Pancreatitis

The pancreas forms digestive juices and is also the source of insulin. Inflammation of the pancreas is called **pancreatitis**. Pancreatitis can be caused by an obstructing gallstone, alcohol abuse, and other diseases. Severe pain may present in the upper left and right quadrants and may often radiate to the back. In addition, the patient may report that the pain is worse after eating. Other signs and symptoms accompanying the pain are nausea and vomiting, abdominal distention, and tenderness. Complications like sepsis or hemorrhage can occur, in which case assessment may also reveal fever or tachycardia.

Appendicitis

The appendix is a small recess in the large intestine. Inflammation or infection in the appendix is called **appendicitis**, and is a frequent cause of acute abdomen. This inflammation can eventually cause the tissues to die and/or rupture, causing an abscess, peritonitis, or shock. Initially, the pain caused by appendicitis is generalized, dull, and diffuse and may center in the umbilical area. The pain later localizes to the right lower quadrant of the abdomen. Appendicitis can also cause referred pain. The patient may also report nausea and vomiting, anorexia (lack of appetite for food), fever, and chills. A classic symptom of appendicitis is rebound tenderness. Rebound tenderness is a result of peritoneal irritation. This can be assessed by pressing down gently and firmly on the abdomen. The patient will feel pain when the pressure is released. Women who are pregnant may not exhibit this symptom.

Gastrointestinal Hemorrhage

Bleeding within the gastrointestinal tract is a symptom of another disease, not a disease itself. Gastrointestinal hemorrhage can be acute, which may be shorter term and more severe, or chronic, which may be of longer duration and less severe. All complaints of bleeding should be considered serious.

A gastrointestinal hemorrhage can occur in the upper or lower gastrointestinal tract. Bleeding in the upper gastrointestinal tract occurs from the esophagus to the upper small intestine. In the esophagus, problems might include esophagitis, esophageal varices secondary to liver failure, or a Mallory-Weiss tear, which results from excessive wretching or vomiting. Hematemesis is frequently seen in patients with upper GI bleeding. The blood is either bright red or has the appearance of coffee grounds depending on where in the GI tract it originated and how briskly it is occurring.

Lower gastrointestinal bleeding occurs between the upper part of the small intestine and the anus. Bowel inflammation, diverticulosis, diverticulitis, cancer, and hemorrhoids are common causes of bleeding in the lower gastrointestinal tract. In lower gastrointestinal bleeding, the bleeding often manifests as melena, or dark tarry stools, as a result of partial digestion of the blood.

Esophagitis

Esophagitis occurs when the lining of the esophagus becomes inflamed by infection or from the acids in the stomach (**gastroesophageal reflux disease [GERD]**). GERD is a condition in which the sphincter between the esophagus and the stomach opens, allowing stomach acid to move up into the esophagus. Also referred to as acid reflux disease, this condition can cause a burning sensation within the chest (heartburn). It is estimated that 60 million people in the United States have GERD. This is approximately 20% of the total population; therefore, GERD is quite common. People diagnosed with GERD may use ant-acids, proton pump inhibitors, and H_2 blockers to treat their condition.

The patient with esophagitis may report pain with swallowing and feeling like an object is stuck in his or her throat. Additional symptoms include heart-burn, nausea, vomiting, and sores in the mouth. In the worst cases, bleeding can occur from the small capillary vessels within the esophageal lining or the main blood vessels.

Esophageal Varices

Esophageal varices occur when the amount of pressure within the blood vessels surrounding the esophagus increases, frequently as a result of liver failure. The esophageal blood vessels eventually drain their blood into the liver. If the liver becomes damaged and blood cannot flow through it easily, blood begins to back up into these portal vessels, dilating the vessels and causing the capillary network of the esophagus to begin leaking. If pressure continues to build, the vessel walls may fail, causing massive upper gastrointestinal bleeding and, quickly afterward, hematemesis.

In industrialized countries, alcohol is the main cause of portal hypertension. Long-term alcohol consumption damages the interior of the liver (cirrhosis), leading to slower blood flow. In developing countries, viral hepatitis is the main cause of liver damage.

Presentation of esophageal varices takes two forms. Initially, the patient shows signs of liver disease—fatigue, weight loss, jaundice, anorexia, edema in the abdomen, abdominal pain, nausea, and vomiting. This very gradual disease process takes months to years before the patient reaches a state of extreme discomfort.

By contrast, the rupture of the varices is far more sudden. The patient may report sudden-onset discomfort in the epigastric region or sternum. He or she may have severe difficulty swallowing, vomiting of bright red blood, hypotension, and signs of shock. If the bleeding is less dramatic, hematemesis and melena are likely. Regardless of the speed of bleeding, damage to these vessels can be life threatening. Spontaneous rupture is often life threatening and significant blood loss at the scene may be evident. Major ruptures can lead to death in a matter of minutes.

Mallory-Weiss Tear

A Mallory-Weiss tear is a tear in the junction between the esophagus and the stomach, causing severe bleeding and potentially death. Primary risk factors include alcoholism and eating disorders. Mallory-Weiss tears affect both men and women equally, but are more prevalent in older adults and older children.

Vomiting is the principal symptom. In women, this syndrome may be associated with severe vomiting related to pregnancy. The extent of the bleeding can range from very minor bleeding, resulting in very little blood loss, to severe bleeding and extreme fluid loss. In extreme cases, patients may experience signs and symptoms of shock, upper abdominal pain, hematemesis, and melena.

Safety Tips

Infection from the bacterium *Clostridium difficile* (commonly referred to as *C. diff*) presents with GI symptoms such as diarrhea. You can spread *C. diff* to other patients if proper hand hygiene is not employed and proper decontamination is not done after each call.

Transmission of *C. diff* occurs in susceptible patients by contact with surfaces contaminated with feces. The bacterium can occasionally be transmitted to patients by contact with the unwashed hands of health care providers. Infections with *C. diff* are generally related to use of antibiotics in patients who are being treated for other infections.

C. diff is not inactivated by alcohol-based hand products. Glove use, good handwashing technique, and cleaning of contaminated surfaces with a chlorine-based cleaning agent are important in preventing spread of this bacterium.

YOU are the Provider PART 3

The patient's vital signs are obtained and recorded. Your assessment of his abdomen reveals that it is tender to palpation and guarding is present. As your partner retrieves the stretcher from the ambulance, the patient tells you that he has high blood pressure, depression, and had his appendix removed 30 years ago. He says he takes Toprol and Diovan. You note that he is becoming more restless and is still experiencing intense pain, which he describes as a 10 on a scale of 0 to 10 (10/10).

Recording Time: 3 Minutes	
Respirations	28 breaths/min; shallow
Pulse	124 beats/min; regular
Skin	Pale, cool, and diaphoretic
Blood pressure	98/60 mm Hg
Oxygen saturation (Spo_2)	96% (on oxygen)

5. What do the patient's vital signs indicate?
6. What do you suspect is the cause of the patient's abdominal pain?

Gastroenteritis

Acute gastroenteritis comprises a family of conditions revolving around a central theme of infection combined with diarrhea, nausea, and vomiting. Bacterial and viral organisms can cause this condition. These organisms typically enter the body through contaminated food or water. Patients may begin to experience an upset stomach and diarrhea as soon as several hours or several days after contact with the contaminated matter. The disease can then run its course in 2 to 3 days or continue for several weeks.

Gastroenteritis may also be caused by noninfectious conditions such as adverse reactions to medications, exposure to certain toxins, or chemotherapy. The symptoms are similar regardless of the underlying cause.

Diarrhea is the principal symptom in both infectious and noninfectious gastroenteritis. Patients may experience large dumping-type diarrhea or frequent small liquid stools. The diarrhea may contain blood and/or pus, and it may have a foul odor or be odorless. Abdominal cramping is frequently reported. Nausea, vomiting, fever, and anorexia are also present. If the diarrhea continues, dehydration will result. As the volume of fluid loss increases, the likelihood of shock increases.

Diverticulitis

Diverticulitis was first recognized around 1900, when the types of foods people ate began to change dramatically. In particular, the amount of fiber within the US diet plummeted as the amount of processed foods eaten increased.

As the amount of fiber consumed as part of the diet decreases, the consistency of the normal stool becomes more solid. This hard stool requires more intestinal contractions, subsequently increasing pressure within the colon. In this environment, small defects within the colonic wall that would otherwise never pose a problem now fail, resulting in bulges in the wall. These small outcroppings eventually turn into pouches, called diverticula. As feces travel through the colon, some may become trapped within these pouches. When bacteria grow there, they cause localized inflammation and infection.

The most common cause of lower GI bleeding in the United States is diverticulosis. Bleeding from diverticulosis is usually bright red (as the blood products do not have time to be digested) and typically painless.

The main symptom of diverticulitis is abdominal pain, which tends to be localized to the left side of the lower abdomen. Classic signs of infection include fever, malaise, body aches, chills, nausea, and vomiting. Bleeding is rare with this condition. Because of the local infections of these pouches, adhesions may develop, narrowing the diameter of the colon and resulting in constipation and bowel obstruction. In severe cases, these infected outcroppings may burst, causing perforation of the affected segment of colon. This may lead to peritonitis, severe infection, and if left untreated, septic shock.

Hemorrhoids

Hemorrhoids are created by swelling and inflammation of the blood vessels surrounding the rectum. They are a common problem, with almost half the population having at least one hemorrhoid by age 50 years. Hemorrhoids may result from conditions that increase pressure on the rectum or irritation of the rectum. Pregnancy, straining at stool, and chronic constipation cause increased pressure. Diarrhea can cause irritation.

Hemorrhoids may be internal (high in the rectum, usually not visible, often painless, and often associated with bright red, brisk bleeding) or external (low in the rectum, often clearly visible, and painful).

Hemorrhoids present as bright red blood during defecation. This bleeding tends to be minimal and is easily controlled. Additionally, patients may experience itching and a small mass on the rectum. Typically, this mass is a clot formed in response to the mild bleeding.

Urinary System

Issues in the urinary system can cause acute abdominal pain. Bladder inflammation, called **cystitis**, is common, especially in women. This condition is generally caused by a bacterial infection and can be referred to as a **urinary tract infection (UTI)**. A bladder infection can be painful. Patients with cystitis usually have lower quadrant abdominal pain. They may also report an urgency and frequency in urination and pressure and pain around the bladder. If the infection is severe, the urethra can become inflamed, causing urinary retention. When you are assessing a patient with cystitis, the patient may report tenderness when you are palpating the abdomen over the bladder (just above the pubic bone). Cystitis can become a serious health problem if the infection spreads to the kidneys.

Kidneys

The kidneys play a major role in maintaining homeostasis, or keeping all body systems in balance. The kidneys preserve this balance by eliminating waste from the blood. When the kidneys fail, the patient loses the ability to excrete waste from the body, leading to a condition called **uremia**. This means that the waste product, urea, which is normally excreted into the urine, remains in the blood.

Chemicals may crystallize in the urine and form **kidney stones** (renal calculi). Kidney stones can grow over time, and if a stone passes into the ureter, it can cause a blockage. Pressure will build up behind the kidney stone and cause swelling in the kidney. Patients with a kidney stone blockage may initially report vague discomfort in the flank, but the pain can become quite intense and typically will radiate to the groin. These patients are often agitated and restless as they try to get into a comfortable position to relieve the pain. They may also report nausea and vomiting. The pain from kidney stones is often caused when the stone moves within the ureter. In many cases, the stone will pass on its own, but in other cases it may have to be surgically removed (or broken up). A slight amount of blood in the urine (hematuria) before or after the stone passes may be present because of irritation of the ureter.

Kidney (renal) failure can be acute or chronic. Acute renal failure is a sudden (possibly over a period of days) decrease in function. It occurs from a variety of causes including hemorrhage, dehydration, trauma, shock, sepsis, heart failure, medications, drug abuse, and kidney stones. Acute renal failure can be reversed with prompt diagnosis and treatment.

Chronic renal failure is irreversible. It is progressive and develops over months and years. It is often caused by diabetes or hypertension. The kidney tissue shrinks and function diminishes. Eventually the patient requires dialysis or a kidney transplant to remove waste products from the bloodstream.

Patients with untreated chronic renal failure or patients with chronic renal failure who have missed scheduled dialysis may exhibit a wide variety of symptoms ranging from simply not feeling well to an altered level of consciousness. In later stages, seizures and coma are possible. Additional signs and symptoms include lethargy, nausea, headaches, cramps, and edema in the extremities and face because of fluid imbalances. Patients with chronic renal failure have a high incidence of heart disease. There is an increased risk of heart failure and cardiac arrest in these patients.

Female Reproductive Organs

Gynecologic problems are a common cause of acute abdominal pain. Always consider that a woman with lower quadrant abdominal pain and tenderness may have a problem related to her ovaries, fallopian tubes, or uterus. Chapter 23, *Gynecologic Emergencies*, covers gynecologic emergencies in depth.

Other Organ Systems

The aorta lies immediately behind the peritoneum. In older people, the wall of the aorta sometimes develops weak areas that swell to form an abdominal aortic aneurysm (AAA). A pulsating mass may be felt in the abdomen, although this is a rare sign and is often hard to detect. Use extreme caution when trying to assess or detect this condition. The development of an aneurysm is rarely associated with symptoms because it occurs slowly, but if the aneurysm tears and ruptures, massive hemorrhage may occur, and the patient will present with signs of acute peritoneal irritation and hemorrhagic shock. The patient may also report radiation of severe pain to the back because the peritoneum can be stripped away from the wall of the main abdominal cavity by the hemorrhage. Back pain is a common symptom when an aneurysm has started to expand and the aortic linings begin to tear. Back pain that cannot be easily explained should be investigated closely in patients who are suspected of having an AAA. The patient generally describes the pain as tearing, which is different than most other descriptions of abdominal pain. The association of acute abdominal signs and symptoms of shock requires prompt transportation. Because this is a fragile situation with a large, leaking artery, avoid unnecessary or vigorous palpation of the abdomen and do not aggressively treat the patient for shock because these actions can cause a small tear to expand. Remember to handle the patient gently during transport.

Pneumonia, especially in the lower parts of the lung, may cause both ileus and abdominal pain. In this situation, the problem lies in an adjacent body cavity, but the intense inflammatory response can reflect in the abdomen.

A **hernia** is a protrusion of an organ or tissue through a hole or opening into a body cavity where it does not belong. Hernias can occur as a result of the following:

- A congenital defect, as around the umbilicus
- A surgical wound that has failed to heal properly
- A natural weakness in an area, such as in the groin

Hernias do not always produce a mass or lump that the patient will notice. At times, the mass will disappear back into the body cavity in which it belongs. In this case, the hernia is said to be reducible. If the mass cannot be pushed back within the body, it is said to be incarcerated.

Special Populations

Geriatric patients are as susceptible to acute abdomen as younger adults. However, the signs and symptoms in geriatric patients might be different. Because of altered pain sensation, geriatric patients with an acute abdomen may not feel any discomfort or may describe the discomfort as mild, even in severe conditions.

Because the older patient has decreased body temperature regulation and response, the patient with an acute abdomen, including peritonitis, may have little or no fever at all.

Because of the older patient's response to the acute abdomen, a delay in identifying the condition and seeking medical attention is possible, putting the patient at risk for complications. You should ask about the patient's medical history, especially the history of recent illness, to identify a potential illness. Ask about abdominal discomfort, when the patient last had a bowel movement and whether she or he was constipated or had diarrhea. Inquire if the patient has had previous bowel obstructions. Inquire as to when the patient last ate, how much fluid he or she has consumed, and whether he or she has vomited. Many geriatric patients think that a few cups of coffee a day is adequate fluid intake, but coffee (especially caffeinated) causes vasoconstriction and dehydration within the digestive system. Quickly determining the severity of the patient's problem can hasten proper treatment and recovery.

Reducible hernias pose little risk to the patient; some people live with them for years. When a hernia is incarcerated, however, its contents may become seriously compressed by the surrounding tissue, eventually compromising the blood supply. This situation, called **strangulation**, is a serious medical emergency. Immediate surgery is required to remove any dead tissue and repair the hernia.

The following signs and symptoms indicate a serious hernia problem:

- A formerly reducible mass is no longer reducible
- Pain at the hernia site
- Tenderness when the hernia is palpated
- Red or blue skin discoloration over the hernia

Any of these signs and symptoms is cause for prompt transport to the emergency department (ED).

Special Populations

Causes of abdominal pain are difficult enough to determine in adults who can provide a good history, but for children who can only tell you they have a stomachache it is even more problematic. It is hard for a parent or caregiver to provide accurate information when pain is so subjective. Confirm with the parent or caregiver the details of the medical history and whether the current problem could be an exacerbation (worsening) of a chronic problem. Chapter 34, *Pediatric Emergencies*, covers the acute abdomen in pediatric patients in depth.

Abdominal pain could mean an infection, be related to something the child ate, or indicate a poisoning. Look for clues that may indicate if the child ingested something poisonous. Consider environmental causes like spider bites (black widow or brown recluse) or metabolic issues like diabetic complications. Confirm the duration and location of the pain and if there has been vomiting.

Assess the child's appearance. Ask if there has been diarrhea or any kind of rash. It is always wise to transport a child with abdominal pain for further assessment.

Words of Wisdom

An acute abdomen usually indicates peritonitis, in which generalized signs can make it challenging to determine exactly where the problem lies, even for physicians. Knowing abdominal assessment steps well and recording your findings in detail are important early factors in the process that leads to diagnosis.

Patient Assessment

Scene Size-up

As always, ensure that the scene is safe and follow standard precautions with a minimum of gloves and eye protection. Consider donning a gown and covering your shoes with disposable, protective covers because there may be feces and urine on the floor and some patients may have active projectile vomiting.

Determine the number of patients at the scene. If your call involves going to the patient's home and he or she does not come to the door, the patient may have had a syncopal episode (fainted). Request police assistance to help you gain access to the patient. Consider the need for additional or specialized medical resources and request them early.

Be alert for clues to help you determine the nature of illness (NOI) or the mechanism of injury. Acute abdomen can be the result of violence, such as blunt or penetrating trauma, so always be vigilant. Chapter 30, *Abdominal and Genitourinary Injuries*, discusses traumatic injuries in detail. Clues will help you develop an early index of suspicion for life threats. For example, a pale and sweating patient who reports tearing pain may have an AAA. Observe the scene closely and interview bystanders or family members if the NOI is not obvious. In some cases, your senses can help give you a clue as to the NOI. For example, gastrointestinal bleeding often has a characteristic odor that you will learn to recognize.

Primary Assessment

Begin assessing the patient by first looking for and treating any life-threatening conditions. Assess the patient's level of consciousness and ABCs; threats to airway, breathing, or circulation are considered life threatening and must be treated immediately. Rapidly observe the patient and his environment. Note the position of the patient. Commonly the patient will have his or her knees drawn up to help alleviate the pain associated with acute abdomen. Consider necessary treatment and transport options and the need for early advanced life support (ALS) assistance.

If the chief complaint indicates a life-threatening problem, assess and treat it immediately. If the chief complaint is a minor problem, it should wait until you have had a chance to assess for and treat any potential life threats.

Ensure that the patient's airway is clear and that the patient's respirations are adequate. Administer oxygen to the patient when needed. As a result of the abdominal pain, the patient may show shallow or inadequate respirations because deep breaths often intensify the pain.

When you are assessing the patient's circulation, remember to assess for major bleeding. Ask the patient about blood in the vomit (hematemesis) or black, tarry stools (melena). The patient's pulse rate and quality, as well as skin condition, may indicate shock. Check the pulses in both arms because a difference in pulse strength may indicate an aortic dissection.

Shock may be caused by hypovolemia or may be the result of a severe infection (septic). If evidence of shock (inadequate perfusion) is present, interventions should include high-flow oxygen, placing the patient supine, and keeping the patient warm. Ensure that you provide prompt treatment for life threats and do not delay transport.

Certain patients should be transported quickly. These include patients who have airway, breathing, or circulation problems, including problems with pulse and perfusion, and patients with suspected internal bleeding. Included in the group to package quickly and transport rapidly are patients who have a poor general impression, especially pediatric and geriatric patients. Pale, cool, diaphoretic skin, tachycardia, hypotension, and altered level of consciousness are all signs of significant illness.

Ensure that the ride during transport is as gentle as possible for the patient. Drive smoothly and steadily. Rapid driving can result in increased vehicle movement, potentially aggravating and possibly worsening the patient's abdominal pain.

YOU are the Provider — PART 4

After providing further treatment, you place the patient onto the stretcher, load him into the ambulance, and proceed to the closest appropriate hospital, which is located 20 miles away. En route, you reassess the patient.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert; restless
Respirations	28 breaths/min; shallow
Pulse	130 beats/min; weak and regular
Skin	Cool, pale, and diaphoretic
Blood pressure	100/62 mm Hg
Spo_2	98% (on oxygen)

7. Are there any special considerations for this patient? If so, what are they?

History Taking

If the patient is responsive, begin with obtaining the SAMPLE history. Ask the following questions specific to the signs and symptoms of a gastrointestinal or urologic emergency:

- **Nausea and vomiting.** Do you feel nauseous? Have you vomited? How many times? Over what period of time? Was there red blood? Did it look like coffee grounds?
- **Changes in bowel habits.** Has there been any change in your bowel habits? Have you been constipated? Did the stool look dark and tarry? Have you had diarrhea? Was there any red blood in it?
- **Urination.** Have you been urinating more or less often? Is there pain when you urinate? Is the color dark or unusual? Is there an unusual odor?
- **Weight loss.** Have you had unexplained weight loss recently? How many pounds?
- **Belching or flatulence.** Have you experienced belching or flatulence? For how long?
- **Pain.** What does the pain feel like? How long have you had this pain? Is the pain constant or intermittent? Have you had similar pain in the past? Have you done anything to relieve the pain?
- **Other.** Ask about any other signs or symptoms related to this complaint, such as "Are there any changes you have noted recently that may be contributing to your pain?"
- **Concurrent chest pain.** If the patient reports chest pain, use OPQRST (Onset, Provocation/ palliation, Quality, Region/radiation, Severity, and Timing of pain) to ask the patient what makes the pain better or worse.

Continue with the SAMPLE history. If the patient is a woman and of childbearing age, determine the date of her last menstrual period. This will determine if the patient could possibly be pregnant or raise the suspicion of other obstetric emergencies.

Ask the patient about his or her last oral intake. It is important to determine whether the patient has ingested any substance that could be causing the acute abdomen. If eating causes pain, discomfort, vomiting, or diarrhea, the patient will eat less often or stop eating. Do not give the patient anything by mouth. Food or fluid may only aggravate many of the symptoms. Also, the presence of food in the stomach increases the risk of aspiration.

WORDS OF WISDOM

Consider pertinent negatives, which are a record of normal findings that warrant no care or intervention. It is important to know and document that the patient denies shortness of breath or radiation of abdominal pain.

Finally, determine the events that led up to the patient's present illness. Question the patient about any recent trauma.

The SAMPLE history may not affect the interventions you perform, but it will help provide needed information for the physician in the ED to aid in determining the cause of the acute abdomen.

Secondary Assessment

In some situations, patients are comfortable only when lying in one particular position, which tends to relax muscles adjacent to the inflamed organ and thus lessen the pain. Therefore, the position of the patient may provide you with an important clue. For example, a patient with appendicitis may draw up the right knee. A patient with pancreatitis may lie curled up on one side.

Information gathered in the history-taking portion of the patient assessment may be used to focus your physical examination of the abdomen. A normal abdomen is soft and not tender to the touch. Pain and tenderness are the most common symptoms of an acute abdomen. The pain may be sharply localized or diffuse and will vary in its severity. Localized pain gives a clue to the problem organ or area causing it. Tenderness may be minimal or so great that the patient will not allow you to touch the abdomen. In some instances, the muscles of the abdominal wall become rigid in an involuntary effort to protect the abdomen from further irritation. This boardlike muscle spasm, called **guarding**, can be seen with major problems such as a perforated ulcer or pancreatitis.

Remember, the patient with peritonitis usually has abdominal pain, even when lying quietly. The patient may have difficulty breathing and may take rapid, shallow breaths because of the pain. Usually, you will find tenderness on palpation of the abdomen or when the patient moves. The degree of pain and tenderness is usually related directly to the severity of peritoneal inflammation.

Use the following steps to assess the abdomen:

1. Explain to the patient what you are going to do in terms of assessing the abdomen.
2. Place the patient in a supine position with the legs drawn up and flexed at the knees to relax the abdominal muscles, unless there is any trauma, in which case the patient will remain supine and stabilized. Determine whether the patient is restless or quiet, and whether motion causes pain.
3. Expose the abdomen and visually assess it. Does the abdomen appear distended (enlarged)? Do you see any pulsating masses (indicates an aortic aneurysm)? Is there bruising to the abdominal wall? Are there any surgical scars?
4. Ask the patient where the pain is most intense. Palpate in a clockwise direction beginning with the quadrant *after* the one the patient indicates is tender or painful; end with the quadrant the patient indicates is tender or painful. If the most painful area is palpated first, the patient may guard against further examination, making your assessment more difficult and less reliable.
5. Remember to be very gentle when palpating the abdomen. Occasionally, an organ within the abdomen will be enlarged and very fragile. Rough palpation could cause further damage. If you see a pulsating mass, do not touch it; doing so could cause the aorta to rupture.
6. Palpate the four quadrants of the abdomen gently to determine whether each quadrant is tense (guarded) or soft when palpated **Figure 18-4**.

Figure 18-4 Check for tenderness or rigidity by gently palpating the abdomen.

YOU are the Provider PART 5

With an estimated time of arrival at the hospital of 22 minutes, you reassess the patient and then call in your radio report. The patient remains conscious and alert, but restless, and is still experiencing 10/10 abdominal pain.

Recording Time: 17 Minutes

Level of consciousness	Conscious and alert; restless
Respirations	28 breaths/min; shallow
Pulse	128 beats/min; weak and regular
Skin	Cool, clammy, and diaphoretic
Blood pressure	6/58 mm Hg
Spo$_2$	97% (on oxygen)

The patient's condition is unchanged on arrival at the hospital. You give your verbal report to the charge nurse. After further assessment and treatment in the emergency department, the patient is taken to surgery. You later learn that he had an expanding abdominal aortic aneurysm, which was successfully repaired.

8. Could you have done anything definitively for this patient in the field? Why or why not?

7. Note whether the pain is localized to a particular quadrant or diffuse (widespread).
8. Palpate and wait for the patient to respond, looking for a facial grimace or a verbal "ouch." Do not ask the patient, "Does it hurt here?" as you palpate.
9. Determine whether the patient exhibits rebound tenderness (may be tender when direct pressure is applied, but very painful when pressure is released). This is an indicator of peritonitis. When you are palpating for rebound tenderness, you should use extreme caution.
10. Determine whether the patient can relax the abdominal wall on command. Guarding or rigidity may be present, which can indicate peritoneal irritation.

Findings of a high respiratory rate with a normal pulse rate and blood pressure may indicate the patient is unable to ventilate properly because deep breathing causes pain. A high respiratory rate and pulse rate with signs of shock, such as pallor and diaphoresis (profuse sweating), may indicate septic or hypovolemic shock. When treating a patient who has a dialysis shunt in his or her arm, it is important not to take a blood pressure in the same arm as the shunt to avoid damaging it.

Special Populations

Older patients may not exhibit rigidity or guarding like a younger adult. Abdominal pain can sometimes be related to cardiac conditions. Abdominal pain is frequently caused by bowel impaction or obstruction. Obstructions can be very serious and can lead to bowel ruptures that often are life threatening. Older patients may also not exhibit the same pain response ability because of deterioration of their sensory systems. Provide transport to an appropriate facility that can meet the needs of a geriatric patient.

Words of Wisdom

When palpating the abdomen of a patient with abdominal complaints, it is important to palpate clockwise, beginning in the quadrant next to the area of the described pain.

Reassessment

Because it is often difficult to determine the cause of an acute abdominal emergency, it is extremely important to reassess your patient frequently to determine whether the patient's condition has changed. Remember, the condition of a patient with an acute abdomen can change rapidly from stable to unstable.

Vital signs must be reassessed and compared with the patient's baseline vital signs. If anything changes en route to the hospital, manage the problem and document any changes or additional treatment.

Reassess the patient and then ask and answer the following questions (where appropriate):

- Has the patient's level of consciousness changed?
- Has the patient become more anxious?
- Has the appearance of the skin changed?

- Has the pain gotten better or worse?
- Has bleeding increased or decreased?
- Is current treatment improving the patient's condition?
- Has an already identified problem gotten better or worse?
- What is the nature of any newly identified problems?

Interventions generally include treatment for shock and providing emotional support. Administer oxygen, cover the patient with a blanket for warmth, and provide gentle transport for the patient without delay. Place the patient in a position of comfort. You will find that patients want to be supine with their knees drawn up. If the patient wants to lay on his or her side, try to make that possible. Be sure that you can observe and maintain the patient's airway because vomiting is common. If the patient's pain is extreme or he or she is showing significant signs of shock, consider the use of ALS assistance (if available) for intravenous fluids and pain management. If transport time is extended and rapid transport is needed, consider air medical transport if available.

Emergency Medical Care

Although you cannot treat the causes of acute abdomen, you can take steps to provide comfort and lessen the effects of shock by reassuring the patient and making the patient feel at ease. Treat the patient for shock even when obvious signs of shock are not apparent. Position patients who are vomiting to maintain a patent airway. Contain the vomitus to prevent the spread of infections (by using a biohazard bag). Airborne bacteria and viruses produced from vomiting can be easily transmitted to others. Ensure you are wearing gloves, eye protection, and a gown to prevent contamination of yourself, and wear a mask to prevent breathing in any infectious organisms. When you have released your patient to the hospital staff, clean the ambulance and any equipment you have used, preferably with an antibacterial cleaner. Do not forget to wash your hands even though you were wearing gloves.

Providing the patient low-flow oxygen may decrease nausea and anxiety. If the patient is having problems breathing, high concentrations of oxygen are more appropriate. Loosen restrictive clothing and transport gently in a position of comfort. Constantly reassess your patient's condition for signs of deterioration.

Dialysis Emergencies

Patients with end-stage renal disease (ESRD), also referred to as chronic renal failure, are treated with either peritoneal dialysis or hemodialysis. In these processes, the patient's blood is filtered and cleansed of the toxins and then returned to the body. The treatment eliminates waste, normalizes the blood chemistry, and reduces excess fluid. If a patient misses a dialysis treatment, weakness and pulmonary edema can be the first in a series of conditions that can become progressively more serious if normal balance is not returned to the patient's body.

The only time you will most likely see such a machine is if your service transports patients to and from dialysis centers. If there is a dialysis machine in a private residence, treatments will most likely be performed by a trained dialysis technician.

In hemodialysis, the patient's blood circulates through a dialysis machine that functions in much the same way as the normal kidneys. Most patients undergoing long-term hemodialysis have some sort of shunt, a surgically created connection between a vein and an artery. The patient is connected to the dialysis machine through this shunt, which allows blood to flow from the body into the dialysis machine and back to the body. It is usually located in the forearm or upper arm **Figure 18-5**.

Figure 18-5 Expose and visualize fistulas or shunts to determine if there is an infection or if you need to control bleeding.

In peritoneal dialysis, large amounts of specially formulated dialysis fluid are infused into (and back out of) the abdominal cavity. This fluid stays in the cavity for 1 to 2 hours, allowing equilibrium to occur. Peritoneal dialysis is very effective but carries a high risk of peritonitis. With proper training, however, peritoneal dialysis can be performed in the home.

The adverse effects of dialysis include hypotension, muscle cramps, nausea and vomiting, hemorrhage from the access site, and infection at the access site. If your call involves a patient on dialysis, start with the ABCs: assess and manage the airway, breathing, and circulation. Provide high-flow oxygen if indicated and manage any bleeding from the access site. Position the patient sitting up in cases of pulmonary edema or supine if the patient is in shock, and transport promptly.

Some dialysis patients also have urinary catheters. The catheter is placed in the bladder so the urine can run into a bag. These catheters can often be a source of infection. The patient may report fever and general malaise (illness) in addition to any symptoms specific to kidney failure. Leave the device in place. Treat any signs and symptoms and transport the patient for further evaluation.

During transport, unless there is a life-threatening event, make all attempts to deliver the patient to a hospital with dialysis capability.

YOU are the Provider SUMMARY

1. What is the definition of an acute abdomen?

Acute abdomen is a term used to describe the sudden (acute) onset of abdominal pain that is not caused by a traumatic injury. It is generally associated with severe, progressive symptoms that require medical attention. Acute abdominal pain can be caused by dysfunction of one or more of the abdominal organs, such as the liver, spleen, gallbladder, stomach, pancreas, kidneys, large or small intestines, or appendix.

2. What is your role as an EMT in treating a patient with abdominal pain?

The underlying cause of a patient's abdominal pain, acute or chronic, is often difficult to identify—even for a physician. As an EMT, it is far more important for you to recognize life-threatening conditions and provide prompt emergency care than it is to identify the underlying cause of the patient's pain. Patients who are in pain, especially when the pain occurs suddenly, are often very anxious and scared; providing emotional support is an important part of your role.

3. What is the proper technique of assessing a patient's abdomen? What should you assess for?

Although assessment of the abdomen may help localize the source of a patient's pain, it should not be prolonged. Place the patient in a supine position with the legs drawn up and flexed at the knees; this position will relax the abdominal muscles and may alleviate some of his or her pain. Look at the abdomen first; does it appear distended (enlarged)? Do you see any pulsating masses (indicates an aortic aneurysm)? Is there bruising of the abdominal wall? Ask the patient where the pain is most intense and assess that area last. If the most painful area is palpated first, the patient may guard against further examination, making your assessment more difficult and less reliable. Gently palpate the four abdominal quadrants to determine whether each quadrant is rigid or soft, or tender, and note the presence of any masses. Pay particular attention to the patient's facial expressions when palpating each abdominal quadrant; they may yield valuable information. Note whether the pain is localized to a particular quadrant or diffuse (wide-spread). Determine whether the patient can relax the abdominal wall on command; if he or she cannot, the abdomen is said to be rigid. Avoid vigorous palpation of the abdomen; doing so will only cause the patient more pain and can worsen his or her condition, especially if one of the abdominal organs is enlarged and fragile.

4. What is the difference between radiating pain and referred pain?

Radiating pain "moves" from its point of origin to other parts of the body, such as the pain from pancreatitis, which may radiate to the back, or pain from a kidney stone blockage, which may radiate to the groin. With radiating pain, there is pain at point A and point B, with a "trail" of pain in between the two points.

Referred pain originates in a particular organ but is described or perceived by the patient as pain in a different location or pain at the point of origin and another location. For example, the origin of pain associated with cholecystitis—inflammation of the gall-bladder—is usually the right upper quadrant of the abdomen. However, the patient commonly reports pain in the right shoulder. In some cases, the patient reports pain in both the right upper quadrant and the right shoulder. Unlike radiating pain, there is no pain in between the two points.

5. What do the patient's vital signs indicate?

The patient's vital signs indicate shock. His respirations are rapid (tachypnea); he has a rapid heart rate (tachycardia); his skin is cool, pale, and diaphoretic (sweaty); and his blood pressure—considering the fact the he has a history of hypertension—is low. Whether the patient has an intra-abdominal infection (peritonitis) or intra-abdominal bleeding, the end result, if untreated, will be the same—death!

It is more important to recognize life-threatening conditions (eg, shock) than it is to determine the exact cause of a patient's abdominal pain, or any pain for that matter. You must begin immediate treatment aimed at maintaining adequate perfusion, such as applying high-flow oxygen (your partner has already done this), keeping him warm, and rapidly preparing for transport.

6. What do you suspect is the cause of the patient's abdominal pain?

Although only a physician can determine the exact cause of the patient's pain, a severe abdominal pain that radiates to the lower back is characteristic of abdominal aortic aneurysm.

The typical patient with an abdominal aortic aneurysm is a man in his late 60s or older. As long as the aneurysm is not expanding, the patient usually will be asymptomatic. When the aneurysm starts to expand, however, the patient has a sudden onset of abdominal pain, which is classically described as a ripping or searing sensation in the abdomen that radiates to the back. When an aortic aneurysm starts expanding and producing symptoms, rupture may be imminent. If aortic rupture occurs, the patient often bleeds to death (exsanguination) very quickly. If the aneurysm is leaking, however, blood will accumulate in the abdominal cavity and cause signs of shock; this is what may be happening to your patient.

7. Are there any special considerations for this patient? If so, what are they?

As with any patient exhibiting signs of shock, your priority is to provide transport to an appropriate medical facility without delay. Patients with a suspected aortic aneurysm must be handled carefully; avoid rough driving and unnecessary bumps in the road. Because this is a fragile situation, with a large, leaking artery, avoid further palpation of the abdomen. Some patients with an abdominal aortic aneurysm have a pulsating mass that can be palpated (and sometimes seen) near the umbilicus. If you see a pulsating mass, *do not* touch it; doing so could cause the aorta to rupture.

Avoid anything that will make the patient more anxious; anxiety causes increases in heart rate and blood pressure. An acute increase in blood pressure, even a slight one, may be all that is needed to cause an aortic rupture. In this particular patient, you should avoid elevating the patient's legs, unless otherwise instructed to do so by medical control. Elevating the lower extremities may cause a surge of blood back to the heart, resulting in an increase in blood pressure.

8. Could you have done anything definitively for this patient in the field? Why or why not?

No. Definitive care (eg, surgically repairing the aneurysm) can only be provided at the hospital. Although paramedics can start intravenous lines and give pain medications, these interventions are simply aimed at controlling pain and partially treating shock, not fixing the aneurysm. Your role as an EMT is to recognize the patient's condition is serious, provide emergency medical treatment, and transport without delay.

EMS Patient Care Report (PCR)

Date: 3-20-16	**Incident No.:** 150109	**Nature of Call:** Abdominal pain		**Location:** 1500 E. River Rd., Apt. 5	
Dispatched: 0320	**En Route:** 0321	**At Scene:** 0333	**Transport:** 0345	**At Hospital:** 0410	**In Service:** 0420

Patient Information

Age: 79 **Sex:** M **Weight (in kg [lb]):** 86 kg (190 lb)	**Allergies:** None **Medications:** Toprol, Diovan **Past Medical History:** Hypertension, depression, appendectomy **Chief Complaint:** Abdominal pain

Vital Signs

Time: 0335	**BP:** 98/60	**Pulse:** 124	**Respirations:** 28	**Spo_2:** 96%
Time: 0345	**BP:** 100/62	**Pulse:** 130	**Respirations:** 28	**Spo_2:** 98%
Time: 0350	**BP:** 96/58	**Pulse:** 128	**Respirations:** 28	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC** **NRM** **BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Thermal management

Narrative

Dispatched for 79-year-old man with abdominal pain. On arrival at the scene, found the patient lying on his side on a couch in his living room; his knees were drawn up to his abdomen. He was conscious and alert, but very restless and in severe pain. His skin was cool, pale, and diaphoretic. The patient states that the pain, which began suddenly, is in his abdomen and is severe. He further states that the pain radiates to his lower back. Pain severity, per patient, is a 10 on a scale of 0 to 10. Patient denies nausea, vomiting, or any other symptoms. History is significant for hypertension, depression, and an appendectomy 30 years ago. Applied high-flow oxygen via nonrebreathing mask, obtained vital signs, and performed further assessment. Vital signs revealed tachycardia, tachypnea, a relatively low blood pressure, and an oxygen saturation level of 96%. Assessment of abdomen revealed that it was diffusely tender to palpation and guarded. No abdominal distention was noted. Covered patient with blanket to keep him warm, placed him onto the stretcher, loaded him into the ambulance, and began transport to the hospital. Continued oxygen therapy en route and continuously monitored his condition. He remained conscious and alert, but restless, and stated that his pain was still a 10/10. Called radio report to the hospital; no further orders were given by the attending physician. Delivered patient to the emergency department without incident. Verbal report was given to charge nurse.**End of report**

Prep Kit

Ready for Review

- The acute abdomen is a medical emergency, requiring prompt but gentle transport.
- The pain, tenderness, and abdominal distention associated with an acute abdomen may be signs of peritonitis, which may be caused by any condition that allows pus, blood, feces, urine, gastric juice, intestinal contents, bile, pancreatic juice, amniotic fluid, or other foreign material to lie within or adjacent to the peritoneum.
- In addition to abdominal disease or injury, problems in the gastrointestinal, genital, and urinary systems may also cause peritonitis.
- Signs and symptoms of acute abdomen include pain, nausea, vomiting, and a tense, distended abdomen.
- Pain is common directly over the inflamed area of the peritoneum, or it may be referred to another part of the body. Referred pain occurs because of the connections between the two different nervous systems supplying the parietal peritoneum and the visceral peritoneum.
- Do not give the patient with an acute abdomen anything by mouth.
- A patient in shock or with any life-threatening condition should be transported without delay. Call for advanced life support assistance if your patient's condition deteriorates during transport.

Vital Vocabulary

acute abdomen A condition of sudden onset of pain within the abdomen, usually indicating peritonitis; immediate medical or surgical treatment is necessary.

appendicitis Inflammation or infection of the appendix.

cholecystitis Inflammation of the gallbladder.

cystitis Inflammation of the bladder.

diverticulitis Inflammation in small pockets at weak areas in the muscle walls.

emesis Vomiting.

gastroesophageal reflux disease (GERD) A condition in which the sphincter between the esophagus and the stomach opens, allowing stomach acid to move up into the esophagus, usually resulting in a burning sensation within the chest; also called acid reflux.

guarding Involuntary muscle contractions (spasm) of the abdominal wall; an effort to protect the inflamed abdomen.

hematemesis Vomiting blood.

hernia The protrusion of an organ or tissue through an abnormal body opening.

ileus Paralysis of the bowel, arising from any one of several causes; stops contractions that move material through the intestine.

kidney stones Solid crystalline masses formed in the kidney, resulting from an excess of insoluble salts or uric acid crystallizing in the urine; may become trapped anywhere along the urinary tract.

melena Black, foul-smelling, tarry stool containing digested blood.

pancreatitis Inflammation of the pancreas.

peritoneum The membrane lining the abdominal cavity (parietal peritoneum) and covering the abdominal organs (visceral peritoneum).

peritonitis Inflammation of the peritoneum.

referred pain Pain felt in an area of the body other than the area where the cause of pain is located.

strangulation Complete obstruction of blood circulation in a given organ as a result of compression or entrapment; an emergency situation causing death of tissue.

uremia Severe kidney failure resulting in the buildup of waste products within the blood. Eventually brain functions will be impaired.

urinary tract infection (UTI) An infection, usually of the lower urinary tract (urethra and bladder) that occurs when normal flora bacteria enter the urethra and grow.

You are dispatched to a homeless shelter for a patient with abdominal pain. Upon arrival you find a 63-year-old man leaning over the toilet vomiting and clutching his abdomen. The patient tells you that he has had the pain for 6 hours but he began vomiting and having throat pain about 30 minutes ago. He states that he had someone call 9-1-1 when the pain became unbearable and he started throwing up bright red blood. This is the first time he has had these symptoms. The pain is in his stomach and throat and he describes it as sharp. He rates the pain as a 10 on a scale of 1 to 10 and states that nothing makes the pain worse or better. He has no allergies and doesn't take any medications although he states that he has a history of a "big liver," high blood pressure, and alcoholism. His last oral intake was a six-pack of beer 4 hours ago. Vital signs are a pulse of 104; respirations of 22; blood pressure 86/58; Spo$_2$ 97% on room air; skin is pale, cool, and diaphoretic.

1. Which of the following conditions could the patient have, based on what you know thus far?

   A. Peptic ulcers
   B. Cholecystitis
   C. Diverticulitis
   D. Nephritis

2. Your partner notes blood in the patient's vomit. The medical term for this is:

   A. hematemesis.
   B. melena.
   C. hematochezia.
   D. steratorrhea.

3. The patient tenses his abdominal muscles during your assessment. This is called:

A. rebound tenderness.
B. tetany.
C. splinting.
D. guarding.

4. You suspect upper gastrointestinal bleeding. All of the following fit into this category, EXCEPT?

A. Esophageal varices
B. Ulcerative colitis
C. Esophagitis
D. Mallory-Weiss tear

5. Based on the patient's presentation and your initial assessment findings you suspect:

A. gastroenteritis.
B. pancreatitis.
C. esophageal varices.
D. cholecystitis.

6. Appropriate management for this patient would include:

A. high-flow oxygen.
B. oral glucose.
C. activated charcoal.
D. placing the patient supine.

7. En route to the emergency department, the patient's condition seems to worsen. Some of his vital signs have changed, while others have not. What is the last vital sign to change in the setting of shock?

A. Heart rate
B. Blood pressure
C. Respiratory rate
D. Pulse oximetry reading

8. What assessment findings support your working diagnosis?

9. What information should you ask the patient about when assessing the nature of illness?

CHAPTER 19

Endocrine and Hematologic Emergencies

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National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Endocrine Disorders

Awareness that

› Diabetic emergencies cause altered mental status (pp 729, 735–736, 740–741)

Anatomy, physiology, pathophysiology, assessment, and management of

› Acute diabetic emergencies (pp 727–741)

Hematology

Anatomy, physiology, pathophysiology, assessment, and management of

› Sickle cell crisis (pp 742, 744–745)
› Clotting disorders (pp 742–745)

Knowledge Objectives

1. Describe the anatomy and physiology of the endocrine system and its main function in the body. (p 727)
2. Discuss the role of glucose as a major source of energy for the body and its relationship to insulin. (p 728)
3. Define the terms diabetes mellitus, hyperglycemia, and hypoglycemia (pp 728–730)
4. Describe the differences and similarities between hyperglycemic and hypoglycemic diabetic emergencies, including their onset, signs and symptoms, and management considerations. (pp 729–730)
5. Distinguish between the individual types of diabetes and how their onset and presentations are different. (pp 730–732)
6. Describe the interventions for providing emergency medical care to both a conscious and unconscious patient with an

altered mental status and a history of diabetes who is having symptomatic hyperglycemia. (p 733)

7. Describe the interventions for providing emergency medical care to both a conscious and unconscious patient with an altered mental status and a history of diabetes who is having symptomatic hypoglycemia. (pp 733–734)
8. Explain the process for assessing and managing the airway of a patient with an altered mental status, including ways to differentiate a hyperglycemic patient from a hypoglycemic patient. (pp 733–735, 741)
9. Explain some age-related considerations when managing a pediatric patient who is experiencing symptomatic hypoglycemia. (p 734)
10. Discuss the steps the EMT should follow when conducting a primary and secondary assessment of a patient with an altered mental status who is suspected of having diabetes. (pp 734–736)
11. Explain when it is appropriate to obtain medical direction when providing emergency medical care to a patient with diabetes. (p 737)
12. Explain some age-related considerations when managing an older patient who has undiagnosed diabetes. (p 737)
13. Provide the forms, dose, administration, indications, and contraindications for giving oral glucose to a patient with a decreased level of consciousness who has a history of diabetes. (p 738)
14. Discuss the composition and functions of blood. (pp 741–742)
15. Describe the pathophysiology of sickle cell disease, complications, and management of sickle cell disease. (pp 742, 745)
16. Describe two types of blood clotting disorders, and the risk factors, characteristics, and management of each. (pp 742–745)

Skills Objectives

1. Demonstrate the assessment and care of a patient with hypoglycemia and a decreased level of consciousness. (pp 729–730, 734–741)
2. Demonstrate how to administer oral glucose paste to a patient who is experiencing a low glucose level. (p 739, Skill Drill 19-1)

Introduction

The endocrine system directly or indirectly influences almost every cell, organ, and function of the body. Consequently, patients with an endocrine disorder often are seen with a multitude of signs and symptoms that require a thorough assessment and immediate treatment.

This chapter discusses diabetes mellitus type 1 and diabetes mellitus type 2. You will gain an understanding of the role of the pancreas in hormone production and release. The determination of hyper-glycemia versus hypoglycemia is explained in detail, because their presentations can be very similar with subtle differences. Further discussion focuses on the signs and symptoms of low and high blood glucose levels as well as the adverse effects of chronically high blood glucose levels.

This chapter also discusses common hematologic emergencies that are often missed in patients. Although hematologic disorders can be difficult to assess and treat in a prehospital setting, your actions may save a patient's life.

Endocrine Emergencies

Anatomy and Physiology

The **endocrine system** is a communication system that controls functions inside the body. This system, along with the other systems, maintains the body's homeostasis. **Endocrine glands** secrete messenger **hormones**, which are chemical substances produced by a gland. Hormones travel through the blood to the end organs, tissues, or cells that they are intended to affect. When the hormone arrives, the cell, tissue, or organ receives the message and an action or cellular process takes place.

Endocrine disorders are caused by an internal communication problem. If a gland is not functioning normally, it may produce more hormone (hypersecretion) than is needed or it may not produce enough hormone (hyposecretion). A gland may be functioning correctly, but the receiving organ may not be responding. The receiving organ in these cases is less responsive to the amount of hormone it would take under normal circumstances to initiate an action or cellular response.

The brain needs two things to survive: **glucose** and oxygen. **Insulin** is necessary for glucose to enter the cells for metabolism. Without the proper balance of hormones (ie, without enough insulin), the cell does not get fed.

The pancreas produces and stores two hormones that play a major role in glucose metabolism: glucagon and insulin. A small portion of the pancreas is filled with the islets of Langerhans. Within these islets are alpha and beta cells. The alpha cells produce glucagon and the beta cells produce insulin.

In a person without diabetes, the pancreas stores and secretes insulin and glucagon in response to the level of glucose in the blood **Figure 19-1**. When a person eats, the level of glucose in his or her blood rises. In response, the pancreas secretes insulin into the blood; this allows the glucose to enter the body's cells and be used for energy. It also allows glucose to be stored in the form of glycogen in the liver and skeletal muscles for use at a later time. As blood glucose levels return to normal, insulin stops being secreted and the body is said to be in a fed state.

YOU are the Provider — PART 1

A call for service comes in at 1500 hours. The call details from dispatch describe a 23-year-old man with weakness and nausea. You arrive on scene to find a previously healthy man who has had flulike symptoms for the last 6 days. The patient's medical history is unremarkable. Your interview reveals that he has two family members with diabetes mellitus. While obtaining the patient's history and performing a physical examination, you find that your patient has symptoms related to eating and drinking. The patient tells you that he has been experiencing the symptoms for a little more than a week. You suspect the symptoms have been occurring much longer though because of his weight loss, unquenchable thirst, unrelenting hunger, and increased frequency of urination.

1. What processes are being described by the patient?
2. What hormone is missing in diabetes mellitus type 1?

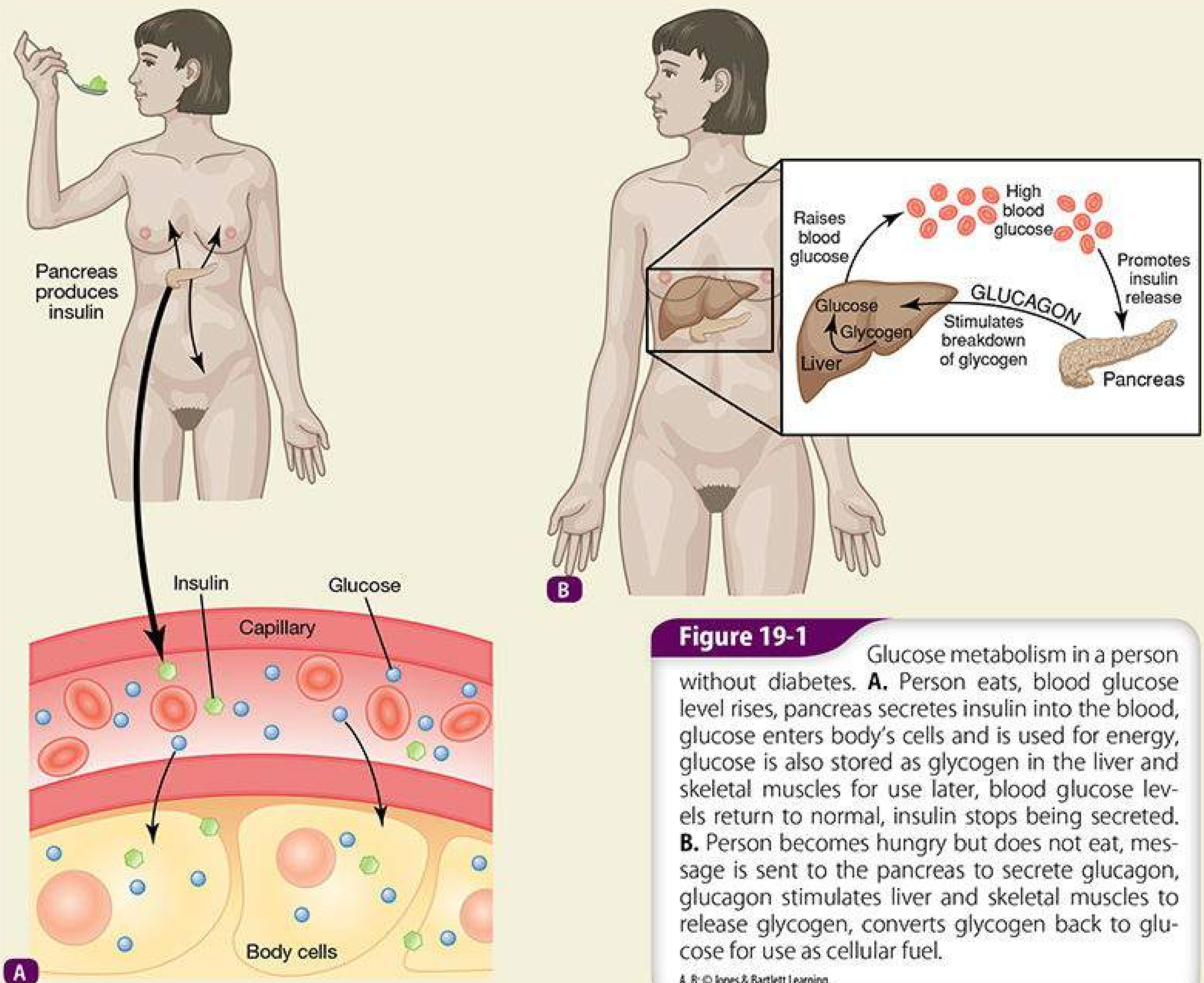

Figure 19-1 Glucose metabolism in a person without diabetes. **A.** Person eats, blood glucose level rises, pancreas secretes insulin into the blood, glucose enters body's cells and is used for energy, glucose is also stored as glycogen in the liver and skeletal muscles for use later, blood glucose levels return to normal, insulin stops being secreted. **B.** Person becomes hungry but does not eat, message is sent to the pancreas to secrete glucagon, glucagon stimulates liver and skeletal muscles to release glycogen, converts glycogen back to glucose for use as cellular fuel.

As time passes, the body will become hungry again. If the hungry individual skips or delays a meal, a message is sent to the pancreas to secrete glucagon. Glucagon then stimulates the liver and the skeletal muscles to release glycogen and converts it back to glucose for use as cellular fuel.

Pathophysiology

According to the American Diabetes Association, in 2012 diabetes mellitus affected approximately 9.3% of the population. **Diabetes mellitus** is a disorder of glucose metabolism, such that the body has an impaired ability to get glucose into the cells to be used for energy. The patient with diabetes has either impaired insulin production or not enough functional receptors on the surface of the cells for the insulin to bind to. Glucose cannot get into the cell, the cell goes unfed, and the level of glucose in the blood remains and continues to rise **Figure 19-2**.

Without treatment, blood glucose levels become too high, which in severe cases may cause life-threatening illness, or coma and death. When diabetes mellitus is properly managed, a process that involves both the patient and physician, the patient can live a relatively normal life. However, people who do not manage their diabetes well often experience severe complications, including blindness, cardiovascular disease, and kidney failure, which dramatically affect the length and quality of life.

There are three types of diabetes: diabetes mellitus type 1, diabetes mellitus type 2, and pregnancy-induced gestational diabetes. A detailed discussion of gestational diabetes can be found in Chapter 33, *Obstetrics and Neonatal Care*.

Treatments for diabetes include medications and injectable hormones that lower the patient's blood glucose level. These hormones and medications, whether administered correctly or incorrectly, can create a medical emergency for the patient with diabetes. If left unrecognized and untreated, a low blood glucose level (hypoglycemia) can be life threatening. You must also recognize the signs and symptoms of a high blood glucose level (hyperglycemia) so you can provide the appropriate treatment and deliver the patient to the next level of care.

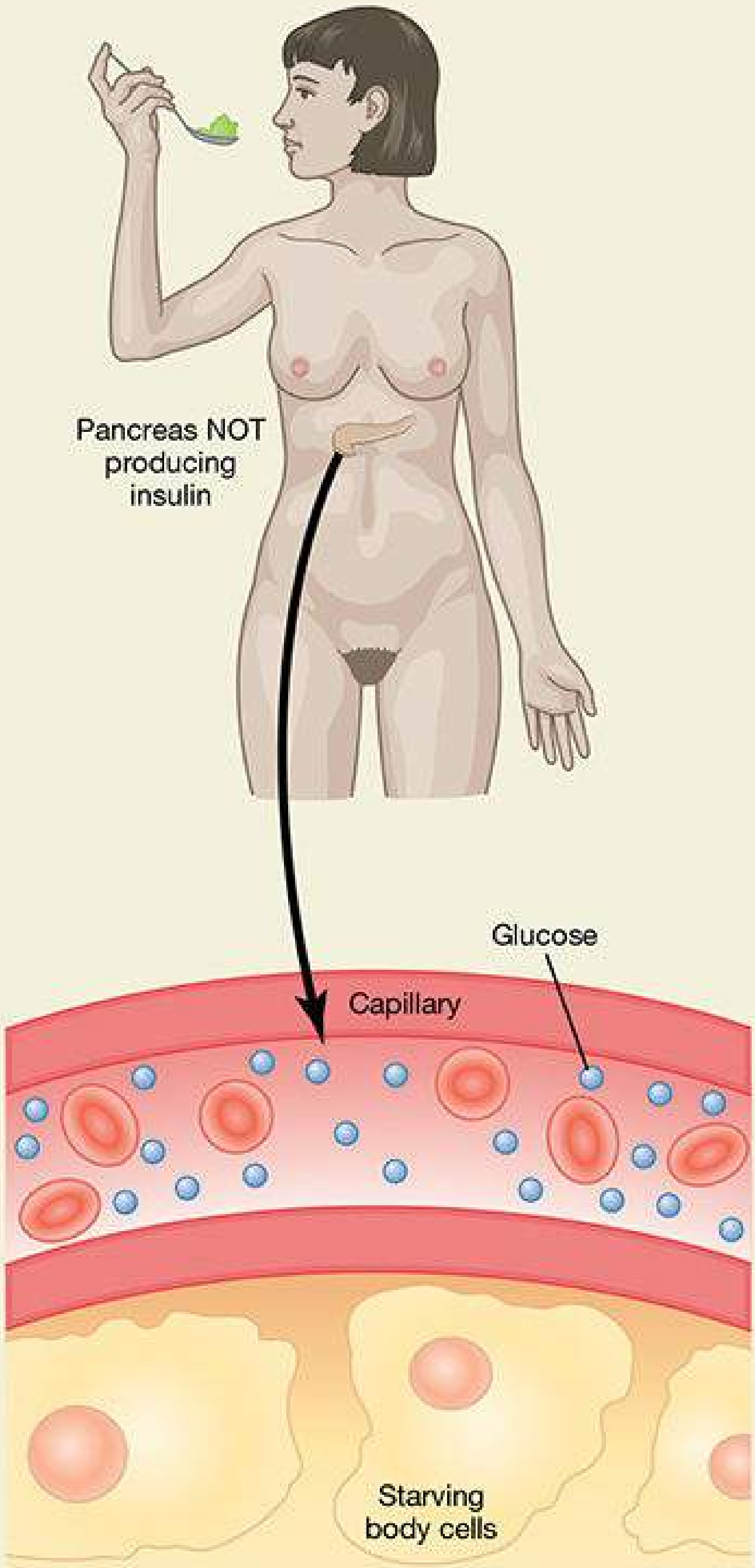

Figure 19-2 Diabetes is defined as the lack of or ineffective action of insulin. Without insulin, cells begin to "starve" because insulin is needed to allow glucose to enter and nourish the cells.

Hyperglycemia is a state in which the blood glucose level is above normal. **Hypoglycemia** is a state in which the blood glucose level is below normal **Figure 19-3**. Hyperglycemia and hypoglycemia can occur with both diabetes mellitus type 1 and type 2. In the field you will encounter many patients displaying the signs and symptoms of high and low blood glucose levels.

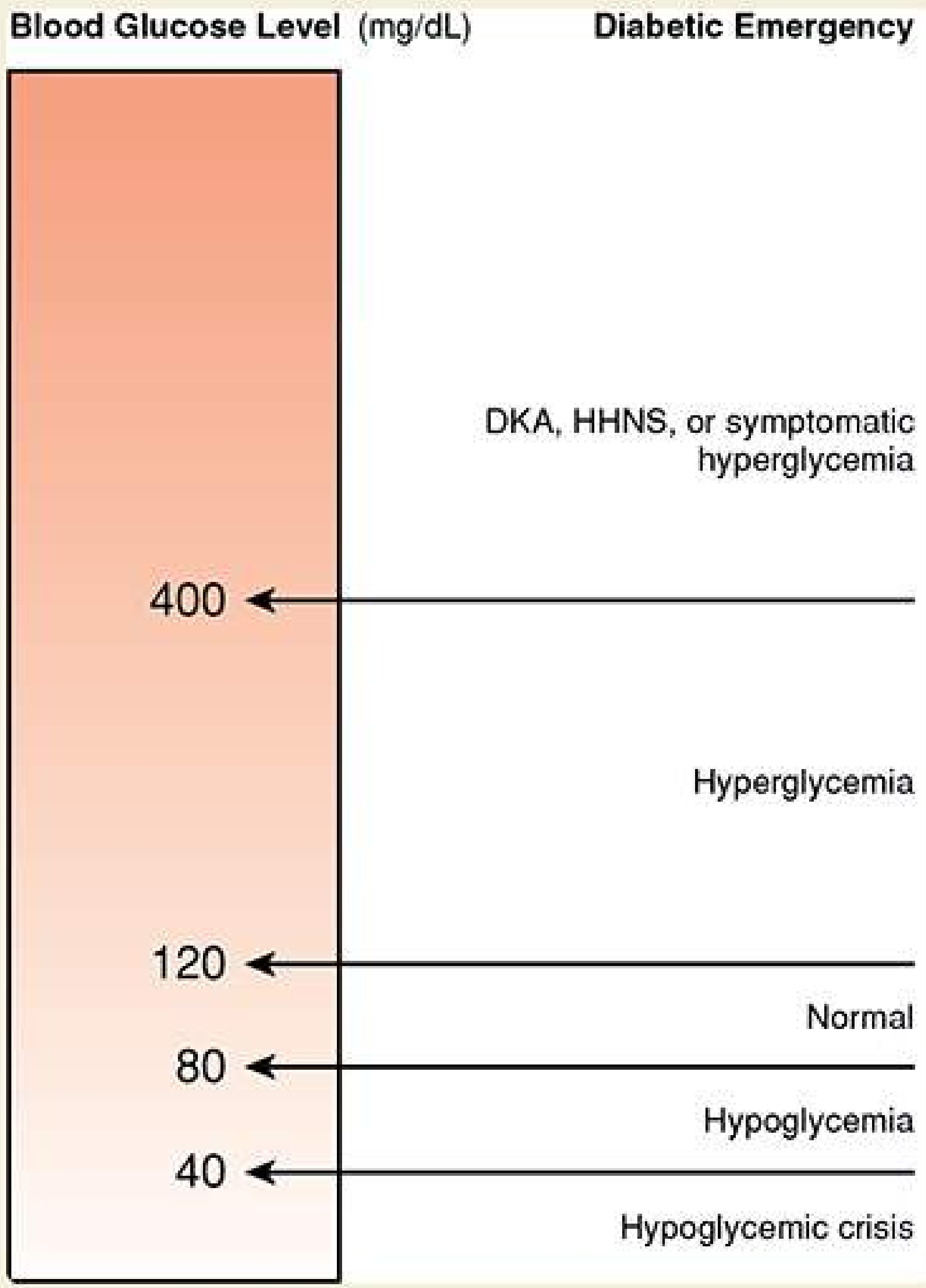

Figure 19-3 The left column illustrates blood glucose levels; the right column illustrates the conditions associated with that particular level of blood glucose. Notice that the normal range is rather small in comparison to the other ranges.

Hyperglycemia and hypoglycemia can be quite similar in their presentation. As an EMT, you must look for the subtle differences that define one disorder from the other Table 19-1. Patients at both extremes, with very low and very high blood glucose levels, can present with altered mental status. Patients with severe hypoglycemia are more likely to have a depressed level of consciousness than patients with hyperglycemia. Be careful not to incorrectly label patients as being intoxicated.

Altered mental status related to diabetic emergencies can often mimic alcohol intoxication, and intoxicated patients often have abnormal glucose levels. Be thorough and check a fingerstick glucose level for all patients with altered mental status.

Table 19-1 Hyperglycemia *Versus* Hypoglycemia

History	Hyperglycemia	Hypoglycemia
Onset	Gradual (hours to days)	Rapid (within minutes)
Skin	Warm and dry	Pale, cool, and moist
Infection	Common	Uncommon
Gastrointestinal tract		
Thirst	Intense	Absent
Hunger	Present and increasing	Absent
Vomiting/abdominal pain	Common	Uncommon
Respiratory system		
Breathing	With diabetic ketoacidosis (DKA) there are rapid, deep (Kussmaul) respirations	Normal; may become shallow or ineffective if hypoglycemia is severe and mental status is depressed
Odor of breath	With DKA there may be a sweet, fruity odor	Normal
Cardiovascular system		
Blood pressure	Normal to low	Normal to low
Pulse	Rapid, weak, and thready	Rapid, weak
Nervous system		
Con-sciousness	Restlessness, possibly progressing to coma; abnormal or slurred speech; unsteady gait	Irritability, confusion, seizure, or coma; unsteady gait
Treatment		
Response	Gradual, within 6 to 12 hours following medical treatment	Immediate improvement after administration of glucose

Hypoglycemia can develop if a person with diabetes takes his or her medications (pills or insulin) as prescribed but fails to eat enough food. Alternatively, a person with diabetes may intentionally or accidentally take too much medication, resulting in low blood glucose levels despite normal dietary intake. All hypoglycemic patients require prompt treatment with oral glucose paste (if alert and able to protect their airway) or injection of glucose (dextrose) or glucagon by an advanced life support (ALS) provider.

Diabetes Mellitus Type 1

Type 1 diabetes is an autoimmune disorder in which the individual's immune system produces antibodies against the pancreatic beta cells. Essentially, this disease is about the missing pancreatic hormone insulin. Insulin is the "key" to the "door" of the cell. Without insulin, glucose cannot enter the cell, and the cell cannot produce energy.

The onset of this disorder usually happens from early childhood through the fourth decade of life. The patient's immune system progressively destroys the ability of the pancreas to produce insulin. Without the insulin from the pancreatic beta cells, the patient must obtain insulin from an external source. Patients with type 1 diabetes cannot survive without insulin. Patients who inject insulin often need to check their blood glucose levels up to six times a day or more using a lancet and a small capillary blood sample read by a glucometer **Figure 19-4**.

Many people with type 1 diabetes have an implanted insulin pump, which continuously measures the body's glucose levels and provides an (adjustable) infusion of insulin and correction doses of insulin based on carbohydrate intake at mealtimes **Figure 19-5**. The presence of an insulin pump limits the number of times patients have to check their fingerstick glucose level. Unfortunately, insulin pumps can malfunction and hyperglycemic or hypoglycemic diabetic emergencies can develop. Always inquire about the presence of an insulin pump—particularly in patients with type 1 diabetes—and ask the patient if it is working properly.

Type 1 diabetes is the most common metabolic disease of childhood. A patient with new-onset type 1 diabetes will have symptoms related to eating and drinking:

- Polyuria
- Polydipsia
- Polyphagia
- Weight loss
- Fatigue

Normal blood glucose level is between 80 and 120 mg/dL. The body's metabolism is sensitive to the levels of particular substances, such as glucose, in the blood. The kidneys filter the blood and thus manage all of the substances present in the blood. At normal levels, glucose remains in the blood as it is filtered.

A

B

C

Figure 19-4 The blood glucose self-monitoring kit with digital meter is a device used by patients at home and by EMTs in the field in many EMS systems. Three types are shown.

A Accu-Chek® Aviva used with permission of Roche Diagnostics; B © Stockbyte/Thinkstock; C © instamatic/iStock.

When a patient's blood glucose level is above normal, the kidney's filtration system becomes overwhelmed and glucose spills into the urine. The increased amount of glucose in the urine causes more water to be pulled out of the bloodstream into the urine. This results in more frequent urination, or **polyuria**.

Figure 19-5 An insulin pump.

JIM BARCUS/MCT/Landov.

Increased urine production and urination also cause dehydration and increased thirst and can lead to severe electrolyte abnormalities. An increase in fluid consumption, called **polydipsia**, occurs in an attempt to quench this thirst.

In the early phase of diabetes, patients may report severe hunger and increased food intake, a condition known as **polyphagia**. Over time though, particularly if diabetes remains undiagnosed or untreated, appetite will decrease and patients often lose weight.

The autoimmune destruction of the pancreatic beta cell takes time to progress. For this reason initial symptoms are typically subtle and not readily apparent to the patient. As the lack of insulin becomes more profound, the patient will notice increasing fatigue and malaise along with vague symptoms of generalized illness.

When the body's cells do not receive the glucose they require for energy, the body resorts to burning fat for energy. When the body burns fat rather than glucose, acid waste is produced. These acids are called ketones. As ketone levels go up in the blood, the ketones also begin to spill into the urine (just like the excess glucose). When the kidneys become saturated with glucose and ketones, they do not work properly to maintain acid-base balance in the body. The body responds with a backup system and the patient begins to breathe faster and deeper. This respiratory pattern is the body's attempt to reduce the acid level by releasing more carbon dioxide (CO_2) through the lungs. This breathing pattern is known as **Kussmaul respirations**.

If fat metabolism and ketone production continue, a life-threatening illness called **diabetic ketoacidosis (DKA)** can develop in patients with diabetes. DKA may present as:

- Generalized illness, accompanied by:
  - Abdominal pain
  - Body aches

- Nausea
- Vomiting
- Altered mental status or unconsciousness (if severe)

If DKA is not rapidly recognized and treated, it can result in death.

When a patient with DKA has an altered mental status, ask the patient's family and friends about the patient's history and presentation. Obtain a glucose level with a fingerstick using a lancet and a glucometer (this is covered in Chapter 9, *Patient Assessment*). The patient with DKA will generally have a fingerstick glucose level higher than 400 mg/dL.

This presentation of the patient with type 1 diabetes in DKA does not only occur when there is an absolute lack of insulin. DKA may also present in cases of a relative lack of insulin, which may occur when there is an acute illness, or an untreated infection or other stressor on the body that leaves the patient with type 1 diabetes in a weakened condition.

Diabetes Mellitus Type 2

Type 2 diabetes is caused by resistance to the effects of insulin at the cellular level. Recall that we described insulin as the key to the door of the cell. Insulin resistance means the lock is unable to accept the key. As a review, in diabetes mellitus type 1 no insulin is produced, so there are no keys. In diabetes mellitus type 2 there are fewer insulin receptors, so there are not enough locks.

Obesity predisposes patients to type 2 diabetes; there is an association between obesity and increased resistance to the effects of insulin. As the number of obese people continues to rise, so does the number of patients with type 2 diabetes.

When diabetes begins, the individual's pancreas produces more insulin in an attempt to make up for the increased levels of blood glucose and dysfunction of cellular insulin receptors. Over time this response becomes inefficient. The blood glucose levels continue to rise and do not respond when the pancreas secretes insulin, a process called insulin resistance. In some cases, insulin resistance can be improved by exercise and dietary modification.

In many instances diet and exercise alone cannot control insulin resistance, and oral medications must be started to better control blood glucose levels. Oral medications used to treat type 2 diabetes vary widely. Some of them increase the secretion of insulin and pose a high risk of hypoglycemic reaction, while others do not Table 19-2. Injectable medications and various insulin preparations are also used for type 2 diabetes when oral medications alone will not regulate blood glucose.

Insulin is a hormone that is destroyed when taken by mouth, so it must be injected. Many of the oral medications listed either encourage the pancreas to produce more insulin or the cells to stimulate receptors for insulin. Other medications decrease the effects of glucagon and decrease the release of glucose stored in the liver (glycogen) so as to not increase the blood glucose levels during sleep or sedentary periods. None of the available medications is the perfect solution for every patient, however.

Diabetes mellitus type 2 is often diagnosed at a yearly medical examination. In some cases, the patient's physician discovers diabetes mellitus type 2 when treating the patient for a complaint related to high blood glucose levels. Examples of such complaints include recurrent infection, change in vision, or numbness in the feet.

Words of Wisdom

The patient with diabetes needs to be vigilant about maintaining a proper glucose level through diet, exercise, and, often, taking medication. If patients with diabetes have prolonged hyperglycemia or other associated conditions, serious long-term complications may develop.

Table 19-2 Common Oral Medications Used to Treat Type 2 Diabetes

Glipizide (Glucotrol)*
Glyburide (DiaBeta, Glynase, Micronase)*
Metformin (Glucophage)
Pioglitazone (Actos), rosiglitazone (Avandia)
Sitagliptin (Januvia)

*These medications increase the risk of hypoglycemia.

Symptomatic Hyperglycemia

Symptomatic hyperglycemia occurs when blood glucose levels are very high. The patient is in a state of altered mental status resulting from several combined problems. In type 1 diabetes, hyperglycemia leads to ketoacidosis with dehydration from excessive urination. In type 2 diabetes, hyperglycemia leads to a nonketotic hyperosmolar state of dehydration due to the discharge of fluids from all of the body systems and eventually out through the kidneys, leading to a much more ominous situation of fluid imbalance. Hyperglycemia does not always result in a crisis event. If an individual has hyperglycemia for a protracted length of time, it is not uncommon for the consequences of diabetes to present. These are wounds that do not heal, numbness in the hands and feet, blindness, renal failure, and gastric motility problems, to name a few.

When blood glucose levels are not controlled in diabetes mellitus type 2, a condition known as **hyperosmolar hyperglycemic nonketotic syndrome (HHNS)** can develop. This condition is similar to DKA in type 1 diabetes. The onset of this disorder is often associated with a profound infection or illness; however, this is not always the case.

Key signs and symptoms of HHNS include:

- Hyperglycemia
- Altered mental status, drowsiness, lethargy
- Severe dehydration, thirst, dark urine
- Visual or sensory deficits
- Partial paralysis or muscle weakness
- Seizures

Higher glucose levels in the blood cause the excretion of glucose in the urine. Patients respond by increasing their fluid intake precipitously (polydipsia) causing an equally precipitous excretion of fluid (polyuria). In HHNS, however, the patient cannot drink enough fluid to keep up with the exceedingly high glucose levels in the blood. The kidneys become overwhelmed and the patient's blood becomes much more concentrated than normal. As HHNS progresses, the urine becomes rather dark and concentrated. The term hyperosmolarity describes very concentrated blood as a result of relative dehydration. As HHNS progresses the patient may become unconscious or have seizure activity due in part to the severe dehydration that results.

Symptomatic Hypoglycemia

Symptomatic hypoglycemia is an acute emergency in which a patient's blood glucose level drops and must be corrected swiftly. A low blood glucose level can occur in patients who inject insulin or use oral medications that stimulate the pancreas to produce more insulin. When insulin levels remain high, glucose is rapidly taken out of the blood to fuel the cells. If glucose levels fall too low, there may be an insufficient amount to supply the brain. The mental status of the patient declines and he or she may become aggressive or display unusual behavior. If blood glucose remains low, unconsciousness and permanent brain damage can quickly follow.

YOU are the Provider — PART 2

You perform a primary assessment of the patient while your partner applies high-flow oxygen via a nonrebreathing mask. You attempt to obtain more information from the patient, but he is slow to answer your questions and is slightly confused. He can tell you that he has been getting progressively worse over the last 3 to 5 days. The patient's friends and wife tell you he has been experiencing weight loss for the last month but he seems to be eating more and more.

Recording Time: 0 Minutes	
Appearance	Weak and confused
Level of consciousness	Conscious, slow to respond, and confused
Airway	Open; clear of secretions or foreign bodies
Breathing	Increased rate and depth
Circulation	Radial pulses, rapid and weak; skin, warm and dry with poor turgor

The patient's wife tells you that he has been urinating frequently and has been drinking large quantities of water, soda, and milk. Your partner assesses his blood glucose level with the glucometer.

3. What should you expect the patient's blood glucose level to read? Why?
4. What is causing the patient's frequent urination and deep, rapid breathing?

Symptomatic hypoglycemia can occur for many different reasons. Some of the more common reasons for a low blood glucose level to develop are the patient or caregiver administered:

- A correct dose of insulin with a change in routine (the patient exercised more, consumed a meal later than usual, or skipped the meal)
- More insulin than necessary
- A correct dose of insulin without the patient eating a sufficient amount
- A correct dose of insulin and the patient developed an acute illness

Hypoglycemia develops much more quickly than hyperglycemia. In some instances, it can occur in a matter of minutes. Hypoglycemia can be associated with the following signs and symptoms:

- Normal to shallow or rapid respirations
- Pale, moist (clammy) skin
- Diaphoresis (sweating)
- Dizziness, headache
- Rapid pulse
- Normal to low blood pressure
- Altered mental status (aggressive, confused, lethargic, or unusual behavior)
- Anxious or combative behavior
- Seizure, fainting, or coma
- Weakness on one side of the body (may mimic stroke)
- Rapid changes in mental status

Hyperglycemia is a complex metabolic condition that usually develops over time and involves all the tissues of the body. Correcting this condition may take many hours in a well-controlled hospital setting. Hypoglycemia, however, is an acute condition that can develop rapidly. A patient with diabetes who has taken his or her standard insulin dose and missed lunch may have symptomatic hypoglycemia before dinner. The condition is just as quickly reversed by giving the patient glucose. Without the glucose, however, the patient can sustain permanent brain damage. Minutes count.

Special Populations

Low blood glucose level events are not uncommon in pediatric patients. Most children adapt well to the routine of managing their diabetes, but during periods of growth their blood glucose may be more difficult to regulate. Some toxic ingestions and overdose cause hypoglycemia in children. Children cannot store excess glucose as effectively as adults; therefore, the blood glucose level can drop even in children without diabetes after a severe injury or illness. As an EMT, you must have a high index of suspicion for a low glucose level when you encounter a child who has an altered mental status or depressed level of consciousness.

Patient Assessment of Diabetes

Scene Size-up

Evaluate scene safety as you arrive on scene and as you approach the patient. Make sure that all hazards are addressed. Remember that patients with diabetes often use syringes to administer insulin. It is possible you may be stuck by a used needle that was not disposed of properly. Insulin syringes on the night-stand, insulin bottles in the refrigerator, a plate of food, or a glass of orange juice are important clues that may help you decide what is possibly wrong with your patient. Evaluate each situation quickly and make sure necessary personal protective equipment is readily available. Use standard precautions. As you approach, question bystanders on events leading to your arrival.

Although your report from dispatch may be for a patient with an altered mental status, keep open the possibility that trauma may have occurred because of a medical incident. Determine mechanism of injury and/or nature of illness. Do not let your guard down even on what appears to be a routine call.

Primary Assessment

Perform a primary assessment to form a general impression of the patient. How does the patient look? Does he or she appear anxious, restless, or listless? Is the patient apathetic or irritable? Is the patient interacting appropriately with his or her environment? These initial observations may lead you to suspect high or low blood glucose values. Identify life threats, and provide lifesaving interventions, particularly airway management. Determine the patient's level of consciousness using the AVPU scale. If a patient who you suspect has diabetes is unresponsive, call for ALS immediately. An unconscious patient may have undiagnosed diabetes. In patients with altered mental status, you may be able to determine whether a diabetic emergency exists by assessing the patient's blood glucose level if you have the proper equipment and training. Perform cervical spine immobilization, when necessary, and provide rapid transport. At the emergency department (ED), diabetes and its complications can be quickly diagnosed.

Remember that even though a person has diabetes, the diabetes may not be causing the current problem; heart attack, stroke, or another medical emergency may be the cause. For this reason, you must always carry out a thorough, careful primary assessment, paying attention to the ABCs.

While you are forming your general impression, assess the patient's airway and breathing. Patients showing signs of inadequate breathing, a pulse oximetry level less than or equal to 94%, or altered mental status should receive high-flow oxygen at 12 to 15 L/min via nonrebreathing mask. A patient who is hyperglycemic may have rapid, deep respirations (Kussmaul respirations) and sweet, fruity breath. A patient who is hypoglycemic will have normal or shallow to rapid respirations. If the patient is not breathing or is having difficulty breathing, open the airway and insert an airway adjunct, administer oxygen, and assist ventilations. Continue to monitor the airway while you provide care.

Once you have assessed airway and breathing and have performed the necessary lifesaving interventions, check the patient's circulatory status. A patient with dry and warm skin indicates hyperglycemia, whereas a patient with moist and pale skin indicates hypoglycemia. The patient with symptomatic hypoglycemia will have a rapid, weak pulse.

Whether you decide to transport at this stage of the assessment will depend on the patient's level of consciousness and the ability to swallow. Patients with an altered mental status and impaired ability to swallow should be transported promptly. Patients who have the ability to swallow and are conscious enough to maintain their own airway may be further evaluated on scene and interventions performed.

History Taking

Investigate the chief complaint or the history of the present illness. Responsive patients usually are able to provide their own medical history. If the patient has eaten but has not taken insulin, it is more likely that hyperglycemia is developing. If the patient has taken insulin but has not eaten, the problem is more likely to be hypoglycemia. A patient with diabetes will often know what is wrong. If the patient is not thinking or speaking clearly (or is unconscious), ask a family member or bystander the same questions.

Physical signs such as tremors, abdominal cramps, vomiting, a fruity breath odor, or a dry mouth may guide you in determining whether the patient is hypoglycemic or hyperglycemic.

You will need to obtain a SAMPLE history from your patient or the family or bystanders if the patient is unable to speak. In addition, be sure to ask the following questions of a patient known to have diabetes:

- Do you take insulin or any pills that lower your blood sugar?
- Do you wear an insulin pump? Is it working properly?
- Have you taken your usual dose of insulin (or pills) today?
- Have you eaten normally today?
- Have you had any illness, unusual amount of activity, or stress?

When you are assessing a patient who might have diabetes, check to see whether he or she has an emergency medical identification device—a wallet card, necklace, or bracelet—or ask the patient or a family member. Remember that the environment, bystanders, and medical identification devices may provide important clues about your patient's condition.

Secondary Assessment

In some instances where the patient is critically ill or injured or the transport time is short, you may not have time to conduct a secondary assessment. In other instances, the secondary assessment may occur on scene or en route to the ED.

First, assess unresponsive patients from head to toe with a secondary assessment of the entire body, looking for clues to their condition. The patient may have experienced trauma resulting from dizziness or from changes in level of consciousness.

As with every call, you should perform a secondary assessment when time permits. With unconscious patients or patients with an altered mental status, you must assume the role of detective and look for problems or injuries that are not obvious because the patient is unable to communicate these to you. Although an altered mental status may be caused by a blood glucose level that is too high or too low, the patient may have sustained trauma or have another metabolic problem. An altered mental status may also be caused by something else, such as intoxication, poisoning, or a head injury. A systematic examination of the patient may provide you with information essential to proper patient care.

When you suspect a diabetes-related problem, a secondary assessment should focus on the patient's mental status and ability to swallow and protect the airway. Obtain a Glasgow Coma Scale score to track the patient's neurologic status.

Obtain a complete set of vital signs, including a measurement of the patient's blood glucose level using a glucometer, if available and local protocols allow. Blood glucose level is commonly determined via a portable glucometer, similar to the one your patient may use at home. The portable blood glucose monitor measures the glucose level in whole blood using either capillary or venous samples. In hypoglycemia, respirations are normal to rapid, pulse is weak and rapid, and skin is typically pale and clammy with a low blood pressure. In hyperglycemia, respirations may be deep and rapid; pulse may be rapid, weak, and thready; and skin may be warm and dry with a normal blood pressure. At times the blood pressure may be low. It should be easier for you to identify abnormal vital signs when you know the blood glucose level is too high or too low. Remember, the patient may have abnormal vital signs and a normal blood glucose value. When this is the case, something else may be causing the patient's altered mental status, vomiting, or other complaints.

It is important to read and understand the operator's manual before using a portable glucometer because the specifications of the device may vary depending on the manufacturer. Some glucometers indicate low ("Lo") when they detect a glucose reading less than 20 mg/dL, whereas others display "Lo" when they detect a reading less than 30 mg/dL. The same is true with a high ("Hi") reading; some glucometers read "Hi" at 550 mg/dL and some at 600 mg/dL; therefore, it is important to know both the upper and lower ranges at which your glucometer functions.

The normal range for glucose levels in blood in nonfasting adults and children is 80 to 120 mg/dL; the blood glucose level in neonates should be above 70 mg/dL.

Reassessment

It is important to reassess the patient with diabetes frequently to assess changes. Is there an improvement in the patient's mental status? Are the ABCs still intact? How is the patient responding to the interventions performed? How must you adjust or change the interventions? In many patients with diabetes, you will note marked improvement with appropriate treatment. Document each assessment, your findings, the time of the interventions, and any changes in the patient's condition. Base your administration of glucose on serial readings if you have access to a glucometer. If a glucometer is not available, a deteriorating level of consciousness indicates that you need to provide more glucose. Again, the use of glucometers and the administration of glucose will be based on your service's protocols and standing orders.

YOU are the Provider — PART 3

Your partner reports that the patient's blood glucose reading on the glucometer is 456 mg/dL. You continue to assess the patient while your partner obtains his vital signs. The patient's wife calls his doctor, who requests that you transport him to the closest hospital. A community hospital is located about 15 miles away.

Recording Time: 5 Minutes	
Respirations	30 breaths/min; deep
Pulse	120 beats/min; weak radial pulses
Skin	Pink, warm, and dry; poor turgor
Blood pressure	112/54 mm Hg
Oxygen saturation (Spo_2)	95% (on oxygen)

5. What other factors can cause hyperglycemia in patients with diabetes?
6. How can you distinguish symptomatic hyperglycemia from symptomatic hypoglycemia?

If your patient is hypoglycemic, conscious, and able to swallow without the risk of aspiration, encourage him or her to take glucose tablets. If those are not available, household sources of glucose may be used, such as juice or other drinks that contain sugar. Do not be afraid to give too much sugar. Do not give sugar-free drinks that are sweetened with saccharin or other synthetic sweetening compounds, because they will have little or no effect. If you are permitted by local protocol, you may also assist the patient in administering a gel preparation or sugar drink. If your hypoglycemic patient is unconscious, or if there is any risk of aspiration, the patient will need intravenous (IV) glucose or intramuscular (IM) or intranasal (IN) glucagon, which most EMTs are not authorized to give. Your responsibility is to provide prompt transport to the hospital, where the proper care can be given. If you are working in a tiered system, AEMTs and paramedics are able to start an IV line and administer IV glucose.

A patient with symptomatic hypoglycemia (rapid onset of altered mental status, hypoglycemia) needs glucose immediately. A patient with symptomatic hyper-glycemia (**acidosis**, dehydration, hyperglycemia) needs insulin and IV fluid therapy. These patients need prompt transport to the hospital for appropriate medical care.

Words of Wisdom

Intranasal glucagon is now available for use in some areas of the country to treat symptomatic hypoglycemia. This has the advantage of not requiring injection yet still achieving rapid absorption even in patients with markedly decreased levels of consciousness. Be aware of this medication and understand your local protocols regarding its use and indications.

Safety Tips

Before you give a conscious patient glucose tablets, anything to eat or drink, or instant glucose, you must ensure that there is no danger of aspiration. One rule of thumb: if patients can lift the cup or squirt the glucose into their own mouths, they are most likely not in danger of aspiration. Watch them carefully!

When there is any doubt about whether a conscious patient with diabetes is going into symptomatic hypoglycemia or symptomatic hyperglycemia, most protocols will err on the side of giving glucose, even though the patient may have hyperglycemia or diabetic ketoacidosis. Untreated hypoglycemia will result in loss of consciousness and can quickly cause significant brain damage or death. The condition of a patient in symptomatic hypoglycemia is far more critical and far more likely to cause permanent problems than the condition of a patient with hyperglycemia or diabetic ketoacidosis. Furthermore, the amount of sugar that is typically given to a patient with symptomatic hypoglycemia is unlikely to make a patient in diabetic ketoacidosis significantly worse. When in doubt, consult medical control.

Determining whether the blood glucose level is too high or too low in a patient with diagnosed diabetes can be difficult when signs and symptoms are confusing and you have no way to test for a blood glucose value. In these situations, perform a thorough assessment and contact the hospital to help sort out the signs and symptoms. The hospital should be a resource for you to help problem-solve situations and provide guidance on how to manage your patient.

Safety Tips

Managing problems related to diabetes and altered mental status poses minimal risk to you because exposure to body fluids is generally very limited. However, some patients can become confused and even aggressive at times. Follow standard precautions, as you would with any other patient. Always use gloves and carefully wash your hands after obtaining and checking a blood sample or coming into contact with any airway secretions.

Special Populations

You may encounter an older patient who has undiagnosed diabetes. The patient is likely to report that he or she has not been feeling well for a while but has not seen a physician. A patient with undiagnosed diabetes or one who is in denial or ignores the advice of his or her physician may call 9-1-1 when the signs and symptoms become pronounced. Nonhealing wounds (which can lead to infection), blindness, renal failure, atypical (silent) myocardial infarction presentation, and other complications are associated with poorly controlled or uncontrolled diabetes. As an EMT, you may be the first to recognize and suggest medical treatment to an older patient. It is important that you recognize the signs and symptoms of diabetes.

Communication with hospital staff is important for continuity of care. Hospital personnel need to be informed about the patient's history, the present situation, your assessment findings, and your interventions and their results.

Document clearly your assessment findings as the basis for your treatment. Patients who refuse transport because their symptoms improve after taking oral glucose may require even more thorough documentation. Patients who receive treatment in the field for hypoglycemia are at great risk for developing symptomatic hypoglycemia in the near future and should be strongly discouraged from refusing further treatment or transportation to the hospital. Many long-acting forms of insulin and most oral diabetic medications remain in the bloodstream far longer than the glucose used to treat these patients. Follow your local protocols for patients who refuse treatment or transport.

Emergency Medical Care for Diabetic Emergencies

Giving Oral Glucose

There are three types of oral glucose preparations available commercially. The most common for EMS providers is a rapidly dissolving gel **Figure 19-6**. The second preparation comes in a large chewable tablet form. The third preparation is a liquid formulation. Glucose gel acts to increase a patient's blood glucose levels. If authorized by your system, you should administer glucose gel to any patient with a decreased level of consciousness who has a history of diabetes. The only contraindications to oral glucose are an inability to swallow and unconsciousness, because aspiration (inhalation of the substance) can occur. Oral glucose itself has no side effects if it is administered properly; however, the risk of aspiration in a patient who does not have a gag reflex is substantial. A conscious patient (even if confused) who does not really need glucose will not be harmed by it. Therefore, do not hesitate to give glucose under these circumstances.

Figure 19-6 Oral glucose is commercially available in gel and tablet form. One tube of gel equals one 15-gram dose.

Courtesy of Paddock Laboratories, Inc.

YOU are the Provider — PART 4

Because of the patient's signs and symptoms, history, and a glucometer reading that indicates a high glucose level, you determine that oral glucose is not indicated. The patient is placed onto the stretcher and loaded into the ambulance. Shortly after departing the scene, you reassess his mental status and vital signs.

Recording Time: 11 Minutes	
Level of consciousness	Conscious but confused
Respirations	30 breaths/min; deep
Pulse	124 beats/min; weak radial pulses
Skin	Pink, warm, and dry; poor turgor
Blood pressure	108/56 mm Hg
Spo_2	96% (on oxygen)

7. What additional treatment should you provide to this patient?

Be sure to wear gloves before placing anything into a patient's mouth. After you have confirmed that the patient is conscious and able to swallow and have obtained an online or off-line order, follow these steps to administer oral glucose **Skill Drill 19-1**:

1. Examine the tube to ensure that it is not open or broken. Check the expiration date Step 1.
2. Squeeze a generous amount onto the bottom third of a bite stick or tongue depressor Step 2.
3. Open the patient's mouth.
4. Place the tongue depressor on the mucous membranes between the cheek and gum, with the gel side next to the cheek Step 3. Once the gel is dissolved, or if the patient loses consciousness or has a seizure, remove the tongue depressor. Repeat until the entire tube has been used. Note that the patient should not swallow the glucose; it acts more quickly when dissolved in the mouth.

Skill Drill 19-1 Administering Glucose

Step 1

Make sure that the tube of glucose is intact and has not expired.

Step 2

Squeeze a generous amount of oral glucose onto the bottom third of a bite stick or tongue depressor.

Step 3

Open the patient's mouth. Place the tongue depressor on the mucous membranes between the cheek and the gum with the gel side next to the cheek. Repeat until the entire tube has been used.

Words of Wisdom

Remember the "six rights" of medication administration:

- Right patient
- Right medication
- Right dose
- Right time
- Right route

• Right documentation

As an EMT, you know the importance of reassessment. The patient with diabetes experiencing an altered mental status event that you treat with a glucose product is one of the most important patients to reassess frequently. As rapidly as you may see a response to your treatment, you can see a deterioration. Be very mindful of the airway when giving an oral medication like a glucose product—not only from the standpoint of placing something into the mouth but for resultant regurgitation of that product, which can be aspirated. Any time you change a patient's mental status with a drug, follow-up must be provided. Therefore, it is always best to provide transport to the next level of care.

Words of Wisdom

Diabetes is a systemic disease affecting all tissues of the body, especially the kidneys, eyes, small arteries, and peripheral nerves. Therefore, you are likely to be called to treat patients with a variety of complications of diabetes, such as heart disease, visual disturbances, renal failure, stroke, and ulcers or infections of the feet or toes. With the exception of heart attack and stroke, most of these will not be acute emergencies. Considering that diabetes is a major risk factor for cardiovascular disease, patients with diabetes should always be suspected of having a potential for heart attack, particularly older patients, even when they do not present with classic symptoms such as chest pain and shortness of breath.

The Presentation of Hypoglycemia

Recognition of the patient with hypoglycemia requires an intuitive approach. There are many classic, by-the-book presentations of hypoglycemia. However, each of the altered mental status presentations is identified in much the same way. The discovery comes from a rapid examination utilizing a list of possible conditions to rule out, leading to the ultimate identification of hypoglycemia.

Seizures

Although seizures are rarely life threatening, you should consider them to be very serious, even in patients with a history of chronic seizures. Seizures, which may be brief or prolonged, are caused by infections, poisoning, hypoglycemia, trauma, or decreased levels of oxygen, or they may be idiopathic (of unknown cause). In children, they may be caused by fever or undiagnosed epilepsy. Although brief seizures are not harmful, they may indicate a more dangerous and potentially life-threatening underlying condition. Because seizures can be the result of a head injury, consider trauma as a cause. In the patient with diabetes, you should also consider hypoglycemia.

Emergency medical care of seizures includes ensuring that the airway is clear and placing the patient on his or her side, if there is no possibility of cervical spine trauma. Do not attempt to place anything in the patient's mouth (eg, a bite stick or an oral airway). Be sure to have suctioning equipment ready in case the patient vomits. Provide oxygen or artificial ventilation if the patient is cyanotic or appears to be breathing inadequately, and provide prompt transport.

Altered Mental Status

Although altered mental status is often caused by complications of diabetes, it may also be caused by a variety of other conditions, including poisoning, infection, head injury, part of the postictal state (period following a seizure), and decreased perfusion to the brain. In diabetes, altered mental status can be caused by hypoglycemia and by ketoacidosis.

The mnemonic AEIOU-TIPS is easily remembered and covers a multitude of conditions that can lead to altered mental status. As such many of these conditions covered by the mnemonic can be confused for a misdiagnosis when the patient's blood glucose level is not assessed. AEIOU-TIPS stands for:

- Alcohol
- Epilepsy, endocrine, electrolytes
- Insulin
- Opiates and other drugs
- Uremia (kidney failure)
- Trauma, temperature
- Infection
- Poisoning, psychogenic causes
- Shock, stroke, seizure, space-occupying lesion, subarachnoid hemorrhage

Most of the items on the preceding list can be associated with or can cause hypoglycemia. A patient might have a seizure due to hypoglycemia. A patient with an altered mental status after a heroin overdose might also be hypoglycemic. Remember to consider diabetic emergencies in patients who present with any of these emergencies, which can alter or depress mental status. Also remember that patients who present with trauma and are unconscious may have become unconscious as a result of a low blood glucose level and secondarily became injured. Always suspect and check for low blood glucose in a patient with altered mental status.

Begin emergency medical care of altered mental status by ensuring that the airway is clear. Be prepared to provide artificial ventilation and suctioning in case the patient vomits, and provide prompt transport.

Misdiagnosis of Neurologic Dysfunction

Occasionally, patients with hypoglycemia or hyper-glycemia are thought to be intoxicated, especially if their condition has caused a motor vehicle crash or other incident. Confined by police at a police station, a patient with diabetes is at risk. In such situations, an emergency medical identification bracelet, necklace, or card may help to save the patient's life. Often, only a blood glucose test performed at the scene or in the ED will identify the real problem. In some EMS systems, you will be trained and allowed to perform the blood glucose testing at the scene. Otherwise, you must always suspect hypoglycemia in any patient with an altered mental status.

Certainly, diabetes and alcoholism can coexist in a patient. But you must be alert to the similarity in symptoms of acute alcohol intoxication and diabetic emergencies. Likewise, hypoglycemia and a head injury can coexist, and you must appreciate the potential for hypoglycemia even when the head injury is obvious.

Relationship to Airway Management

Patients with an altered mental status, particularly those who are difficult to awaken, may not have a gag reflex. When the gag reflex is not working, patients cannot expel foreign materials in their mouths (including vomit), and their tongues will often relax and obstruct the airway. Therefore, you must carefully monitor the airway in patients with hyperglycemia, hypoglycemia, or with a diabetic complication such as stroke or seizure. Place the patient in a lateral recumbent position, and make sure suction is readily available.

Hematologic Emergencies

Hematology is the study of blood-related diseases. The focus of this section is on three disorders that can create a prehospital emergency:

- Sickle cell disease (also called hemoglobin S disease)
- Hemophilia A (also called classic hemophilia or factor VIII deficiency)
- Thrombophilia

The composition of blood, the mechanisms that these three conditions present to the patient, and, more importantly, the symptoms you must recognize as a provider are discussed.

Anatomy and Physiology

Blood and Its Parts

Blood is made up of four components:

- Erythrocytes (red blood cells)
- Leukocytes (white blood cells)
- Platelets
- Plasma

Each of the components of the blood serves a purpose in maintaining a person's homeostatic balance. Each of the body's other systems provides for and utilizes the blood in a very specific way. In turn the blood transports oxygen and carbon dioxide into and out of tissues to sustain the function of the organ system and tissues.

Red blood cells (RBCs) make up 42% to 47% of a person's total blood volume. RBCs contain an important protein, hemoglobin, which carries 97% of the oxygen in the blood and some of the carbon dioxide.

White blood cells (WBCs) make up 0.1% to 0.2% of a person's blood cell volume. In a healthy person, WBCs collect dead cells and provide for their correct disposal. In times of health, WBC levels are low. When an infection develops, WBCs and all of their complementary defense systems are activated and their numbers grow.

Platelets make up 4% to 7% of a person's blood cell volume and are essential for clot formation. When damage occurs to your skin or to a blood vessel, platelets are sent to the site of injury to assist in forming a blood clot to stop the bleeding. Without this protective response, bleeding from a simple cut could be uncontrollable.

Plasma serves as the transportation media for all of the blood components as well as proteins and minerals.

Pathophysiology

Sickle Cell Disease

Sickle cell disease, also called *hemoglobin S disease*, is an inherited blood disorder that affects the RBCs. The name sickle cell comes from the first case report of the disease in 1910, when Dr. James Herrick wrote that the red blood cells looked like a sickle **Figure 19-7**. The odd-shaped cells protect the individual from contracting malaria. The protection is useful to people who live in the sub-Saharan African malaria belt, but it is not useful to people who do not live in regions endemic for malaria.

There are several variants that make up this genetic disease. It is sufficient to simply understand that the issues of sickle cell can happen to any of the variants. This disease is common among people of African, Caribbean, and South American ancestry. It is present but less common in Mediterranean and Middle Eastern people. All newborns in the US are tested for sickle cell disease shortly after birth, regardless of their race or ethnic background.

The sharp and misshapen cells lead to dysfunction in oxygen binding and unintentional clot formation. These unintentional clots may result in a blockage known as **vasoocclusive crisis**.

People with sickle cell disease can experience hypoxia, or a lack of oxygen in the body's cells and tissues. The blockages that result from sickle cell crises or vasoocclusive crises can result in substantial pain and organ damage, which can trigger calls to EMS for help.

The life span of normal RBCs is approximately 110 to 120 days; sickled cells have a much shorter life span. This results in more cellular waste products in the bloodstream, which can contribute to sludging (clumping) of the blood. Maintaining hydration status is important to these patients as is maintaining their general health, since insufficient hydration leads to increased clumping of cells.

Complications associated with sickle cell disease include:

- Anemia
- Gallstones
- Jaundice
- Splenic dysfunction

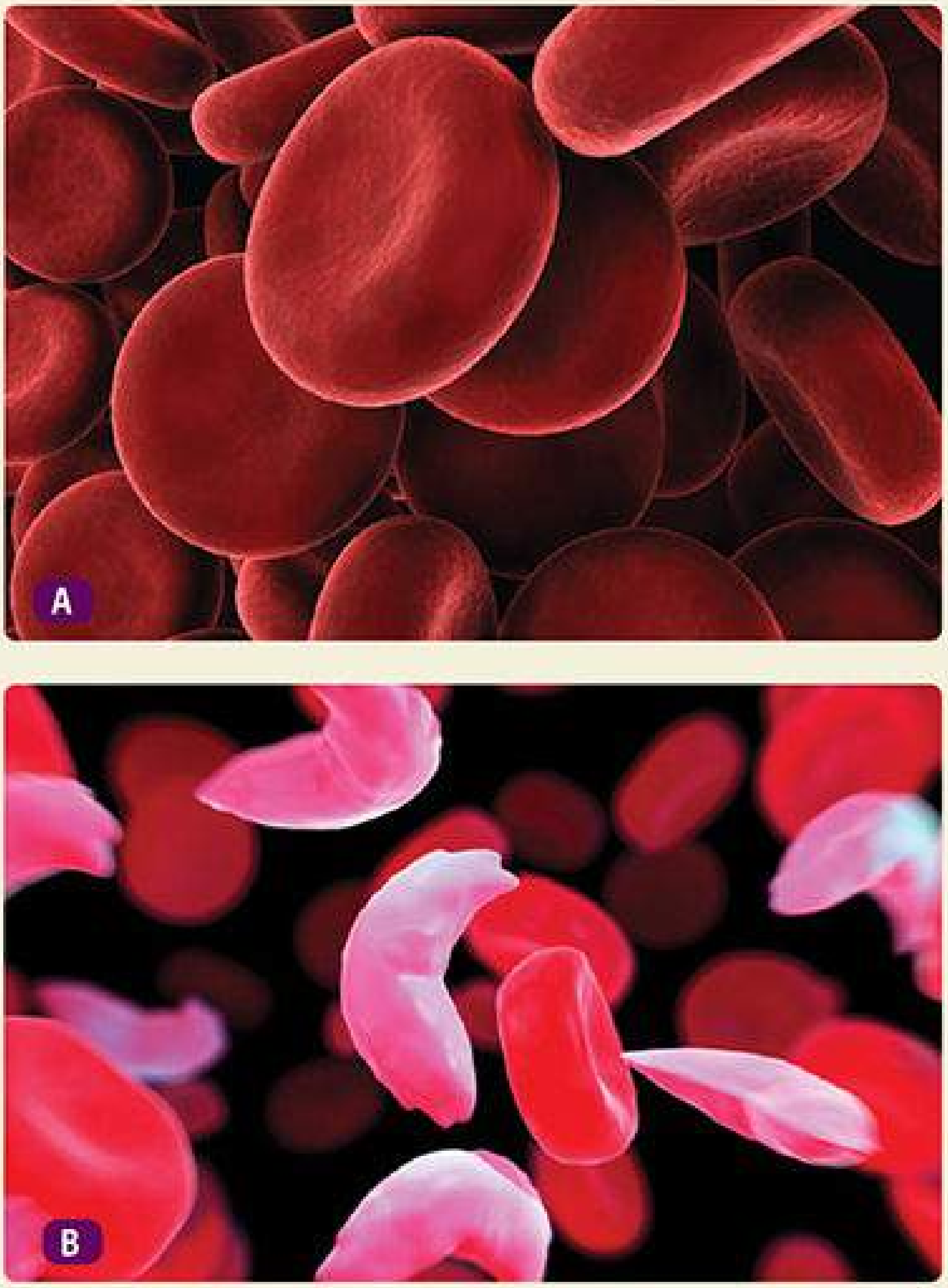

Figure 19-7 **A.** Normal red blood cells. **B.** Sickle cells.

A: © Sebastian Kaulitzki/Shutterstock; B: © Science Picture Co/Science Source.

- Vascular occlusion with ischemia:
  - Acute chest syndrome (hypoxia, dyspnea, chest discomfort, and fever)
  - Stroke
  - Joint necrosis (specifically the head of the femur and the humerus)
  - Pain crises
  - Acute and chronic organ dysfunction/failure

— Retinal hemorrhages

— Increased risk of infection

Many of these complications are very painful and potentially life threatening. In the face of these complications the sickle cell patient is also more susceptible to infections.

Hemophilia

Hemophilia is rare; according to the Hemophilia Federation of America, there are only about 20,000 Americans who have the disorder.

Hemophilia A affects mostly males. Males inherit the condition from a mother who is a carrier but does not have the disease; females only inherit the condition if their mother is a carrier and their father has the disease.

People with hemophilia A have a decreased ability to create a clot after an injury. A healthy individual will clot in as little as 13 seconds from a paper cut, and not longer than about 7 minutes from something more serious that requires direct pressure. Having an extended bleeding time from the inability to clot can be life threatening.

A patient who is otherwise healthy but has hemophilia A can have a minor trauma, such as a simple ankle sprain while playing soccer. Most people would ignore the sprain and simply continue to play the game. The patient with hemophilia A would begin to swell from uncontrolled bleeding in the region of the injury and continue to do so, making the seemingly minor injury a significant problem.

Acute bleeding from any source may be life threatening depending on where the bleeding occurs. Patients with hemophilia A typically have intravenous factor VIII replacement infusions, which help the blood clot, either close at hand or with them.

Common complications of hemophilia A include:

- Long-term joint problems, which may require a joint replacement
- Bleeding in the brain (intracerebral hemorrhage)
- **Thrombosis** due to treatment

Thrombophilia

Thrombophilia is a disorder in the body's ability to maintain the viscosity and smooth flow of blood through the venous and arterial systems. In thrombophilia, the concentration of particular elements in the blood creates what amounts to clogging or blockage issues.

Thrombophilia is a general term for many different conditions that result in the blood clotting more easily than normal. This results from either inherited (genetic) disorders, medications, or other factors. Patients with cancer are at increased risk of forming life-threatening blood clots. Whatever the risk factors, the common theme is that clots can spontaneously develop in the blood of the patient.

Deep Vein Thrombosis

Deep vein thrombosis (DVT) is a common medical problem in sedentary patients and in patients who have had recent injury or surgery. While several risk factors increase the chance that a patient will develop a DVT, there are several methods to prevent blood clot formation, including blood-thinning medications, compression stockings, and mechanical devices—all of which you may encounter in the field.

YOU are the Provider — PART 5

You reassess the patient and then call your radio report to the receiving hospital. The patient is still conscious, but confused. Your estimated time of arrival at the hospital is 8 minutes.

Recording Time: 17 Minutes	
Level of consciousness	Conscious, but confused
Respirations	28 breaths/min; deep
Pulse	118 beats/min; weak radial pulses
Skin	Pink, warm, and dry; poor turgor

Blood pressure	110/58 mm Hg
Spo_2	97% (on oxygen)

You arrive at the hospital and transfer patient care to the attending physician. After further assessment and treatment in the emergency department, the patient is admitted to the medical intensive care unit.

8. What treatment is provided at the hospital for patients with symptomatic hyperglycemia that cannot be provided in the prehospital setting?

DVT is a particularly worrisome risk for patients who have had joint replacement surgery. Be suspicious of this in a patient with a recent history of joint replacement who complains of leg swelling. Travelers, truck and long-distance bus drivers, and bedridden nursing home patients are all at higher risk for DVT because they are sedentary for long periods of time.

If DVT develops in an individual, anticoagulation therapy may be administered. A patient with DVT may be treated in the hospital with IV medications and then transitioned to oral medications before discharge. Some patients are sent home with self-administered subcutaneous injectable medications to treat or prevent DVT. Oral medications are typically administered for at least 3 months after diagnosis of a DVT to ensure another DVT does not develop. Patients prescribed medications to treat DVT are at increased risk of bleeding complications (ie, gastrointestinal bleeding), and minor trauma is more likely to produce severe internal or external hemorrhage.

A life threat can develop if the clot from the DVT travels from the patient's lower extremity to the lung, causing a pulmonary embolus. Pulmonary emboli can cause chest pain, difficulty breathing, or, if the clots are large, sudden cardiac arrest. Pulmonary embolism is discussed in Chapter 15, *Respiratory Emergencies*.

Patient Assessment of Hematologic Disorders

Scene Size-up

Although your report from dispatch may be for a patient with an unknown medical problem, most patients presenting with a sickle cell crisis have had a crisis before and will relay that information to the dispatcher. As you approach the scene, ensure your safety by assessing for hazards. Standard precautions should consist of gloves and eye protection at a minimum. Remember to evaluate each situation quickly and make sure the necessary personal protective equipment is readily available.

Determine whether this is your only patient and whether trauma was involved. Decide whether you will need any additional resources. Patients experiencing a vasoocclusive crisis are often in extreme pain and would benefit from ALS providers being able to administer analgesics.

Remember that trauma may have occurred because of a medical incident. Determine the mechanism of injury and/or nature of illness.

Primary Assessment

An African American patient or any patient of Mediterranean descent who reports severe pain may have undiagnosed sickle cell disease.

Perform cervical spine immobilization, if indicated. Remember that even though a person has a history of sickle cell disease, sickle cell disease may not be causing the current problem; trauma or another type of medical emergency may be the cause. For this reason, you must always perform a thorough, careful primary assessment, paying attention to the ABCs and immediately correcting any life-threatening issues.

Perform a primary assessment to form an initial general impression of the patient. How does the patient look? Does the patient appear anxious, restless, or listless? Is the patient apathetic or irritable? Determine the patient's level of consciousness.

While you are forming your general impression, assess the patient's airway and breathing. Patients showing signs of inadequate breathing or altered mental status should receive high-flow oxygen at 12 to 15 L/min via nonrebreathing mask. A patient who is experiencing a sickle cell crisis may have increased respirations as a result of severe pain or exhibit signs of pneumonia. If the patient is having difficulty breathing, open the airway and insert an airway adjunct, administer oxygen, and assist ventilations. Continue to monitor the airway as you provide care.

Once you have assessed the airway and breathing and have performed the necessary interventions, check the patient's circulatory status. An increased heart rate represents a compensatory mechanism, in an attempt to force the sickled cells through smaller blood vessels.

In patients with suspected hemophilia, be alert for signs of acute blood loss such as pallor, weak pulse, and hypotension. Note any bleeding of unknown origin, such as nosebleeds, bloody sputum, and blood in the urine or stool. Owing to blood loss, patients with hemophilia may exhibit signs of hypoxia.

Whether you decide to rapidly transport the patient will depend on the severity of the patient's pain and the patient's wishes. Patients with a history of sickle cell disease, but those who have not had a crisis in some time, may require emotional support and refuse transport. However, transport to an ED should always be recommended to any patient who is experiencing a sickle cell crisis or hemophilia.

History Taking

If the patient is conscious, what is the chief complaint or history of present illness?

Responsive medical patients are able to provide their own medical history to help you identify a cause for their severe pain. Physical signs, such as swelling of the fingers and toes, priapism, and jaundice may guide you in determining whether the patient is experiencing a sickle cell crisis. Also important to ascertain is whether the pain is isolated to a single location or if pain is felt throughout the entire body. Is the patient having any visual disturbances? Is the patient experiencing any gastrointestinal problems, such as nausea, vomiting, or abdominal cramping? Is the patient reporting any chest pain or shortness of breath?

In a patient with known sickle cell disease, ask the following questions in addition to obtaining a SAMPLE history:

- Have you had a crisis before?
- When was the last time you had a crisis?
- How did your last crisis resolve?
- Have you had any illness, unusual amount of activity, or stress lately?

Secondary Assessment

Next, systematically examine the patient, focusing on major joints at which cells congregate. Evaluate and document mental status using the AVPU scale.

Obtain a complete set of vital signs, including a measurement of the patient's oxygen saturation level. In patients experiencing a sickle cell crisis, respirations are normal to rapid, pulse is weak and rapid, and skin is typically pale and clammy with a low blood pressure.

Use pulse oximetry, if available. However, keep in mind that the oxygen saturation reading you obtain may be inaccurate as a result of the patient's anemic state.

Reassessment

It is important to reassess the patient frequently to determine if there have been changes in his or her condition. For example, are there changes in the patient's mental status? Are the ABCs still intact? How is the patient responding to the interventions performed? Should you adjust or change the interventions? Document each assessment, your findings, the time of the interventions, and any changes in the patient's condition.

Administer supplemental oxygen via nonre-breathing mask at 12 to 15 L/min to attempt to compensate for decreased cellular oxygenation related to the sickled cells or hemophilia.

At the hospital, care for sickle cell patients can include analgesics for pain, penicillin to treat infection, IV fluid for hydration, and, depending on the severity of the crisis, a blood transfusion.

Distinguishing a true sickle cell crisis from other nonspecific causes of pain can be difficult. Remember to perform a thorough assessment and consult with medical control as soon as feasible.

Hospital care for a patient with hemophilia may include IV therapy to treat hypotension, and a transfusion of plasma. Analgesics may also be appropriate.

Communication with hospital staff is important for continuity of care. Inform hospital personnel about the patient's history, the present situation, your assessment findings, and your interventions and their results.

Document clearly your assessment findings as the basis for your treatment. Follow your local protocols for patients who refuse treatment or transport.

Emergency Medical Care for Hematologic Disorders

Emergency care for patients with hematologic disorders is mainly supportive and symptomatic. Patients showing signs of inadequate breathing or altered mental status should receive high-flow oxygen at 12 to 15 L/min via nonrebreathing mask and should be placed in a position of comfort and transported rapidly to the hospital.

YOU are the Provider SUMMARY

1. What processes are being described by the patient?

This presentation can be typical of many illnesses until you begin to ask the correct questions. The 3-to-5-day, subtle flulike presentation is often how diabetes mellitus type 1 presents. People must eat to have energy, but the lack of insulin deprives cells of the fuel they need, and therefore no energy is produced.

The onset of diabetes mellitus type 1 takes some time to progress. For this reason symptoms are initially subtle and are overlooked by the patient. As the lack of insulin becomes more profound, the patient will notice increasing fatigue and malaise along with weight loss.

The patient is experiencing (1) polydipsia, (2) polyuria, and (3) polyphagia.

Without insulin, glucose accumulates in the blood. Glucose spills into the urine until it reaches the kidney's maximum level to excrete. The glucose in the urine pulls a substantial amount of water with it resulting in large amounts of urination (polyuria), causing dehydration. The patient experiences thirst, causing him or her to drink large amounts of fluid; this is polydipsia. Finally, eating in excess (polyphagia) occurs in the face of weight loss. Polyphagia develops because of the starvation of the patient at the cellular level.

Many times the patient does not recognize these symptoms, but family and friends might.

2. What hormone is missing in diabetes mellitus type 1?

The missing hormone is insulin. Insulin is the key to the door of the cell. Without insulin, nutrition cannot get into the cell.

3. What should you expect the patient's blood glucose level to read? Why?

Based on the description of increased food intake with weight loss, increased fluid intake, and increased urination, this patient appears to be in diabetic ketoacidosis. In these cases, the blood glucose level will be in the mid 400s to 500s or even higher.

4. What is causing the patient's frequent urination and deep, rapid breathing?

The frequent urination is occurring because the patient is drinking large amounts of fluid. An increase in his blood glucose level resulted in glucose spilling into the urine. He is excreting large amounts of urine because glucose in the urine pulls water out with it.

Deep, rapid breathing, known as Kussmaul respirations, is caused by the ketones that are accumulating in the blood and are being eliminated from the lungs during exhalation. Kussmaul respirations often have a fruity or sweet odor.

5. What other factors can cause hyperglycemia in patients with diabetes?

Changing meal times, insulin dosage changes, or a variation in exercise can result in a hyperglycemic or hypoglycemic event. The patient in this chapter's scenario has new-onset diabetes and is in DKA. An infection could put an otherwise well-regulated patient with type 1 diabetes into DKA rather easily.

Noncompliance with medication use can also result in hyperglycemic episodes.

6. How can you distinguish symptomatic hyperglycemia from symptomatic hypoglycemia?

A key to distinguishing a hyperglycemic emergency from a hypoglycemic emergency is the time of symptom onset. Hyperglycemia, ketoacidosis, and dehydration typically progress over hours to days. By contrast, hypoglycemia has an acute onset—often over a period of a few minutes.

Symptomatic hyperglycemia and symptomatic hypoglycemia also present with relatively different signs and symptoms. Signs and symptoms of symptomatic hyperglycemia include tachycardia; signs of dehydration (warm, dry skin, poor skin turgor, and sunken eyes); deep, rapid breathing (Kussmaul respirations), which indicates the respiratory system is attempting to eliminate ketones from the body; a sweet or fruity (acetone) breath odor; and mental status changes ranging from confusion to coma.

Symptomatic hypoglycemia presents with signs and symptoms similar to hypoxemia and shock, including rapid, shallow respirations; pale, cool, clammy (diaphoretic) skin; tachycardia; weakness, which may be confined to one side of the body and mimic a stroke; and varying degrees of mental status change, including confusion, irritability, combativeness, seizures, and coma.

7. What additional treatment should you provide to this patient?

The patient's signs and symptoms clearly point to symptomatic hyperglycemia, specifically DKA. Symptomatic hyperglycemia requires definitive care that can only be provided at the hospital. Prehospital treatment at the EMT level is aimed at providing supportive care (ie, maintaining the ABCs) and promptly transporting the patient to the hospital. En route, closely monitor the patient's mental status and breathing adequacy; if his respirations become slow and/or shallow—especially if his mental status deteriorates further—assist his ventilations with a bag-valve mask (BVM).

Some patients with symptomatic hyperglycemia become so dehydrated that hypovolemic shock develops; therefore, it is important to closely monitor the patient's perfusion status (eg, heart rate, peripheral pulse quality, blood pressure, mental status). If signs of shock are observed, keep the patient warm and in a supine position. Although the patient is extremely thirsty, do not give him anything to drink; doing so increases the risk of aspiration if he vomits.

8. What treatment is provided at the hospital for patients with symptomatic hyperglycemia that cannot be provided in the prehospital setting?

Symptomatic hyperglycemia is a complex medical problem that causes numerous complications; it cannot be treated in the prehospital setting and it cannot be changed quickly. Insulin is needed to restore circulating blood glucose to a normal level, and IV fluids are needed to correct dehydration.

This underscores the importance of performing a rapid assessment, initiating treatment without delay, and promptly transporting the patient to the hospital.

If your transport time will be prolonged, consider an intercept with an advanced life support unit, if available; AEMTs and paramedics are trained to start IV lines and administer fluids.

EMS Patient Care Report (PCR)

Date: 09-19-16	**Incident No.:** 011609	**Nature of Call:** Weakness, nausea		**Location:** 445 Landon Way	
Dispatched: 1500	**En Route:** 1502	**At Scene:** 1508	**Transport:** 1529	**At Hospital:** 1545	**In Service:** 1558

Patient Information

Age: 23 **Sex:** M **Weight (in kg [lb]):** 91 kg (200 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** None **Chief Complaint:** Weakness and confusion

Vital Signs

Time: 1513	**BP:** 112/54	**Pulse:** 120	**Respirations:** 30	**Spo_2:** 95%
Time: 1519	**BP:** 108/56	**Pulse:** 124	**Respirations:** 30	**Spo_2:** 96%
Time: 1525	**BP:** 110/58	**Pulse:** 118	**Respirations:** 28	**Spo_2:** 97%
Time: 1539	**BP:** 106/60	**Pulse:** 116	**Respirations:** 30	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

9-1-1 dispatch for a patient with weakness/nausea. Arrived on scene and found the patient, a 23-year-old man, lying on the couch in his living room. He was conscious, but confused. His airway was patent, and his breathing was deep and rapid. The patient's wife advised that he has been sick for the past few days. He has been urinating excessively and has been drinking a lot of water. Further assessment of the patient revealed that his radial pulse was rapid and weak; his skin was pink, warm, and dry; and he had poor skin turgor. Applied high-flow oxygen via nonrebreathing mask at 15 L/min and performed further assessment. Breath sounds were clear to auscultation bilaterally, pupils were equal and reactive to light, there were no gross signs of trauma, and the patient had a sweet, fruity odor on his breath. Vital signs were obtained and blood glucose level was assessed and noted to be 456 mg/dL. The patient's wife spoke with his physician, who requested EMS transport to the closest appropriate facility. Patient was placed onto stretcher and loaded into the ambulance. Mental status and vital signs were reassessed and transport was begun. Continued to monitor patient en route; his mental status and vital signs remained unchanged. Continued oxygen therapy, which maintained his oxygen saturation above 95%. Notified receiving facility of our impending arrival; no further medical direction was given. Delivered patient to emergency department; his condition was unchanged. Gave verbal report to attending physician, transferred patient care, and returned to service.**End of report**

Ready for Review

- Diabetes is a disorder of glucose metabolism or difficulty metabolizing carbohydrates, fats, and proteins.
- There are two types of diabetes. Type 1 diabetes typically develops in childhood and requires daily insulin to control blood glucose. Type 2 diabetes typically develops in middle age and often can be controlled with diet, activity, and oral medications.
- Both types of diabetes are serious systemic diseases, especially affecting the kidneys, eyes, small arteries, and peripheral nerves.
- Patients with diabetes have chronic complications that place them at risk for other diseases, such as heart attack, stroke, and infections. Most often, however, you will be called on to treat the acute complications of blood glucose imbalance. These include hyperglycemia (excess blood glucose) and hypoglycemia (insufficient blood glucose).
- Hyperglycemia is typically characterized by excessive urination and resulting thirst, in conjunction with the deterioration of body tissues.
- Hyperglycemia is usually associated with dehydration and ketoacidosis and can result in marked rapid (often deep) respirations; warm, dry skin; a weak pulse; and a fruity breath odor. Hyperglycemia must be treated in the hospital with insulin and IV fluids.
- Symptoms of hypoglycemia classically include confusion; rapid respirations; pale, moist skin; diaphoresis; dizziness; fainting; and even coma and seizures. This condition is rapidly reversible with the administration of glucose or sugar. Without treatment, however, permanent brain damage and death can occur.
- Because a blood glucose level that is either too high or too low can result in altered mental status, you must perform a thorough history and patient assessment to determine the nature of the problem. When the problem cannot be determined, it is best to treat the patient for hypoglycemia.
- Be prepared to give oral glucose to a conscious patient who is confused or has a slightly decreased level of consciousness; however, do not give oral glucose to a patient who is unconscious or otherwise unable to swallow properly or protect his or her own airway.
- In all cases, providing emergency medical care and prompt transport is your primary responsibility.
- Sickle cell disease is a blood disorder that affects the shape of red blood cells.
- Symptoms of sickle cell disease are pain in the joints, fever, respiratory distress, and abdominal pain.
- Patients with sickle cell disease have chronic complications that place them at risk for other diseases, such as heart attack, stroke, and infection. Most often, however, you will be called on to treat the acute complications of severe pain.
- Patients with hemophilia are not able to control bleeding because clots do not develop as they should.
- Emergency care in the prehospital setting is supportive for patients with sickle cell disease or a clotting disorder such as hemophilia.

Vital Vocabulary

acidosis A pathologic condition that results from the accumulation of acids in the body.

diabetes mellitus A metabolic disorder in which the ability to metabolize carbohydrates (sugars) is impaired, usually because of a lack of insulin.

diabetic ketoacidosis (DKA) A form of hyperglycemia in uncontrolled diabetes in which certain acids accumulate when insulin is not available.

endocrine glands Glands that secrete or release chemicals that are used inside the body.

endocrine system Regulates metabolism and maintains homeostasis.

glucose One of the basic sugars; it is the primary fuel, in conjunction with oxygen, for cellular metabolism.

hematology The study and prevention of blood-related disorders.

hemophilia A congenital abnormality in which the body is unable to produce clots, which results in uncontrollable bleeding.

hormone A chemical substance produced by a gland that regulates the activity of organs and tissues.

hyperglycemia An abnormally high blood glucose level.

hyperosmolar hyperglycemic nonketotic syndrome (HHNS) A life-threatening condition resulting from high blood glucose that typically occurs in older adults, and which causes altered mental status, dehydration, and organ damage.

hypoglycemia An abnormally low blood glucose level.

insulin A hormone produced by the islets of Langerhans (endocrine gland located throughout the pancreas) that enables glucose in the blood to enter cells; used in synthetic form to treat and control diabetes mellitus.

Kussmaul respirations Deep, rapid breathing; usually the result of an accumulation of certain acids when insulin is not available in the body.

polydipsia Excessive thirst that persists for long periods, despite reasonable fluid intake; often the result of excessive urination.

polyphagia Excessive eating; in diabetes, the inability to use glucose properly can cause a sense of hunger.

polyuria The passage of an unusually large volume of urine in a given period; in diabetes, this can result from the wasting of glucose in the urine.

sickle cell disease A hereditary disease that causes normal, round red blood cells to become oblong, or sickle shaped.

symptomatic hyperglycemia A state of unconsciousness resulting from several problems, including ketoacidosis, dehydration because of excessive urination, and hyperglycemia.

symptomatic hypoglycemia Severe hypoglycemia resulting in changes in mental status.

thrombophilia A tendency toward the development of blood clots as a result of an abnormality of the system of coagulation.

thrombosis A blood clot, either in the arterial or venous system.

type 1 diabetes An autoimmune disorder in which the individual’s immune system produces antibodies to the pancreatic beta cells, and therefore the pancreas cannot produce insulin; onset in early childhood is common.

type 2 diabetes A condition in which insulin resistance develops in response to increased blood glucose levels; can be managed by exercise and diet modification, but is often managed by medications.

vasoocclusive crisis Ischemia and pain caused by sickle-shaped red blood cells that obstruct blood flow to a portion of the body.

Assessment *in Action*

You are working a detail for the women's state volleyball championship at the local university gym when you are dispatched to the visiting team locker room for a player who is feeling weak and dizzy. You are met at the locker room door by the coach who points to a young woman lying supine on a bench. The coach informs you that the player has a history of diabetes and takes insulin on a regular basis. As you approach the patient, you run through some of the information that you know about diabetes.

1. Diabetes is a metabolic disorder in which the body's ability to metabolize _________ is impaired.

   A. protein
   B. fats
   C. glucose
   D. electrolytes

2. When the concentration of glucose drops in the blood, the body will release _______, a hormone that will assist other organs in the process of converting stored sugars into usable sugars.

   A. insulin
   B. epinephrine
   C. glucagon
   D. dopamine

3. Patients with diabetes who overexert themselves are prone to rapid:

   A. drops in their ability to sweat.
   B. increases in their blood pressure.
   C. drops in their blood glucose levels.
   D. increases in their blood glucose levels.

4. Which of the following organs can rapidly sustain permanent damage when the body's glucose level is too low?

   A. Brain

B. Heart
C. Kidney
D. Liver

5. Based on the information described in the scenario, which question should you ask this patient first?

   A. "Are you having any pain?"
   B. "When was the last time you ate?"
   C. "Do you feel short of breath?"
   D. "When was your last menstrual cycle?"

6. What other sudden onset signs and symptoms may your patient exhibit?

   A. A slow, bounding pulse
   B. Rapid, deep respirations
   C. Nausea and vomiting
   D. Pale, moist skin

7. Your partner prepares to perform a fingerstick to check the patient's glucose level. A normal glucose level is:

   A. 20 mg/dL.
   B. 80 mg/dL.
   C. 140 mg/dL.
   D. 200 mg/dL.

8. List and explain three signs and/or symptoms that can give you clues about the presence of diabetic ketoacidosis.
9. Differentiate between hyperglycemia and hypoglycemia. Explain which you think is more ominous and why.
10. Describe the likely problem presented in the scenario.

CHAPTER
20

Immunologic Emergencies

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Immunology

Recognition and management of shock and difficulty breathing related to

› Anaphylactic reactions (pp 757–764)

Anatomy, physiology, pathophysiology, assessment, and management of

› Hypersensitivity disorders and/or emergencies (pp 753–764)
› Anaphylactic reactions (pp 753–764)

Knowledge Objectives

1. Define the terms allergic reaction and anaphylaxis. (p 753)
2. Explain the difference between a local and a systemic response to allergens. (p 753)
3. List the five categories of stimuli that could cause an allergic reaction or an extreme allergic reaction. (p 755)
4. Differentiate the primary assessment for a patient with a systemic allergic or anaphylactic reaction and a local reaction. (pp 757–759)
5. Explain the importance of managing the ABCs of a patient who is having an allergic reaction. (p 757)
6. Discuss the steps in the primary assessment that are specific to a patient who is having an allergic reaction. (pp 757–758)
7. Explain the factors involved when making a transport decision for a patient having an allergic reaction. (p 758)
8. Review the process for providing emergency medical care to a patient who is experiencing an allergic reaction. (pp 760–764)
9. Explain the rationale, including communication and documentation considerations, when determining whether to administer epinephrine to a patient who is having an allergic reaction. (pp 761–764)
10. Describe some age-related contraindications to using epinephrine to treat an allergic reaction in a geriatric patient. (p 764)

Skills Objectives

1. Demonstrate how to remove the stinger from a honeybee sting and proper patient management following its removal. (pp 760–761)
2. Demonstrate how to use an EpiPen auto-injector. (pp 762–763, Skill Drill 20-1)

Introduction

Death as a result of allergic reaction is rare, but is possible. As an EMT, you will often respond to calls involving an allergic reaction. When managing allergy-related emergencies, you must be aware of the possibility of acute airway obstruction and cardiovascular collapse and be prepared to treat these life-threatening complications. You must also be able to distinguish between the body's usual response to a sting or bite and an allergic reaction, which may require epinephrine. Your ability to recognize and manage the many signs and symptoms of allergic reactions may be the only thing standing between a patient's life and imminent death.

This chapter describes **immunology**, the study of the body's immune system, and the five categories of stimuli that may provoke allergic reactions—in particular, insect bites and stings. You will learn what to look for in assessing patients who may be having an allergic reaction and how to care for them, including administration of epinephrine.

Anatomy and Physiology

The **immune system** protects the human body from substances and organisms that are foreign to the body. Without the immune system for protection, life as you know it would not exist. You would be under constant attack from any type of invader, such as a bacterium or virus, that wanted to make your body a home. Fortunately, most people have immune systems that are well equipped to detect unauthorized visits or invading attacks by foreign substances. Once a foreign substance invades the body, the body goes on alert and initiates a series of responses to inactivate the invader.

Pathophysiology

There are many conditions related to the immune system, but an allergic reaction is the only immunologic emergency you will treat as an EMT. Contrary to what many people think, an **allergic reaction**, an exaggerated **immune response** to any substance, is not caused directly by an outside stimulus, such as a bite or sting. Rather, it is a reaction by the body's immune system, which releases chemicals to combat the stimulus. Among these chemicals are **histamines** and **leukotrienes**, both of which contribute to an allergic reaction. Given the right person and the right circumstances, almost any substance can become an **allergen**. However, some people do not experience allergic reactions the first time they are exposed to an allergen. First, the person becomes *sensitized* (exposed for the first time) to the substance, and then his or her immune system learns to recognize it. When the patient is exposed to the substance again, an allergic reaction occurs. As a result, some patients may not have any idea what is causing their allergic reaction—or may not realize they are having one at all—so you must be able to recognize the signs and symptoms and maintain a high index of suspicion. An allergic reaction may be mild and local—characterized by itching, redness, or tenderness—or it may be severe and systemic, a condition known as **anaphylaxis** **Figure 20-1**.

Anaphylaxis is an extreme allergic reaction that is life threatening and involves multiple organ systems. In severe cases, anaphylaxis can rapidly result in shock and death. Two of the most common signs of anaphylaxis are widespread **urticaria**, or hives, small areas of generalized itching or burning that appear as multiple, small, raised areas on the skin **Figure 20-2**, and **angioedema**, areas of localized swelling **Figure 20-3**. Another often-observed sign is **wheezing**, a high-pitched, whistling breath sound that is typically heard on expiration, usually resulting from bronchospasm/bronchoconstriction and increased mucus production. You may also note hypotension due to vasodilation, as well as increased capillary permeability (wherein fluid from the bloodstream seeps into the tissues). One symptom that is often overlooked in patients experiencing an allergic reaction is persistent gastrointestinal dysfunction (eg, nausea, vomiting, and abdominal cramps).

YOU are the Provider — PART 1

You and your partner respond to a call involving a 33-year-old man experiencing shortness of breath. Upon arrival, you observe a conscious patient in obvious respiratory distress, breathing rapidly with audible wheezing, whose skin is flushed red and covered in hives. When you attempt to question the patient, you find he can only speak in two-to-three word sentences.

1. What, if any, additional resources should you request?
2. What intervention(s) should you perform without delay?

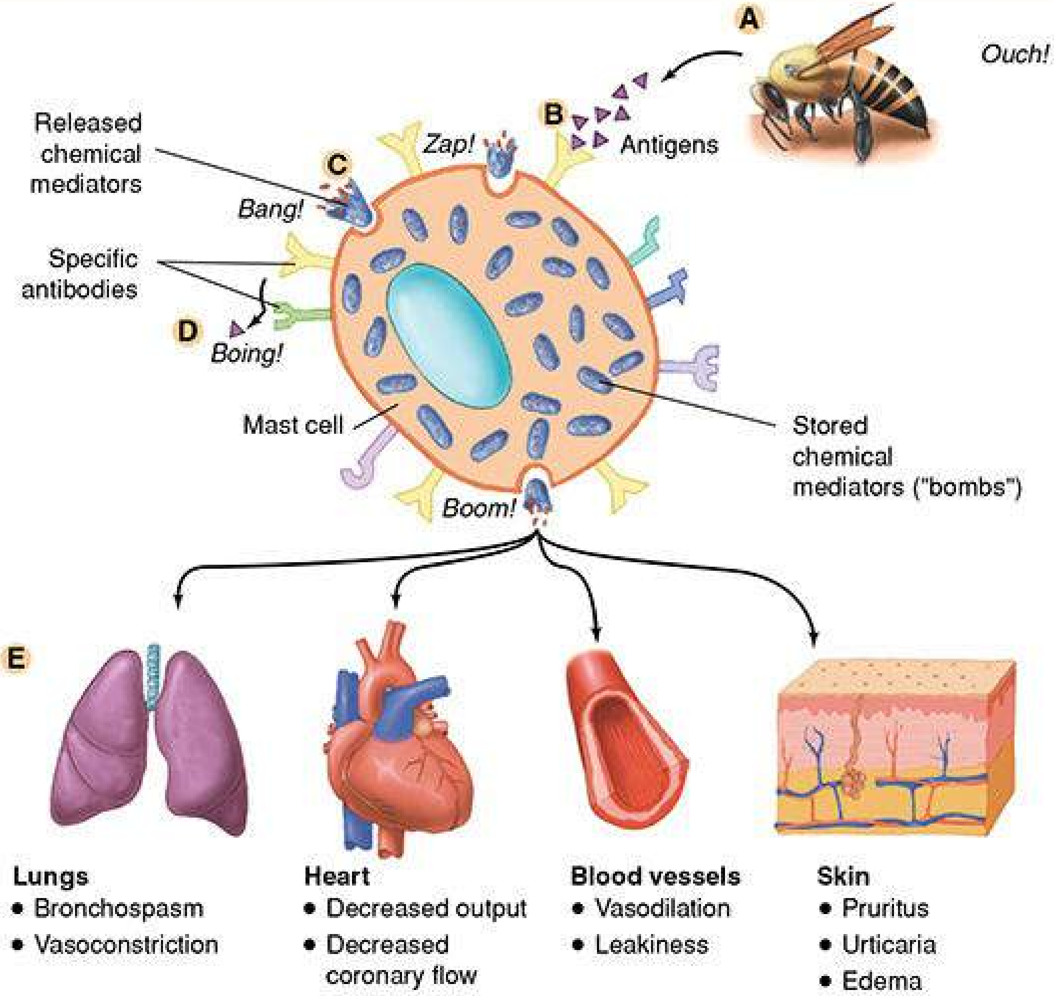

Figure 20-1 The sequence of events in anaphylaxis. **A.** The antigen is introduced into the body. **B.** The antigen-antibody reaction at the surface of a mast cell. **C.** The release of mast cell chemical mediators. **D.** Specific antibody reacts with its corresponding antigen. **E.** Chemical mediators exert their effects on end organs.

Figure 20-2 Urticaria, or hives, may appear following exposure to an allergen and is characterized by multiple, small, raised areas on the skin. Urticaria may be one of the warning signs of an impending anaphylactic reaction.

Figure 20-3 Angioedema, localized swelling associated with allergic reactions. If the site of swelling includes the lips, tongue, larynx, or other such structures, airway obstruction may occur.

Common Allergens

The most common allergens fall into one of the following five general categories:

- **Food.** Certain foods, such as shellfish and peanuts, may be the most common trigger of anaphylaxis. These foods account for 30% of deaths from anaphylaxis, most commonly in adolescents and young adults. Symptoms of a food allergy may take more than 30 minutes to appear and may not include the presence of skin signs, such as hives. However, the reaction can be quite severe and involve the respiratory and/or cardiovascular systems. It is possible for a patient to be unaware of the exposure; for example, a person allergic to peanuts may eat something without knowing that one of the ingredients is peanuts.
- **Medication.** The second most common source of anaphylactic reactions is medication, particularly antibiotics (eg, penicillin) and nonsteroidal anti-inflammatory drugs (NSAIDs). If the medication is injected, the reaction may be immediate (within 30 minutes) and severe **Figure 20-4**. Reactions to oral medications may take more than 30 minutes to appear, but can also be very severe.
- **Plants.** People who inhale dust, pollen, mold, mildew, or other organic materials to which they are sensitive may experience an allergic reaction. Some common plant allergens include ragweed, ryegrass, maple, and oak.
- **Chemicals.** Certain chemicals, makeup, soap, hair dye, latex, and various other substances can cause severe allergic reactions. Latex is of particular concern to health care providers; patients can be sensitive to it, but so can you! Up to 12% of health care providers will become sensitized to latex. For some, simply being in the same room as someone wearing powdered latex gloves can cause a reaction. It is a good practice to routinely use latex alternatives such as nitrile gloves. Follow your local protocol.
- **Insect bites and stings.** When an insect bites or stings you, the act of injecting its venom is called envenomation.

Envenomation by a honeybee, wasp, ant, yellow jacket, or hornet may cause a localized reaction, causing swelling and itching at the site, or a severe and systemic reaction (ie, anaphylaxis).

Figure 20-4 A severe allergic reaction to medication.

Courtesy of Carol B. Guerrero.

Insect Stings

There are more than 100,000 species of bees, wasps, and hornets in the world. According to the Cleveland Clinic Center for Continuing Education, approximately 3% of adults and 1% of children are allergic to the venom of these stinging insects, accounting for at least 50 deaths in the United States per year. Deaths from anaphylactic reactions to stinging insects far outnumber deaths from snake bites. In about half of these deaths, the victim had never experienced a reaction to prior stings.

The stinging organ of most bees, wasps, and hornets is a small, hollow spine projecting from the abdomen. Venom can be injected through this spine directly into the skin. The stinger of the honeybee is barbed, so the bee cannot withdraw it **Figure 20-5A**. Therefore, the bee leaves a part of its abdomen embedded with the stinger and dies shortly after flying away. If the stinger is not removed from the skin (discussed later in this chapter), it can continue to inject venom for up to 20 minutes. Wasps and hornets do not have this handicap; they can sting repeatedly **Figure 20-5B**. Because these insects usually fly away after stinging, it is often impossible to identify which species was responsible for the injury.

Figure 20-5 Most stinging insects inject venom through a small, hollow spine that projects from the abdomen. **A.** The stinger of the honeybee is barbed; the honeybee cannot withdraw its stinger once it has stung someone. **B.** The wasp's stinger is unbarbed, meaning that it can inflict multiple stings.

A: © manfredxy/ShutterStock.; B: © Heintje Joseph T. Lee/ShutterStock.

Some ants, especially the fire ant **Figure 20-6A**, also strike repeatedly, injecting a particularly irritating **toxin**, or poison, at the bite sites. It is not uncommon for a patient to rapidly sustain multiple ant bites, usually on the feet and legs **Figure 20-6B**.

Signs and symptoms of insect stings and bites include sudden pain, swelling, localized heat, widespread urticaria, and redness in light-skinned people, usually at the site of injury. There may be itching and sometimes a **wheal**, which is a raised, swollen, well-defined area on the skin **Figure 20-7**. Applying ice sometimes makes them less irritating. The swelling associated with an insect bite may be dramatic and sometimes frightening to the patient or to you. However, as long as these manifestations remain localized, they are not usually serious.

In more severe (anaphylactic) cases, patients may experience bronchospasm and wheezing, chest tightness and coughing, dyspnea, anxiety, gastrointestinal complaints, and hypotension. Occasionally, respiratory failure occurs. If untreated, an anaphylactic reaction can proceed rapidly to death. In fact, more than two-thirds of patients who die of anaphylaxis do so within the first 30 minutes, so rapid treatment and transport is essential.

Figure 20-6 **A.** The fire ant. **B.** Fire ants inject an irritating toxin at multiple sites. Bites are generally found on the feet and the legs and appear as multiple small, raised pustules.

A: Courtesy of Scott Bauer/USDA; B: © Scott Camazine/Alamy.

Figure 20-7 A wheal is a whitish, firm elevation of the skin that occurs after an insect sting or bite.

© Simon Krzic/ShutterStock.

Scene Size-up

First and foremost, ensure the scene is safe. The patient's environment or recent activity may indicate the source of the reaction, such as a sting or bite from an insect, a food allergy at a restaurant, or a new medication. A respiratory problem reported by dispatch may be an allergic reaction, but until a field impression of allergic reaction is firmly established, be mindful of other potential causes of respiratory distress as well. Do not neglect the possibility that traumatic injury may also be present, secondary to the medical emergency. Follow standard precautions with a minimum of gloves and eye protection. Consider the need for additional resources, such as advanced life support (ALS) personnel.

Primary Assessment

When a patient presents with an allergic reaction, you should quickly identify and treat any immediate or potential life threats. It is essential that you pay careful attention to the patient's ABCs, as deterioration can occur at almost any time and with very little warning. This is not only paramount during the primary assessment; ABCs should continue to be reassessed repeatedly throughout transport to the emergency department (ED).

Allergic reactions may present as respiratory distress or as cardiovascular distress in the form of shock. Patients experiencing a severe allergic reaction will often appear very anxious. If your general impression finds the person anxious and in distress, immediately call for ALS backup if available. Sometimes patients who are known to have severe allergies wear a medical identification tag (eg, necklace or bracelet). Such clues could provide crucial information in situations where the patient is found unresponsive or is otherwise unable to answer questions about his or her medical history.

The most severe form of allergic reactions, anaphylaxis, can cause rapid swelling of the upper airway. You may have only a few minutes to assess the airway and provide lifesaving measures; however, not all allergic reactions are anaphylactic reactions. So, work quickly to assess the patient to determine the severity of the symptoms and the number of body systems affected.

Quickly assess for increased work of breathing, use of accessory muscles, head bobbing, tripod positioning, nostril flaring, and abnormal breath sounds. Recall that wheezing occurs because of narrowing of the air passages, which is mainly the result of contraction of muscles around the bronchioles in reaction to the allergen, and mobilization of mucus in an attempt to "push out" the allergen. Exhalation, normally the passive, relaxed part of breathing, becomes harder as the patient tries to cough up the secretions or move air past the constricted airways. The fluid in the air passages and the constricted bronchi together produce the wheezing sound. As the patient's condition worsens, breath sounds may even diminish to the point of being almost silent. **Stridor**, a harsh, high-pitched sound heard on inspiration, occurs when swelling in the upper airway (near the vocal cords and throat) begins to close off the airway. It can eventually lead to total obstruction.

As the patient with respiratory failure attempts to compensate by breathing more rapidly, and as respirations become more difficult, the patient may eventually fatigue and may even stop breathing. In the latter case, cardiac arrest will shortly follow respiratory arrest.

YOU are the Provider — PART 2

The closest hospital is 15 minutes away, while the closest ALS ambulance is over 1 hour away. You perform a primary assessment of the patient and note the following:

Recording Time: 0 Minutes	
Appearance	Anxious; widespread hives
Level of consciousness	Conscious and alert, but mildly confused
Airway	Open, clear of obstructions or foreign bodies
Breathing	Rapid with audible wheezing
Circulation	Radial pulse, rapid rate and strong; skin, flushed and warm, covered with urticaria

The patient reports dyspnea and states that his entire body is itching. Your partner applies high-concentration oxygen via a nonrebreathing mask.

3. Is this patient experiencing a local reaction or anaphylaxis?

4. What body system(s) should you focus your secondary assessment on and why?

Assist the patient into a comfortable position, generally in a high-Fowler position, in an effort to maximize ventilations. This will help perfusion to the brain while easing respiratory effort. However, if signs of shock emerge, the patient should immediately be placed in the supine position as tolerated.

Quickly listen to the lungs on each side of the chest. Do not hesitate to initiate high-flow oxygen therapy. For a patient in severe respiratory distress, you may have to assist ventilations using a bag-valve mask (BVM), attached to a high concentration of oxygen. This can be done in an unresponsive patient or a patient with an altered level of consciousness. The positive-pressure ventilations you provide will force air beyond the swelling in the airway and into the lungs while you await more definitive treatment.

Although respiratory complaints are most common, some patients in anaphylaxis may not present with severe respiratory symptoms but primarily with signs and symptoms of circulatory distress, such as hypotension. Palpating for the presence and quality of a radial pulse will help you quickly identify how the circulatory system is responding to the reaction.

Assess for a rapid pulse rate; pale, cool, cyanotic or red, moist skin; and delayed capillary refill, all of which may indicate hypoperfusion. Treatment for shock includes oxygen, proper positioning, (ie, recumbent or supine as tolerated), and preventing the loss of body heat. The definitive treatment for shock resulting from anaphylaxis is epinephrine.

If anaphylaxis is suspected, or if a relatively mild allergic reaction appears to be worsening, immediate transport is warranted. Before leaving the scene, be sure to take along the patient's medications (eg, auto-injectors and inhalers). If the patient is calm and does not exhibit severe signs and symptoms, consider continuing the assessment at the scene. However, if in doubt, always err on the side of emergency transport.

History Taking

Investigate the patient's chief complaint or history of the present illness. Identify signs and symptoms Table 20-1.

If the patient is responsive, begin by obtaining the SAMPLE history (including OPQRST) and the following information specific to allergic reactions:

- **Have any interventions already been completed?** Prior to your arrival, the patient may have begun self-treatment with his or her own medication, such as an epinephrine auto-injector, a bronchodilator inhaler, or antihistamines such as chlorpheniramine (Chlor-Trimeton) or diphenhydramine (Benadryl).
- **Has the patient experienced a severe allergic reaction in the past?** If so, what happened? The patient's answers may indicate how severe the present reaction may become. For example, if the patient was hospitalized or required intubation due to a previous reaction, you should perceive this as an ominous sign and assume that he or she may have another reaction of equal or even greater severity. In such cases, rapid transport and treatment, as well as ALS care, are among the highest priorities.

Table 20-1 Additional Signs and Symptoms of an Allergic Reaction

Respiratory System	Cardiovascular System	Skin	Other Findings
▪ Sneezing or an itchy, runny nose (early sign) ▪ Shortness of breath (dyspnea) ▪ Tightness in the chest or throat ▪ Irritating, persistent dry cough ▪ Hoarseness ▪ Rapid, labored, or noisy respirations ▪ Wheezing and/or stridor (which may progress to a silent chest with anaphylaxis; late sign)	▪ Increase in pulse rate (tachycardia; early sign) ▪ Red, flushed, hot skin (early sign) or pale, cyanotic, cool skin (late sign) as the vascular system fails ▪ Decrease in blood pressure (hypotension) as the blood vessels dilate (late sign)	▪ Flushing, itching, or burning skin, especially common over the face and upper chest ▪ Urticaria over large areas of the body; may be internal or external ▪ Swelling, especially of the face, neck, hands, feet, and/or tongue, either local (angioedema) or generalized ▪ Cyanosis or pallor around the lips ▪ Warm, tingling feeling in the face, mouth, chest, feet, and hands	▪ Decreasing mental status (early sign of hypoperfusion), from mild confusion or lethargy to loss of consciousness or coma ▪ Anxiety; a sense of impending doom ▪ Gastrointestinal problems, including nausea, vomiting, or abdominal cramps ▪ Headache ▪ Itchy, watery eyes ▪ Dizziness

- **Be alert for any statements regarding the ingestion of foods that commonly cause allergic reactions.** What was the patient doing, or what was the patient exposed to, before the onset of symptoms? This information may be the key to effective treatment, regardless of any prior history of allergic reactions.

Inquire about the presence of gastrointestinal complaints such as nausea and vomiting.

Secondary Assessment

If indicated, perform a rapid full-body scan or conduct a physical examination focused on the area(s) of chief complaint.

If the patient is unconscious or otherwise unable to communicate, remove clothing as necessary and observe for the presence of bee stingers, signs of contact with chemicals, and other clues suggestive of a reaction. Remember to look for a medical alert tag, which could indicate a severe allergy to a particular substance.

If you have not already done so, auscultate for abnormal breath sounds such as wheezing or stridor, and carefully inspect the skin for swelling, rashes, or urticaria. A rapidly spreading rash can be concerning because it may indicate a systemic reaction. The skin may appear pale or cyanotic and cool; however, red, hot skin is typical in the early stages, suggesting a systemic reaction as the blood vessels lose their ability to constrict and blood moves outward and closer to the skin. If a systemic reaction continues, the body will have difficulty supplying blood and oxygen to the vital organs. One of the first signs that this has occurred will be altered mental status, as the brain is deprived of oxygen and glucose.

Vital signs help determine whether the body is compensating for the stress imposed upon the body by the reaction. Assess baseline vital signs, including the pulse and respiratory rate, blood pressure, pupillary response, and oxygen saturation. Remember that skin signs may be unreliable indicators of hypoperfusion, as they may vary widely or be hidden by rashes and swelling.

YOU are the Provider — PART 3

After your partner collects the patient's medications, which include an EpiPen and albuterol inhaler, you begin rapid transport to the emergency department (ED). En route, you obtain the SAMPLE history and learn that the patient is allergic to peanuts and that he was eating dinner at a new restaurant 20 minutes before his symptoms began. Since then, his symptoms have intensified and he wonders if his meal contained peanuts. You reassess his vital signs.

Recording Time: 5 Minutes

Respirations	28 breaths/min; labored
Pulse	120 beats/min; weak at the radial artery
Skin	Pale and cool; widespread urticaria; angioedema of the lips
Blood pressure	88/60 mm Hg
Oxygen saturation (Spo_2)	88% (on oxygen)

During the secondary assessment, you note increased swelling of the patient's face and lips. He is having greater difficulty speaking, and auscultation reveals worsening wheezes on exhalation. Your partner removes the nonrebreathing mask and begins assisting the patient's respirations using a BVM attached to high-flow oxygen.

5. During the primary assessment, why did the patient first present with warm skin? What is the significance of the changes in his skin color and temperature to pale and cool?

6. What are the therapeutic effects of epinephrine when given for anaphylaxis?

In a patient experiencing an allergic reaction, pulse oximetry can be a useful method to assess the patient's perfusion status. However, it is important to remember that pulse oximetry is just another tool in your toolbox. The decision to apply oxygen to a patient experiencing an allergic reaction should be based on a careful assessment of the patient's airway patency, work of breathing, and abnormal lung sounds upon auscultation, not solely on the pulse oximetry readings.

Reassessment

En route to the receiving hospital, repeat the primary assessment. Reassess vital signs, and repeat a focused physical examination of the affected body systems. If the patient is unstable, conduct this reassessment every 5 minutes. If the patient is stable, reassess every 15 minutes. The patient experiencing a suspected allergic reaction should be monitored with vigilance. Deterioration of the patient's condition can be rapid and fatal, so special attention should be given to any signs of airway compromise. The patient's anxiety level and mental status should be monitored as well, as these may provide additional indications of the course of the reaction. Monitor for signs of shock, and, if present, treat immediately.

To treat allergic reactions, you must first identify the severity of the reaction. Mild reactions may only require supportive care and monitoring. On the other hand, anaphylaxis can produce severe or rapidly progressing signs and symptoms, requiring more aggressive treatment, including epinephrine and ventilatory support. In either situation, the patient should be transported to a medical facility for further evaluation.

Recheck your interventions. If you administered epinephrine, what was the effect? Has the patient's condition improved? Does the patient need a second dose? If so, remember to consult medical control before administering any subsequent doses for which you have not already obtained authorization. Also, keep in mind that even if the patient experiences relief following the administration of epinephrine, transport to the ED is still warranted, as the medication's effect will wear off and the symptoms may return.

Your documentation should not only include the signs and symptoms found during your assessment, but should also clearly show *why* you chose the care you provided. Finally, be certain to record the patient's response to your treatment.

Emergency Medical Care of Immunologic Emergencies

If the patient appears to be having a severe allergic or anaphylactic reaction, you should administer basic life support and provide prompt transport to the hospital. If the allergic reaction was caused by an insect sting and the stinger is still in place, attempt to remove the stinger by scraping the skin with the edge of a sharp, stiff object such as a credit card **Figure 20-8**. Do not use tweezers or forceps to remove the stinger because this may squeeze more venom into the wound. Gently wash the area with soap and water or a mild antiseptic. Try to remove any jewelry from the area before swelling begins. Position the injection site slightly below the level of the heart, and apply ice or cold packs to the area. Placing ice over the injury site may slow absorption of the toxin, diminish swelling, and relieve pain, but like any other attempt to reduce swelling with ice, you should be careful not to place the ice pack directly on the skin or leave it in place for too long, as doing so may cause more damage. It is not recommended that ice be placed for longer than 10 minutes at a time.

YOU are the Provider — PART 4

Per standing orders, you have online medical control authorization to administer epinephrine. After confirming that the EpiPen is prescribed to the patient and is not beyond its expiration date, you administer it in the lateral aspect of his thigh. Then, as you continue transport, you reassess the patient and note the following:

Recording Time: 10 Minutes	
Level of consciousness	Conscious and alert
Respirations	22 breaths/min; less labored; wheezing continues
Pulse	124 beats/min; stronger at the radial artery
Skin	Pink, warm, and dry; hives are still present
Blood pressure	104/66 mm Hg
Spo_2	**95% (on oxygen)**

7. In addition to the patient's vital signs, what else should you reassess?
8. How often should you reassess this patient?

Figure 20-8 To remove the stinger of a honeybee, gently scrape the skin with the edge of a sharp, stiff object such as a credit card.

Be alert for signs of airway swelling and other signs of anaphylaxis such as nausea, vomiting, and abdominal cramps, and do not give the patient anything by mouth. Place the patient in the supine position as indicated, and give oxygen if needed. Monitor the patient's vital signs, and be prepared to provide further support as needed.

Epinephrine

The body normally produces epinephrine Table 20-2. **Epinephrine** is a sympathomimetic hormone. This means it mimics the sympathetic (fight or flight) response. Epinephrine has various properties that cause the blood vessels to constrict, which reverses vasodilation and hypotension; this, in turn, elevates the diastolic pressure and improves coronary blood flow. Other properties of epinephrine increase cardiac contractility and relieve bronchospasm in the lungs. Because epinephrine has immediate action, it can rapidly reverse the effects of anaphylaxis. Epinephrine is prescribed by a physician and comes predosed in an epinephrine auto-injector (EpiPen). In some EMS systems, you may be authorized to carry epinephrine as part of your regular on-board medications; in others, you may be permitted to help patients self-administer their own medication. Refer to local protocols or consult online medical control.

Table 20-2	Epinephrine
Indications	Severe allergic reaction causing airway, breathing, or circulatory compromise or an anaphylactic reaction
Contraindications	None in a life-threatening emergency; however, consult medical control when the patient has a history of heart disease or acute coronary syndrome
Actions	Vasoconstriction and increased cardiac contractility, bronchodilation
Side effects	Tachycardia, sweating, pale skin, dizziness, headache, palpitations
Typical dose	Adults: 0.3 mg (EpiPen) Children: 0.15 mg (EpiPen Jr)

Administering an Epinephrine Auto-Injector

All allergic emergency kits should contain a prepared, auto-injectable syringe of epinephrine, ready for intramuscular (IM) injection, along with instructions for its use Figure 20-9.

The adult EpiPen system delivers 0.3 mg of epinephrine via a spring-loaded needle and syringe system; the infant-child system (EpiPen Jr) delivers 0.15 mg. The spring-loaded needle automatically injects the epinephrine when the user firmly presses the device into the lateral thigh (thus the term auto-injector). If the patient is known to have an allergy, he or she may carry his or her own EpiPen. If the patient is able to use the auto-injector on his or her own, your role is limited to assisting him or her if needed.

To use, or help the patient use, the auto-injector, you should first receive a direct order from medical control or follow local protocol. Follow standard precautions, and make sure the medication has been prescribed specifically for that patient. If it has expired or is discolored, do not give the medication. In such an instance, you should inform medical control, and continue to provide emergency transport.

Figure 20-9 Patients who experience severe allergic reactions often carry their own prescription epinephrine, which comes predosed in an auto-injector or a prefilled syringe.

Once you have done these things, follow the steps in **Skill Drill 20-1**.

1. Remove the safety cap from the auto-injector, and, if possible, quickly wipe the patient's thigh with alcohol or some other antiseptic Step 1. (Note: though it is best practice to clean the site, do not delay administration of the drug to do so.) If the patient is displaying signs of life-threatening anaphylaxis, it is possible to administer the auto-injector directly through the patient's clothing.
2. Place the tip of the auto-injector against the lateral part of the patient's thigh, midway between the groin and the knee Step 2.
3. Push the injector firmly against the thigh until a click is heard. This indicates that the injector has activated and medication is being administered. Maintain steady pressure to prevent kickback from the spring in the syringe, and prevent the needle from being pushed out of the injection site too soon. Hold the injector in place until the medication has been injected (10 seconds).
4. Remove the injector from the patient's thigh and dispose of it in the proper biohazard container.
5. Rub the area for 10 seconds Step 3.

YOU are the Provider — PART 5

Following standing orders, you administer a dose of albuterol from the patient's meter-dosed inhaler in order to treat the bronchospasm responsible for his wheezing. A few minutes later, you call the receiving hospital and supply your radio report, including the most recent set of vital signs:

Recording Time: 20 Minutes

Level of consciousness	Conscious and alert
Respirations	18 breaths/min; unlabored; wheezing improved
Pulse	114 beats/min; strong and regular
Skin	Pink, warm, and dry; scattered hives
Blood pressure	128/72 mm Hg
Spo_2	97% (on oxygen by nonrebreathing mask; patient no longer requires positive-pressure assistance)

You deliver the patient to the ED, where the attending physician asks you how much epinephrine the patient has received.

9. What is the dose and concentration of epinephrine contained in an adult EpiPen?

Skill Drill 20-1 Using an EpiPen Auto-injector

Step 1

Remove the auto-injector's safety cap, and quickly wipe the thigh with antiseptic, if possible.

Step 2

Place the tip of the auto-injector against the lateral part of the thigh. Push the auto-injector firmly against the thigh until a click is heard. Hold it in place until all the medication has been injected (10 seconds).

Step 3

Rub the area for 10 seconds.

6. Record the time and dose of the injection on your patient care report.
7. Reassess and record the patient's vital signs after using the auto-injector.
8. If the patient's signs and symptoms do not improve after 5 minutes and the patient has another auto-injector, consider assisting the patient with the administration of a second (and final) dose of epinephrine.

Other allergy kits may contain oral or IM anti-histamines, agents that block the effect of hista-mine. These work relatively slowly, within several minutes to 1 hour. Because epinephrine can have an effect within 1 minute, it is the primary way to save the life of someone having a severe anaphylactic reaction.

Because epinephrine constricts blood vessels, it may cause the patient's blood pressure to rise significantly. Other side effects include increased pulse rate, anxiety, cardiac dysrhythmias, pallor, dizziness, chest pain, headache, nausea, and vomiting. In a life-threatening situation, the administration of epinephrine outweighs the risk of side effects. Remember that *patients who do not exhibit signs of respiratory compromise or hypotension and do not meet the criteria for a diagnosis of anaphylaxis should not be given epinephrine.*

Words of Wisdom

Allergic reactions to bites and stings can progress quickly to life threats. With good care, severe signs and symptoms may subside just as quickly. Performing a multisystem examination and documenting your findings are important before and after treatment. Give particular attention to skin signs and respiratory, circulatory, and mental functioning. If the patient's symptoms seem to resolve and he or she no longer desires to go to the hospital, explain that the effects of epinephrine can wear off before the underlying allergic reaction has fully resolved, and life-threatening symptoms may recur.

Administering Intramuscular Epinephrine

Some areas may allow administration of epinephrine by intramuscular injection, using a vial of 1:1,000 concentration epinephrine along with a needle and syringe. The typical adult dose is 0.3 mg, injected into the midanterolateral thigh. The pediatric dose is weight-based, with the most commonly administered dosage being 0.15 mg in the form of the EpiPen Jr, with a maximum single dose of 0.3 mg. It is critical to remember that with IM epinephrine injection, the concentration must be 1:1,000. Other concentrations are available, but are not used in IM injections for anaphylaxis. Be familiar with whether your protocols allow for epinephrine IM injection.

Special Populations

When you encounter a geriatric patient experiencing anaphylaxis, obtain a complete and accurate medical history. Because of the potential side effects of epinephrine, such as increased pulse rate, increased myocardial oxygen demand, and increased workload of the heart, you must weigh the risk versus benefit in epinephrine administration. If the patient has a history of cardiac problems, such as a previous heart attack or coronary artery disease, the administration of epinephrine is relatively contraindicated, meaning potential harm could occur to the patient if he or she receives epinephrine. In situations such as these, if available, online medical control should be contacted for guidance. If the patient is prescribed an EpiPen and has signs and symptoms of anaphylaxis, assist the patient with administration if needed.

YOU are the Provider — SUMMARY

1. What, if any, additional resources should you request?

You should consider requesting the response of an advanced life support (ALS) unit. Consider the time it will take to reach the nearest hospital versus the time needed to rendezvous with an ALS unit, the feasibility of requesting transport by helicopter, etc. Understand and follow your local protocols.

2. What intervention(s) should you perform without delay?

Because the patient's respiratory distress is an immediate life threat, providing high-concentration oxygen is the first action you should take.

3. Is this patient experiencing a local reaction or anaphylaxis?

The presence of widespread urticaria (hives) indicates that the patient is experiencing a systemic allergic reaction. Systemic reactions vary in severity and can range from diffuse (widespread) hives and itching to cardiovascular collapse and death.

A local reaction is characterized by tenderness, redness, itching, and swelling at and immediately adjacent to the bite or sting. In many cases, the reaction is not "allergic" in nature—it is simply irritation and inflammation that is caused by the bite or sting itself.

It is important to perform a careful and thorough assessment of patients who are exposed to something to which they have a confirmed allergy. A seemingly local and mild reaction can become systemic and severe within a matter of minutes.

4. What body system(s) should you focus your secondary assessment on and why?

Further assessment of the patient should focus on body systems that are commonly affected by an allergic reaction—

the respiratory and circulatory systems and the skin. In most cases, a severe allergic reaction occurs within minutes of exposure; however, it may be delayed for up to an hour in some patients.

Your primary assessment has revealed no immediate threats to your patient's airway, breathing, or circulation; however, the presence of a widespread rash indicates a systemic reaction and warrants a more thorough assessment. As you continue to assess the patient, look for clinical signs that indicate a worsening reaction and be prepared to assist ventilations and treat for shock.

Signs of respiratory system involvement include respirations that become rapid, labored, or noisy; wheezing; stridor; an irritating, persistent dry cough; hoarseness; and tightness in the chest or throat.

Signs of circulatory system involvement include tachycardia (initially), followed by pallor, dizziness, and hypotension. A decreasing level of consciousness indicates a decrease in cerebral blood flow; this is usually secondary to vascular dilation and hypotension.

The patient already has widespread hives, and his skin is flushed. However, you should further assess the skin by looking for swelling—especially of the face, tongue, neck, hands, and feet. If the patient reports a warm, tingling feeling in the face, mouth, chest, feet, and hands, this should also be cause for concern.

5. During the primary assessment, why did the patient first present with warm skin? What is the significance of the changes in his skin color and temperature to pale and cool?

When vasodilation and increased capillary permeability occur in the early stages of an allergic reaction, fluid leaks out of the bloodstream and into the subcutaneous (fatty) layer of the skin. This causes swelling, redness, warmth, and urticaria of the skin. But as the reaction progresses, bronchoconstriction impairs oxygenation and ventilation, producing hypoxemia. Clinical signs of hypoxemia, include altered mental status, tachycardia, cyanosis, and a low oxygen saturation (Spo_2).

Tachycardia indicates that the body is attempting to compensate for decreased perfusion and hypoxemia by releasing more epinephrine (adrenaline) into the bloodstream to pump more blood to the body's organs, tissues, and cells.

Hypotension occurs because of widespread vasodilation and a decrease in arterial pressure—again, in response to the body's massive release of histamines. As the blood pressure falls, the brain and other vital organs are deprived of oxygen.

6. What are the therapeutic effects of epinephrine when given for anaphylaxis?

Epinephrine (adrenaline)—a hormone that is normally produced by the body—works to rapidly increase the heart rate, dilate the bronchioles in the lungs, and raise the blood pressure by constricting the blood vessels. During anaphylaxis, however, the body may not produce enough epinephrine to enable these actions; therefore, epinephrine is administered to compensate for the body's slow response.

Epinephrine does not stop the allergic reaction itself; it reverses the negative effects of bronchoconstriction and vasodilation, which are caused by the reaction. Therefore, when epinephrine is administered to the patient, it dilates the bronchioles, which improves breathing, and constricts the blood vessels, which increases the blood pressure and improves perfusion.

7. In addition to the patient's vital signs, what else should you reassess?

Ask him if he still feels like he has a lump in his throat; this was likely the result of mild upper airway swelling caused by angioedema and *must* be reassessed. Even though he did not present with obvious external angioedema, you should still reassess his face, lips, tongue, neck, and other parts of his body for swelling.

Auscultate his breath sounds to determine if wheezing is still present. Scattered wheezing may still be heard, even though the patient is not exhibiting any outward signs of respiratory distress.

Reassess his skin to determine if his hives are resolving or if they are still present. In most cases, hives will persist, at least to some degree, following the administration of epinephrine. You will usually notice improvement in the patient's breathing and perfusion status (eg, mental status, blood pressure, peripheral pulse quality) before you see resolution of hives.

8. How often should you reassess this patient?

This patient should be considered high-priority or critical and, therefore, should be reassessed every 5 minutes en route to the receiving facility.

9. What is the dose and concentration of epinephrine contained in an adult EpiPen?

The adult EpiPen contains 0.3 milligrams (mg) of a 1:1,000 concentration for intramuscular injection. A 1:1,000 concentration contains 1 mg of epinephrine per 1 milliliter (mL). Therefore, 0.3 mL contains 0.3 mg of epinephrine—all of which is injected into the patient's thigh.

EMS Patient Care Report (PCR)

Date: 01-3-16	**Incident No.:** 011709	**Nature of Call:** Shortness of breath		**Location:** 1444 City Park Drive	
Dispatched: 1310	**En Route:** 1310	**At Scene:** 1316	**Transport:** 1322	**At Hospital:** 1339	**In Service:** 1350

Patient Information

Age: 33 **Sex:** M **Weight (in kg [lb]):** 73 kg (160 lb)	**Allergies:** Peanuts; no known drug allergies **Medications:** Prescribed EpiPen and albuterol inhaler **Past Medical History:** Previous allergic reaction to peanuts; required hospitalization **Chief Complaint:** Dyspnea, urticaria, and itching

Vital Signs

Time: 1322	**BP:** 88/60	**Pulse:** 120	**Respirations:** 28	**Spo_2:** 88%
Time: 1327	**BP:** 104/66	**Pulse:** 124	**Respirations:** 22	**Spo_2:** 95%
Time: 1332	**BP:** 128/72	**Pulse:** 114	**Respirations:** 18	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Epinephrine 0.3 mg via EpiPen, albuterol inhaler

Narrative

Medic 85 responded to a local restaurant where a 33-year-old man presented with dyspnea, generalized urticaria, and itching approximately 20 minutes after eating his meal. The patient was conscious and alert; his airway was patent and his breathing was rapid with audible wheezes. The patient was placed on oxygen via nonrebreathing mask. He stated that he was uncertain whether or not his meal had contained peanuts, a food to which he is severely allergic. He further stated that the last time he ingested a product containing peanuts, he had to be hospitalized. Partner retrieved patient's EpiPen and albuterol inhaler while further assessment was performed. Patient was then placed onto the stretcher, loaded into the ambulance, and transported to the hospital. As assessment continued en route, patient's condition began to deteriorate. He remained conscious, but became confused. He began experiencing increasing respiratory distress, as well as hypotension and a falling oxygen saturation. Auscultation revealed bilateral expiratory wheezing in all lung fields. The patient's face and lips began to show signs of swelling. At that time, the nonrebreathing mask was exchanged for a BVM attached to 15 L/min of oxygen, and his respirations were assisted. Patient denied chest discomfort and other past medical history. The patient was unable to self-administer his EpiPen; therefore, it was given by EMS, following standing orders, in the lateral aspect of his right thigh; dose given was 0.3 mg of 1:1,000 concentration. Reassessment showed that his symptoms had begun to resolve; his mental status had improved and he stated that it was easier to breathe. Blood pressure and oxygen saturation also improved. Hives were still present, although they appeared to be resolving. However, the wheezing continued; thus, per standing orders, the patient was assisted in the administration of his albuterol inhaler. Continued to monitor patient's condition throughout transport; he continued to improve and was delivered to the ED staff without incident. Gave verbal report to charge nurse and returned to service.**End of report**

Prep Kit

Ready for Review

- An allergic reaction is a response to chemicals the body releases to combat certain stimuli, called allergens.
- Allergic reactions occur most often in response to five categories of stimuli: food, medication, plants, chemicals, and insect bites and stings.
- The reaction may be mild and local, involving itching, redness, and tenderness, or it may be severe and systemic, including shock and respiratory failure.
- Anaphylaxis is a life-threatening allergic reaction mounted by multiple organ systems, which must be treated with epinephrine.
- Wheezing and skin wheals can be signs of anaphylaxis.
- All patients with suspected anaphylaxis require oxygen.
- When assessing a person who may be having an allergic reaction, you should check for flushing, itching, and swelling skin, hives, wheezing and stridor, a persistent cough, a decrease in blood pressure, a weak pulse, dizziness, abdominal cramps, and headache.
- Because epinephrine can have an effect within 1 minute, it is the primary way to save the life of someone having a severe anaphylactic reaction.
- You may help a patient to administer an epinephrine auto-injector (EpiPen) with authorization from medical control.
- Always provide prompt transport to the hospital for any patient who is having an allergic reaction. Remember that signs and symptoms can rapidly become more severe. Carefully monitor the patient's vital signs en route; be especially alert for airway compromise.

Vital Vocabulary

allergen Substance that cause an allergic reaction.

allergic reaction The body's exaggerated immune response to an internal or surface agent.

anaphylaxis An extreme, life-threatening, systemic allergic reaction that may include shock and respiratory failure.

angioedema Localized areas of swelling beneath the skin, often around the eyes and lips, but it can also involve other body areas as well.

envenomation The act of injecting venom.

epinephrine A substance produced by the body (commonly called adrenaline), and a drug produced by pharmaceutical companies that increases pulse rate and blood pressure; the drug of choice for an anaphylactic reaction.

histamines Chemical substances released by the immune system in allergic reactions that are responsible for many of the symptoms of anaphylaxis, such as vasodilation.

immune response The body's response to a substance perceived by the body as foreign.

immune system The body system that includes all of the structures and processes designed to mount a defense against foreign substances and disease-causing agents.

immunology The study of the body's immune system.

leukotrienes Chemical substances that contribute to anaphylaxis; released by the immune system in allergic reactions.

stridor A harsh, high-pitched respiratory sound, generally heard during inspiration, that is caused by partial blockage or narrowing of the upper airway; may be audible without a stethoscope.

toxin A poison or harmful substance.

urticaria Small areas of generalized itching and/ or burning that appear as multiple raised areas on the skin; hives.

wheal A raised, swollen, well-defined area on the skin resulting from an insect bite or allergic reaction.

wheezing A high-pitched, whistling breath sound that is most prominent on expiration, and which suggests an obstruction or narrowing of the lower airways; occurs in asthma and bronchiolitis.

Assessment *in Action*

You and your partner are dispatched to 1284 NW 152 Avenue for a child experiencing respiratory distress. On arrival, a frantic woman meets you at the door and begs you to hurry. She informs you that her 12-year-old son was playing in the backyard when he felt a sudden pain on the back of his leg. You find the child on the back porch, in obvious distress, leaning forward in a chair with his elbows on his knees, struggling to catch his breath. Due to severe dyspnea, he is unable to answer your questions. You also notice that his left arm is in a cast. Your partner immediately applies a nonrebreathing mask as you complete the primary assessment. The child's respirations are rapid and shallow, and his pulse is rapid and thready. His skin is pale with patches of raised red spots on his hands, arms, and face. Your partner conducts a systematic rapid physical exam as you obtain vital signs and a SAMPLE history from the mother. When you inquire about allergies, the mother tells you the child had a very mild reaction to a bee sting several months ago. His medical history also includes asthma, anxiety, and a recent fracture of his arm. Your partner informs you that he heard wheezes in all lung fields and observed additional raised red spots on the child's chest.

1. The raised red spots are most likely:

   A. angioedema.
   B. acne.
   C. urticaria.
   D. a fungal infection.

2. What should you do first?

A. Administer albuterol.
B. Transport to the hospital.
C. Administer epinephrine.
D. Coach the patient to slow his breathing.

3. What possible chemical is being released into this patient's body during this reaction?

A. Histamine
B. Antihistamine
C. Epinephrine
D. Glucose

4. Which medication should be administered first for this patient?

A. Albuterol
B. Epinephrine
C. Acetaminophen (Tylenol)
D. Diphenhydramine (Benadryl)

5. Your partner indicates that he heard wheezes in all lung fields. What did he hear?

A. A high-pitched whistling sound caused by bronchoconstriction
B. A coarse, low-pitched breath sound heard in patients with chronic mucus in the upper airways
C. A high-pitched noise heard primarily on inspiration
D. Crackling, moist breath sounds

6. Your partner notes the presence of a medical alert bracelet around the patient's wrist. What should be done and why?
7. Your partner suggests that, in addition to epinephrine, the two of you should assist the patient in using his albuterol inhaler. How should you respond? Why?
8. Following the administration of epinephrine, the patient reports that his heart is beating "very fast." How should you respond?
9. Besides an allergic reaction, provide an example of another illness or injury you should consider as part of the differential diagnosis.

CHAPTER
21

Toxicology

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Toxicology

› Recognition and management of
  - Carbon monoxide poisoning (pp 774–775)
  - Nerve agent poisoning (pp 789–790)

› How and when to contact a poison control center (p 774)

› Anatomy, physiology, pathophysiology, assessment, and management of
  - Inhaled poisons (pp 774–775, 779–781)
  - Ingested poisons (pp 777, 779–782)
  - Injected poisons (pp 777–781)
  - Absorbed poisons (pp 776–777, 779–781)
  - Alcohol intoxication and withdrawal (pp 783–784)

Knowledge Objectives

1. Define toxicology, poison, toxin, and overdose. (p 771)
2. Identify the common signs and symptoms of poisoning or toxic exposure. (p 772)
3. Describe how poisons and toxins can enter the body. (pp 773–778)
4. Describe the assessment and treatment of a patient with a suspected poisoning or toxic exposure. (pp 779–794)
5. Describe the assessment and treatment of a patient with a suspected overdose. (pp 779–791)

6. Discuss scene safety considerations for working at a scene with a potentially hazardous material or violent patient. (p 779)
7. Understand the role of airway management in a patient suffering from poisoning or overdose. (pp 779–793)
8. Explain the use of activated charcoal, including indications, contraindications, and the need to obtain approval from medical control before administration. (pp 780–782)
9. Identify the main types of toxins and poisons and their effects, including alcohol, opiates and opioids, sedative-hypnotic drugs, inhalants, hydrogen sulfide, sympathomimetics, synthetic cathinones, marijuana, hallucinogens, anticholinergic agents, and cholinergic agents. (pp 782–791)
10. Discuss how to manage a patient who has overdosed on an opioid or opiate and who has gone into cardiac or respiratory arrest. (pp 784–785)
11. Describe the assessment and treatment of a patient with suspected food poisoning. (pp 791–793)
12. Describe the assessment and treatment of a patient with suspected plant poisoning. (pp 793–794)

Skills Objectives

1. Demonstrate how to assess and treat a patient with a suspected poisoning. (pp 779–781)
2. Demonstrate how to assess and treat a patient with a suspected overdose. (pp 780–781)
3. Demonstrate how to administer activated charcoal. (pp 781–782)

Introduction

Every day, each of us comes into contact with things that are potentially poisonous. This is not surprising when you consider that almost any substance may be a poison in certain circumstances. Different doses can turn even a remedy into a poison. Consider a common medication such as aspirin. When taken in recommended doses, it is a safe and effective pain reliever (analgesic). Too much aspirin, however, can result in death.

According to the National Poison Data System, acute poisoning affects approximately 2 million people each year. Chronic poisoning—often caused by the long-term abuse of medications, tobacco, and alcohol—is more common. Fortunately, deaths caused by acute poisoning are fairly rare. Rates of death as the result of acute poisoning in children have decreased steadily since the late 1960s, when child-resistant caps were introduced for drug bottles and containers. However, deaths caused by chronic poisoning in adults have risen in the last few years, primarily as the result of drug abuse.

In this chapter, the term *poisoned* includes acute and chronic poisonings. As an EMT, you must recognize that patients with either type of condition may have a variety of symptoms. Although you cannot stop chronic substance abuse in a patient, you may be able to prevent death caused by the acute effects of a poison, simply by providing airway management and symptomatic care during transport.

This chapter discusses how to identify a patient who has been poisoned or exposed to a toxin, and how to gather clues about the substance. Also described are the different ways in which a poison or toxin is introduced into the body. The chapter then discusses the signs, symptoms, and treatment of specific poisons. Hazardous materials exposure, food poisoning, and plant poisoning are also discussed.

Words of Wisdom

Drugs interact with one another. Food, alcohol, vitamins, over-the-counter (OTC) medications, homeopathic agents, and other substances can prevent a drug from working as expected. These interactions can alter the effectiveness of the drug and increase the risk of adverse (harmful) effects.

Identifying the Patient and the Poison

Toxicology is the study of toxic or poisonous substances. A **poison** is any substance whose chemical action can damage body structures or impair body function. A **toxin** is a poisonous substance produced by bacteria, animals, or plants that acts by changing the normal metabolism of cells or by destroying them. Toxins can have acute effects (for example, an injection of heroin may cause respiratory arrest) and chronic effects (for example, years of substance abuse may lead to a weakened immune system). **Substance abuse** is the misuse of any substance to produce a desired effect (for example, heroin intoxication). A common complication of substance abuse is **overdose**, when a patient takes a toxic or lethal dose of a substance.

Your primary responsibility to the patient who has been poisoned is to recognize that a poisoning has occurred. Your own safety plays a key role here as well; pay attention to your surroundings **Figure 21-1**. The where, what, and how of the exposure is important. Keep in mind that very small amounts of some poisons or toxins can cause considerable harm or death. Never let your guard down and allow yourself to become exposed to the same substance. If you have even the slightest suspicion that an **ingestion** (swallowing) or exposure to a toxic substance has occurred, notify medical control and begin emergency treatment immediately. Discussion of issues relating to suicide is covered in Chapter 22, *Psychiatric Emergencies*.

Figure 21-1 Never open a door or approach a scene until you have ascertained that the area is safe to enter. Keep in mind that very small amounts of some poisons or toxins can cause considerable harm or death.

Courtesy of Darin Dowe/Law and Order Magazine/Hedon Media Group.

Symptoms and signs of poisoning or overdose vary according to the specific agent, as shown in Table 21-1. Some poisons cause the pulse to speed up, whereas others cause it to slow down; some poisons cause the pupils to dilate, while others cause the pupils to constrict. If respiration is depressed or difficult, cyanosis may occur. Some chemical compounds will irritate or burn the skin or mucous membranes, resulting in burning or blistering. The presence of such injuries at the patient's mouth strongly suggests the ingestion of a poison, such as lye. If possible, ask the patient the following questions while you obtain the SAMPLE history (Signs and symptoms; Allergies; Medications; Pertinent past medical history; Last oral intake; Events leading up to the injury or illness):

- What substance did you take?
- When did you take it (or become exposed to it)?
- How much did you ingest?
- Did you have anything to eat or drink before or after you took it?
- Has anyone given you an antidote or any substance orally since you ingested it?
- How much do you weigh?

Be extremely careful in dealing with a child who has ingested a poisonous substance. Although such incidents usually do not lead to death, family members may be distraught, and your calm, professional attitude will help to ease the tension. Remember, however, that a single swallow or single pill of some substances can kill a child.

Table 21-1 Typical Signs and Symptoms of Specific Overdoses

Agent	Signs and Symptoms
Opiates (Examples: morphine, codeine) Opioids (Examples: heroin, methadone, oxycodone)	▪ Hypoventilation or respiratory arrest ▪ Pinpoint pupils ▪ Sedation or coma ▪ Hypotension
Sympathomimetics (Examples: epinephrine, albuterol, cocaine, methamphetamine)	▪ Hypertension ▪ Tachycardia ▪ Dilated pupils ▪ Agitation or seizures ▪ Hyperthermia
Sedative-hypnotics (Examples: diazepam, secobarbital, flunitrazepam, midazolam)	▪ Slurred speech ▪ Sedation or coma ▪ Hypoventilation ▪ Hypotension
Anticholinergics (Examples: atropine, diphenhydramine, chlorpheniramine, doxylamine, *Datura stramonium* [jimsonweed])	▪ Tachycardia ▪ Hyperthermia ▪ Hypertension ▪ Dilated pupils ▪ Dry skin and mucous membranes ▪ Sedation, agitation, seizures, coma, or delirium ▪ Decreased bowel sounds

Cholinergics (Examples: organophosphates, pilocarpine, nerve gas)	▪ Airway compromise
	▪ SLUDGEM:
	  ▪ **S** Salivation, sweating
	  ▪ **L** Lacrimation (excessive tearing of the eyes)
	  ▪ **U** Urination
	  ▪ **D** Defecation, drooling, diarrhea
	  ▪ **G** Gastric upset and cramps
	  ▪ **E** Emesis (vomiting)
	  ▪ **M** Muscle twitching/miosis (pinpoint pupils)

Words of Wisdom

Do not judge the patient for becoming exposed to a poisonous substance, especially if the exposure was an incident of self-harm. Always treat the patient with respect and compassion.

Try to determine the nature of the poison. Look around the immediate area for objects that may provide clues: an overturned bottle, a needle or syringe, scattered pills, chemicals, the remains of food or drink items, or even an overturned or damaged plant. Place any suspicious material in a plastic bag and take it with you to the hospital, along with any containers you find.

Drug containers at the scene can provide critical information. In addition to the name and concentration of the drug, a pill bottle label may list specific ingredients, the number of pills that were originally in the bottle, the name of the manufacturer, and the dose that was prescribed. This information can help emergency department physicians determine how much has been ingested and what specific treatment may be required. For certain food poisonings, a food container that lists the name and location of the restaurant or vendor may help save the life of the patient and possibly other customers.

If the patient vomits, examine the contents for pill fragments. Wear proper personal protective equipment (PPE) for this activity. Note and document anything unusual that you see.

How Poisons Enter the Body

Emergency care for a patient who has been poisoned may range from reassuring an anxious parent or caregiver to performing cardiopulmonary resuscitation (CPR). For these patients, definitive treatment can only be provided at the emergency department, so transport promptly whenever poisoning is involved. Often, you will not administer a specific **antidote** (a substance that will counteract the effects of a particular poison) because most poisons do not have one. Depending on local protocols, the antidote most commonly available to EMTs is naloxone (Narcan), which is used to reverse the effects of an opioid overdose. Naloxone is discussed later in the chapter. If you work in a tiered system, advanced life support (ALS) backup may also be appropriate, because these providers can administer additional medications and therapies.

In general, the most important treatment you can perform for a poisoning is to dilute and/or physically remove the poisonous agent. How you do this depends on how the poison entered the patient's body in the first place. The four routes to consider are as follows:

- Inhalation **Figure 21-2A**
- Absorption (surface contact) **Figure 21-2B**
- Ingestion **Figure 21-2C**
- Injection **Figure 21-2D**

YOU are the Provider — PART 1

It is 0220 hours. Your unit is dispatched to a prominent gated community. A security guard meets you and fire department personnel at the gate and escorts you to 1968 Holly Creek Place. Dispatch advises you the patient is female with acute onset of "flulike symptoms." As you arrive, you notice several police cars on scene as well. You and your paramedic partner enter the home and find a 17-year-old girl slouched on the couch. There is a strong odor of vomit on her clothing and she appears sleepy.

The patient's mother is by her side and there is a basin with vomit on the floor beside them. The father reports he was awakened when the teenager and her friends came home from a party and were making a lot of noise. He found his daughter on the front porch and brought her inside.

1. In addition to providing immediate lifesaving treatment, what else should you do when you arrive at this scene?
2. How can knowledge of various signs and symptoms caused by different types of medications improve the care you provide to a patient?

Figure 21-2 There are four routes by which a poison can enter the body. **A.** Inhalation. **B.** Absorption (surface contact). **C.** Ingestion. **D.** Injection.

A: © Jones & Bartlett Learning. Photographed by Kimberly Potvin; B: © American Academy of Orthopaedic Surgeons; C: © Jaimie Duplass/ShutterStock; D: © Cate Frost/ShutterStock.

Words of Wisdom

Poison Centers

The American Association of Poison Control Centers (AAPCC) supports the nation's poison centers in their efforts to prevent and treat poison exposures. The phone number of your regional poison center is typically listed on the inside cover of your local phone book or on the AAPCC website. The telephone number for the Poison Help hotline is 1-800-222-1222 (available 24 hours a day, 7 days a week). Staff members at every center have access to information about virtually all of the commonly used medications, chemicals, and substances that could possibly be poisonous. These experts know the appropriate emergency treatment for each, including the antidote, if there is one.

If you believe a patient has been poisoned, immediately provide the poison center with all relevant information: when the poisoning occurred; evidence found at the scene; a description of the suspected poison, including the amount involved; and the patient's size, weight, and age. If necessary, medical control can contact the regional poison center for you and relay specific instructions back to you. Follow your local protocols.

A medical toxicologist is a physician who specializes in caring for patients who have been poisoned. These specialists work in special facilities called medical toxicology treatment centers, located throughout the United States. At times, your medical control may divert a patient who meets certain poisoning criteria to one of these centers instead of to the closest hospital.

You and your medical control center should know the telephone number of your regional poison center and have it available in the event you encounter an unexpected case of poisoning.

All four routes of poisoning can lead to serious and possibly life-threatening conditions. Take care to treat these patients appropriately and to keep yourself safe from harm. If you are uncertain how to treat a patient who has been poisoned or exposed to a specific substance, find the container if possible, and contact medical control and/or the poison control center before you proceed. Always assess the situation and determine whether the scene is safe before you approach the patient.

Inhaled Poisons

Patients who have inhaled poison—including natural gas, sewer gas, certain pesticides, carbon monoxide, and chlorine—should be moved to fresh air immediately. Depending on how long the patient was exposed, he or she may require supplemental oxygen **Figure 21-3**. During the scene size-up, if you suspect the presence of a toxic gas, call for specialized resources such as the hazardous materials (HazMat) team. Never approach a contaminated patient unless you have specialized HazMat training and are using the appropriate PPE. It will be necessary to use a self-contained breathing apparatus to protect yourself from poisonous fumes. If you are not specifically trained in the use of this apparatus or do not have appropriately fit-tested equipment available, defer to appropriately trained and equipped personnel. Patients may need to be decontaminated by the HazMat team after they are removed from the toxic environment. The patient's clothing should be removed in this process because it may contain trapped gases that can be released, exposing you to the substance. You cannot administer emergency care until this step has been completed and there is no danger of the poison contaminating you.

Some inhaled poisons, such as carbon monoxide, are colorless and odorless and produce severe hypoxia without damaging or even irritating the lungs. Others, such as chlorine, are very irritating to the tissues and cause airway obstruction and pulmonary edema. The patient may have the following signs and symptoms: burning eyes, sore throat, cough, chest pain, hoarseness, wheezing, respiratory distress, dizziness, confusion, headache, or stridor in severe cases. The patient may also have seizures or an altered mental status. Most inhaled toxins can be treated by removing the patient from the exposure and applying oxygen. However, some inhaled agents cause progressive lung damage, even after the patient has been removed from direct exposure; the damage may not be evident for several hours. Meanwhile, it may take 2 or 3 days or more of intensive care to restore normal lung function. For this reason, all patients who have inhaled poison require prompt transport to an emergency department. Be prepared to use supplemental oxygen via a nonrebreathing mask and/or ventilatory support with a bag-valve mask (BVM), if necessary. Remember that pulse oximetry readings may be inaccurate with inhaled poisons. Make sure a suction unit is available in case the patient vomits.

Figure 21-3 Patients who have inhaled poisons may need supplemental oxygen and prompt transport to the emergency department.

© Photodisc.

Words of Wisdom

According to the Centers for Disease Control and Prevention, during the winter months, the increased use of alternative heating systems in poorly-ventilated spaces can lead to an increase in carbon monoxide poisonings.

As with other poisonings, it is helpful to take the containers, bottles, and labels with you when you transport the patient to the hospital. Some patients use inhaled poisons to commit suicide. A common method is for the patient to sit inside a vehicle with the engine running in an enclosed garage. The exhaust fumes from the vehicle contain high levels of carbon monoxide that will cause the patient to become unconscious and eventually stop breathing. A variation of this method is chemical or detergent suicide, which involves using a tightly sealed vehicle as a type of gas chamber. These people mix household chemicals inside the vehicle to produce hydrogen sulfide gas, which is quickly fatal. When you approach the vehicle and open the door, you may be overcome by the gas as well. If you suspect this type of scenario has taken place, contact HazMat responders and have them remove the victim. Hydrogen sulfide is discussed in more detail later in the chapter.

Words of Wisdom

Any time there is more than one patient and no evidence of the mechanism of injury (MOI) or nature of illness (NOI), be suspicious. This is especially true when you encounter patients with changes in level of consciousness, especially at an industrial site or in an enclosed space. Toxic fumes may be odorless and colorless or may seem harmless, such as in the case of sewer gas. If the substance is in the atmosphere, it will affect the emergency providers as well as the patients. An EMT who is incapacitated is no help to anyone.

Absorbed and Surface Contact Poisons

Poisons that come in contact with the surface of the body can affect the patient in many ways. Many corrosive substances will damage the skin, mucous membranes, or eyes, causing chemical burns, rashes, or lesions. Acids, alkalis, and some petroleum (hydrocarbon) products are very destructive. Other substances are absorbed into the bloodstream through the skin and have systemic effects, just like medications or drugs taken via the oral or injectable routes. Other substances, such as poison ivy or poison oak, may cause an itchy rash without being dangerous to the patient's health. It is important, therefore, to distinguish between contact burns and contact absorption.

Words of Wisdom

Absorption of toxic substances through the skin is a common problem in the agriculture and manufacturing industries. Most solvents, insecticides, herbicides, and pesticides are toxic and can be readily absorbed through the skin.

Signs and symptoms of absorbed poisons include a history of exposure, liquid or powder on a patient's skin, burns, itching, irritation, redness of the skin in light-skinned people, or typical odors of the substance.

Emergency treatment for a typical contact poisoning includes the following two steps:

1. Avoid contaminating yourself or others.
2. While protecting yourself from exposure, remove the irritating or corrosive substance from the patient as rapidly as possible.

Remove all clothing that has been contaminated with poisons or irritating substances. If a dry powder has been spilled, thoroughly brush off the chemical (avoid creating a dust cloud), flush the skin with clean water for 15 to 20 minutes, and then wash the skin with soap and water. If liquid material has been spilled on a patient, flood the affected part for 15 to 20 minutes. If the patient has a chemical agent in the eyes, irrigate them quickly and thoroughly. To avoid contaminating the other eye as you irrigate the affected eye, make sure the fluid runs from the bridge of the nose outward **Figure 21-4**. Initiate this action on the scene and continue it during transport. Keep in mind that you may have to help the patient keep his or her eyes open.

Many chemical burns occur in industrial settings, where safety showers and specific protocols for handling surface burns are available. If you are called to such a scene, a HazMat team should be available to assist you. Always ensure you, your team members, and the exposed patient are thoroughly decontaminated prior to transport. Failure to do so will result in the risk of contaminating the entire emergency department and staff. After effective decontamination has occurred, promptly transport to the emergency department for definitive care. Obtain a **material safety data sheet (MSDS)** (or safety data sheet [SDS]) from industrial sites and transport it with the patient. If it is not immediately available, ask the company to fax it to the receiving hospital while you are en route. This will help to identify and quickly make available specific interventions and potential antidotes. Chapter 39, *Incident Management*, discusses hazardous materials and decontamination in detail.

YOU are the Provider — PART 2

You approach the patient and the mother tells you she vomited up some pills. You glance down at the basin of vomit on the floor and note several different colors of pill fragments. You also notice a vomit stain on the patient's shirt is speckled with different colors. As you begin your assessment of the patient, you note her respirations are very slow.

Recording Time: 0 Minutes	
Appearance	Slouched into the couch with her head down, motionless
Level of consciousness	Sleepy and not responding without stimulation
Airway	Oral secretions; snoring respirations
Breathing	Slow rate; shallow depth; breath sounds diminished to absent
Circulation	Radial pulses, rapid and weak; skin is cool, pale, and wet; no gross bleeding

3. On the basis of your initial assessment, what is the most appropriate treatment for this patient?
4. On the basis of the patient's initial presentation, what type of drug should you suspect she overdosed on?

Figure 21-4 If chemical agents are in the patient's eyes, irrigate the eyes quickly and thoroughly, ensuring that the irrigation fluid runs from the bridge of the nose outward. (Use of a nasal cannula is pictured.)

Ingested Poisons

According to the AAPCC, approximately 80% of all poisoning is by mouth (ingestion). Ingested poisons include liquids, household cleaners, contaminated food, plants, and, in most cases, drugs. Ingested poisoning is usually accidental in children and, except for contaminated food, deliberate in adults. Plant poisonings are common among children, who like to explore and often bite the leaves of various bushes or shrubs.

The signs and symptoms of ingested poisons vary greatly with the type of poison, the age of the patient, and the time that has passed since the ingestion. Small children may respond by crying if the poison is an acid or alkaline, and these types of poisons often cause burns around the mouth. Gastrointestinal pain may be present in some cases, and patients may vomit before or after your arrival. If the patient has an altered mental status, it is critical that you protect the patient from aspirating if he or she vomits. Other signs and symptoms depend on the substance involved; for example, some poisons may cause cardiac dysrhythmias whereas others may cause seizures. It is important to treat these signs and symptoms and notify the poison center and medical control of the patient's condition. Consider whether there is unabsorbed poison remaining in the gastrointestinal tract and whether you can safely and effectively prevent its absorption.

Words of Wisdom

Be aware that some chemicals react with water. Although small amounts can usually be flushed safely with large quantities of water, larger amounts of such chemicals can give off toxic fumes or explode when wet. Be sure to check the relevant warnings and placards, and avoid potential injury to your patient and yourself by calling for additional resources (HazMat team) when in doubt.

When the patient has ingested a toxin, some EMS systems allow EMTs to administer activated charcoal by mouth.

Activated charcoal is discussed later in the chapter.

Although every poison will result in a specific set of symptoms and signs, always immediately assess the airway, breathing, and circulation (ABCs) of every patient who has been poisoned. Many patients have died as a result of conditions related to the ABCs that might have been managed easily. Be prepared to provide aggressive ventilatory support and CPR, if necessary, to a patient who has ingested an opioid, a sedative, or a barbiturate, each of which can cause depression of the central nervous system (CNS) and slow breathing.

Injected Poisons

Exposure by injection includes intravenous drug abuse and envenomation by insects, arachnids, and reptiles (these injuries are covered in Chapter 20, *Immunologic Emergencies* and Chapter 32, *Environmental Emergencies*). Injected poisons cannot be diluted or removed from the body in the field because they are usually absorbed quickly into the body or cause intense local tissue destruction. When people become ill from an injected poison, their condition can be life threatening and you must act quickly **Figure 21-5**.

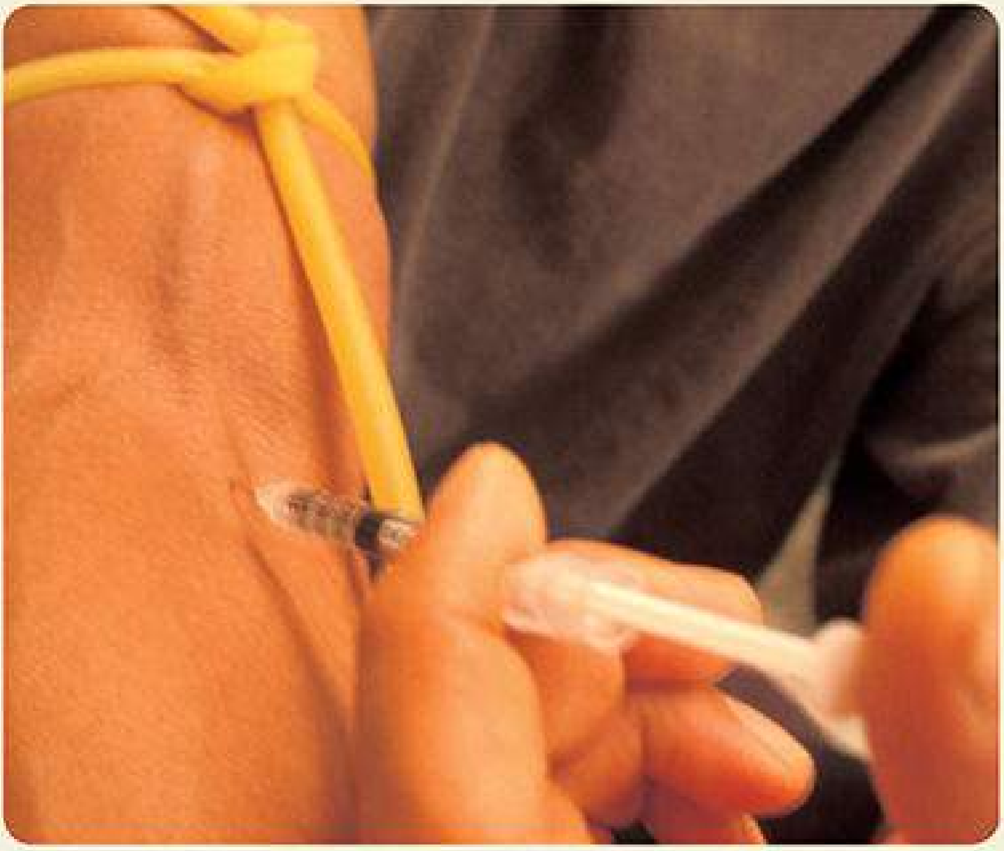

Figure 21-5 Injected poisons are impossible to dilute or remove from the body in the field; therefore, prompt transport to the emergency department is critical.

Words of Wisdom

Take time at the scene to make thorough notes about the nature of the poisoning. You can then use this information to state the type and amount of substance and the time and route of exposure in your radio, verbal, and written reports. The busy emergency department staff will also appreciate clear notes that can quickly be handed over on arrival.

Signs and symptoms of poisoning by injection include weakness, dizziness, fever, chills, and unresponsiveness, or the patient may be easily excited.

If you suspect that rapid absorption has occurred, monitor the patient's airway, provide high-flow oxygen for any patient with respiratory distress or signs of hypoxia (Spo_2 level is less than 94%, cyanosis), and be alert for nausea and vomiting. Remove rings, watches, and bracelets from areas around the injection site if swelling occurs. Prompt transport to the emergency department is essential. Take all containers, bottles, and labels with the patient to the hospital.

YOU are the Provider — PART 3

The patient's respirations continue to slow and then stop completely. You, your partner, and the fire crew begin to manage the patient. She is placed on the floor supine. One of the firefighters begins ventilation with a BVM and oxygen. You set up an IV line and your partner initiates IV access.

Recording Time: 6 Minutes	
Respirations	Apneic; assisted ventilations
Pulse	116 beats/min; weak and regular
Skin	Cool, pale, and wet
Blood pressure	96/50 mm Hg
Oxygen saturation (Spo_2)	91% (on oxygen)

As you treat the patient, a law enforcement officer brings inside one of the friends that brought the patient home. He reports they went to a "skittle party" earlier that night. He explains the teenagers took prescription pills from their parents' medicine cabinets, mixed them up in a bowl, and then took turns selecting pills to get high. They were also drinking beer and liquor.

While your partner establishes the IV line, you check the patient's pupils. You and your partner agree they are pinpoint. As the IV line is secured, your partner asks you to prepare a preloaded syringe of naloxone to be administered to the patient. You hand the syringe to your partner, then check the patient's blood glucose level. The glucometer registers a fingerstick glucose level of 112 mg/dL.

5. Would activated charcoal benefit this patient? Why or why not?
6. Why is naloxone being given to this patient?

Patient Assessment

Scene Size-up

When you have a situation that involves a toxicologic emergency, a well-trained dispatcher can obtain important information pertaining to a poisoning call that will help you anticipate the proper protection needed to ensure your safety. The dispatcher may be able to obtain information pertaining to the MOI/NOI, the number of patients involved, whether additional resources are needed, and whether trauma is involved. If this information has been obtained before your arrival, you must assess the scene nevertheless to ensure your safety and to determine the accuracy of the dispatcher's information.

Because of the risk of possible cross-contamination by poisons that can be inhaled, absorbed, ingested, and injected, you must take appropriate standard precautions. As you approach the scene, think like a detective and look for clues that might indicate the substance involved. Ask yourself the following questions:

- Is there an unpleasant or odd odor in the room? If so, is the scene safe? (This could indicate an inhaled poison.)
- Are there medication bottles near the patient or at the scene? If so, is there medication missing that might indicate an overdose?
- Are there alcoholic beverage containers present?
- Are there syringes or other drug paraphernalia on the scene?
- Is there a suspicious odor and/or drug paraphernalia present that may indicate the presence of an illegal drug laboratory? Drug laboratories can be volatile, so ensure scene safety **Figure 21-6**.

The location of the patient may help contribute to identifying a suspected poisoning, and other clues such as empty pill bottles or open bottles of household cleaners near the patient may provide further information to help you determine what happened. Keep a constant eye on the surroundings, and keep an open mind when questioning the patient or bystanders to avoid mistaken conclusions.

Figure 21-6 An illegal laboratory capable of producing large quantities of methamphetamine.

Courtesy of DEA.

Primary Assessment

To best determine the severity of the patient's condition, first obtain a general impression of the patient, assess his or her level of consciousness, and determine any life threats. With substance abuse and poisonings, do not assume a conscious, alert, and oriented patient is in stable condition and has no apparent life threats. The patient may have a harmful or even lethal amount of poison in his or her system that has not had time to produce systemic reactions. A primary assessment that reveals a patient with signs of distress and/or altered mental status gives you early confirmation that the poisonous substance is causing systemic reactions.

Quickly ensure that the patient has an open airway and adequate ventilation. If the patient has any difficulty breathing, begin oxygen therapy. In situations where a patient may have an inhalation injury (typically carbon monoxide and/or cyanide poisoning), place the patient on high-flow oxygen regardless of the pulse oximetry reading. If the patient is unresponsive to painful stimuli, consider inserting an airway adjunct to ensure an open airway. Have suction available; these patients are susceptible to vomiting. You may also have to assist a patient's ventilations with a BVM because some substances act as depressants on the body's systems.

Once the airway and breathing have been assessed and appropriate interventions performed, assess the patient's circulatory status. You will find variations in a patient's circulatory status depending on the substance involved. Assess the pulse and skin condition. Some poisons are stimulants, and others are depressants. Some poisons will cause vasoconstriction and others vasodilation. Although bleeding may not be obvious, alterations in consciousness may have contributed to trauma and bleeding.

Consider prompt transport for patients with obvious alterations in the ABCs or for patients you have determined have a poor general impression. Some industrial settings may have specific decontamination stations and antidotes available at the site. Remember, everyone who is exposed to the hazardous material must be thoroughly decontaminated by the HazMat team before leaving the scene.

History Taking

After you have managed the life threats during the primary assessment, investigate the chief complaint or history of present illness. Obtain the patient's medical history. In many situations, you can perform this in the ambulance en route to the hospital. If your patient is responsive and can answer questions, begin with an evaluation of the exposure and the SAMPLE history. If the patient is unresponsive, attempt to obtain the history from coworkers, bystanders, friends, or family members. Medical identification jewelry and wallet cards may also provide information about the patient's medical history.

In these situations, the SAMPLE history guides you in what to focus on as you continue to assess the patient's complaints, and the physical examination and vital signs tell you what is happening to the patient's body. These three assessments give you direction in the interventions your patient might need.

In addition to the SAMPLE history, ask the following questions:

- **What is the substance involved?** If you know the substance involved, you will be better able to access the appropriate resource, such as the poison center, to determine lethal doses, time before adverse effects begin, effects of the substance at toxic levels, and appropriate interventions.
- **When did the patient ingest or become exposed to the substance?** This will let you know if and when the adverse effects will begin. This will also let the emergency physician know what adverse effects can be reversed and which ones cannot because of the length of time the patient has been exposed to the substance.
- **How much did the patient ingest or what was the level of exposure?** With this information, the poison center will be able to inform you whether the patient has had a harmful or lethal dose.
- **Over what period did the patient take or was the patient exposed to the substance?** Did the exposure occur all at once or over minutes or hours?
- **Has the patient or a bystander performed any intervention on the patient? Has the intervention helped?** The patient's or bystander's intervention may cause complications. The emergency physician will need to know this information to be able to adjust interventions accordingly.
- **How much does the patient weigh?** If activated charcoal is indicated and permitted by local protocols, you will need to determine the dose based on the patient's weight. The antidote or neutralizing agent given by the emergency physician may be based on the patient's weight as well.

Secondary Assessment

In some instances, such as a critically ill patient or a short transport time, you may not have time to conduct a secondary assessment.

Your physical examination should focus on the area of the body involved with the route of exposure and the particular drug or chemical the patient was exposed to. For example, if you suspect a person has ingested a poison, inspect the mouth for indications of poisoning. Are there burns from caustic chemicals? Are there plant or pill fragments? If the person's skin came in contact with a poison, is there a rash or burns? How large an area is involved? If a respiratory exposure occurred, auscultate the lungs. Is there good air movement in and out of the lungs? Do you hear any wheezing or crackles? Learn about the effects of general classes of drugs and chemicals so that you will become familiar with specific and common poisons.

Your priority is to manage the ABCs during the primary assessment. These interventions take precedence over a thorough physical examination. However, once the ABCs have been addressed and managed, conducting a thorough physical examination will often provide additional information on the exposure the patient experienced. A general review of all body systems may help to identify systemic problems. Perform this review, at a minimum, on patients with extensive chemical burns or other significant trauma and on patients who are unresponsive.

A complete set of baseline vital signs is important. Many poisons have no outward indications of the seriousness of the exposure. Alterations in the level of consciousness, pulse, respirations, blood pressure, and skin are more sensitive indicators that something serious is wrong.

Reassessment

The condition of patients exposed to poisons may change suddenly and without warning. Continually reassess the adequacy of the patient's ABCs. Repeat the vital signs, and compare them with the baseline set obtained earlier in your assessment. Evaluate the effectiveness of interventions you have provided. If your assessment has provided necessary information about the poisonous substance, you may be able to anticipate changes in the patient's condition. If the patient has consumed a harmful or lethal dose of a poisonous substance, reassess the vital signs at least every 5 minutes. If the patient is in stable condition and there are no life threats, reassess every 15 minutes. If the poison or the level of exposure (eg, the number and type of pills taken) is unknown, careful and frequent reassessment is mandatory.

The treatment you provide for poisoned patients depends a great deal on what they were exposed to, how they were exposed, and other signs and symptoms found in your assessment. Remember, supporting the ABCs is your most important task. Contact your medical control or a poison center to discuss treatment options for particular poisonings. Dilute airborne exposures with oxygen, remove contact exposures with large amounts of water unless contraindicated, and consider activated charcoal for ingested poisons (if permitted by local protocol).

Once you have completed your primary assessment, history taking, and secondary assessment, contact medical control to request necessary interventions. Report to the hospital as much information as you have about the poison or chemical that the patient was exposed to. If a material safety data sheet is immediately available in a work setting, take it with you to the hospital.

Emergency Medical Care

First, ensure scene safety by following standard precautions and performing external decontamination. Remove tablets or pill fragments from the patient's mouth, and wash or brush dry poison from the patient's skin. Treatment focuses on support. Assess and maintain the patient's ABCs. If the patient has difficulty breathing, provide oxygen to the patient, and perform assisted ventilations if necessary. Keep the patient warm, treat for shock as necessary, and transport promptly to the nearest appropriate hospital.

In certain cases, some EMS systems allow EMTs to give activated charcoal by mouth. As discussed in Chapter 11, *Pharmacology,* activated charcoal binds to specific toxins—for example, pills that have been ingested—and prevents their absorption by the body. The toxins are then carried out of the body in the stool.

Activated charcoal is not indicated, nor will it be effective, for patients who have ingested alkali poisons, cyanide, ethanol, iron, lithium, methanol, mineral acids, or organic solvents. If the patient has a decreased level of consciousness and cannot protect his or her airway, do not give activated charcoal.

If local protocol permits, your ambulance will likely carry plastic bottles of premixed suspension, each containing up to 50 g of activated charcoal **Figure 21-7**. Some common trade names for the suspension form are InstaChar, Actidose, and LiquiChar. The usual dose for an adult or child is 1 g of activated charcoal per kilogram of body weight (more if food is present). The usual adult dose is 30 to 100 g, and the usual pediatric dose is 15 to 30 g for children younger than age 13.

Figure 21-7 Activated charcoal comes as a pre-mixed suspension.

© Chuck Stewart, MD.

Before you give a patient charcoal, obtain approval from medical control. Consider the amount of the toxin and the patient's condition. In most cases, the activated charcoal should be used within 1 hour of ingestion. Next, shake the bottle vigorously to mix the suspension. The medication looks like mud, so it is best to cover the outside of the container so that the fluid is not visible and ask the patient to drink it with a straw. Some patients may not tolerate the medication due to its gritty texture. You might need to convince the patient why this intervention is important, particularly if the patient is a child, but never force him or her. If the patient takes a long time to drink the mixture, you will have to shake the container frequently to keep the medication mixed. Once the patient has finished, discard the container from which the charcoal was administered. Be sure to record the time when you administered the activated charcoal. If the patient refuses the activated charcoal, document the refusal and your attempts to counsel the patient, and transport the patient for further evaluation.

The adverse effects of ingesting activated charcoal include constipation and black stools. If the patient has ingested a poison that causes nausea, he or she may vomit after taking activated charcoal, and the dose will have to be repeated. As you reassess the patient, be prepared for vomiting, nausea, and possible airway conditions.

Words of Wisdom

While one EMT explains the activated charcoal treatment to the patient, the other EMT can prepare a large plastic garbage bag to hang on the patient as a bib. This will help contain the charcoal suspension if the patient vomits.

Specific Poisons

Over time, a person who routinely misuses a substance may need increasing amounts of it to achieve the same result. This is called developing a **tolerance** to the substance. A person with an **addiction** has an overwhelming desire or need to continue using the substance, at whatever cost, with a tendency to increase the dose. This does not happen only with the classic drugs of abuse, such as cocaine or heroin. Almost any substance can be abused, including laxatives, nasal decongestants, vitamins, and food.

The importance of safety awareness when caring for drug users cannot be overemphasized. Known drug users have a fairly high incidence of serious and undiagnosed infections, including human immunodeficiency virus and hepatitis. These patients, when intoxicated, may bite, spit, hit, or otherwise injure you, causing you to come into contact with their blood and other body fluids. Always wear appropriate PPE. A calm, professional approach can defuse frightening situations, but keep your safety and that of your team uppermost in mind. Expect the unexpected and remember: The drug user, not the drug, can pose the greatest threat.

YOU are the Provider — PART 4

Your partner administers the naloxone slowly, titrating the dose until the patient begins to breathe on her own. After about 30 seconds, the patient starts moving and pushing the BVM away from her face. You apply a nonrebreathing mask at 15 L/min, which the patient tolerates. You reassess her condition and vital signs and prepare for transport.

Recording Time: 11 Minutes	
Level of consciousness	Conscious, but sleepy
Respirations	12 breaths/min; adequate depth
Pulse	84 beats/min; regular and stronger
Skin	Cool; color is improving
Blood pressure	108/52 mm Hg
Spo_2	96% (on oxygen)

7. What other issues about this patient should concern you?
8. How would this patient's presentation have differed had she overdosed on a sympathomimetic?

Alcohol

As a new EMT, you will notice that many calls for service have a connection to alcohol use. Alcohol can damage the liver, whether thorough chronic overuse or occasional heavy use (binge drinking). According to the Centers for Disease Control and Prevention, 1 in 10 deaths among working-age adults in the United States can be attributed to excessive alcohol use. Many people dismiss the dangers of drinking and do not understand that binge use can be more damaging than chronic use, depending on the frequency of the binging and the surrounding circumstances. According to the Institute for Health Metrics and Evaluation, binge use has increased more than 17% since 2005.

Alcohol is a powerful CNS depressant. It is a **sedative**, a substance that decreases activity and excitement, and a **hypnotic**, meaning that it induces sleep. In general, alcohol dulls the sense of awareness, slows reflexes, and reduces reaction time **Figure 21-8**. It may also cause aggressive and inappropriate behavior and lack of coordination. However, a person who appears intoxicated may have other medical conditions as well. Look for signs of head trauma, mental illness, toxic reactions, or uncontrolled diabetes. Severe acute alcohol ingestion may cause hypoglycemia, which may contribute to the symptoms. You should assume that all intoxicated patients are experiencing a drug overdose and require a thorough examination by a physician. In most states, patients who are impaired in any way—whether by mental illness, medical condition, or intoxication—cannot legally refuse transport. Always consult with your supervisor, law enforcement, or medical control in these situations. Chapter 22, *Psychiatric Emergencies*, covers this topic in more detail.

Figure 21-8 Alcohol intoxication causes altered mental status, slowed reflexes, and impaired reaction time.

Alcohol increases the effects of many drugs and is commonly taken with other substances. OTC drugs, including antihistamines and diet medications, can cause serious complications when combined with alcohol.

If a patient exhibits signs of serious CNS depression, provide respiratory support. This may be difficult, however, because depression of the respiratory system can also cause **emesis**, or vomiting. The vomiting may be forceful or even bloody (**hematemesis**) because large amounts of alcohol irritate the stomach. Internal bleeding should also be considered if the patient appears to be in shock (hypoperfusion) because blood might not clot effectively in a patient who has a prolonged history of alcohol abuse.

Special Populations

Drug and alcohol abuse among teenagers is one of the most common issues in society today. Most teenagers are encouraged to experiment with drugs through peer pressure. Often, older teenagers will encourage younger teenagers to try combinations of drugs. In other cases, an older teenager who has developed a tolerance will give too large of a dose of a drug to a first-time user, resulting in an overdose. Many teenagers will do things they know are not safe just to gain acceptance from their peers. Often teenagers will lie about taking drugs out of fear of being arrested. Reassure them that your intent is only to give them the best treatment possible.

Also be aware that some teenagers use drugs to attempt suicide. According to the American Psychological Association, teen suicide is a growing health concern and the third-leading cause of death for young people ages 15 to 24. Do not be judgmental with these teenagers and treat them as you would any other patient, with empathy and patience.

A patient in alcohol withdrawal may experience frightening hallucinations, or **delirium tremens (DTs)**. About 1 to 7 days after a person stops drinking or when alcohol consumption levels are decreased suddenly, DTs may develop. Alcoholic hallucinations come and go. A patient with an otherwise clear mental state may see fantastic shapes or figures or hear odd voices. Such auditory and visual hallucinations often precede DTs, which are a more severe complication.

Patients may experience one or more of the following signs and symptoms:

- Agitation and restlessness
- Fever
- Sweating
- Tremors
- Confusion and/or disorientation
- Delusions and/or hallucinations
- Seizures

Provide prompt transport after you have completed your assessment and given necessary care. A person who is experiencing hallucinations or DTs is extremely ill. Should seizures develop, treat them as you would any other seizure. Do not restrain the patient, although you must protect him or her from self-injury. If the patient has difficulty breathing, provide supplemental oxygen and watch carefully for vomiting; have suction ready. Hypovolemia may develop because of sweating, fluid loss, insufficient fluid intake, or vomiting associated with DTs. If you see signs of hypovolemic shock, clear the airway, and turn the patient's head to one side to minimize the chance of aspiration during transport. These patients may not respond appropriately to suggestions or conversation; they are often confused and frightened. Therefore, use a calm and relaxed approach. Reassure the patient, and provide emotional support.

Safety Tips

In situations that involve toxic substances, your safety is paramount. Always be aware of the environment. When dealing with patients who have taken illegal drugs, be cautious and be prepared for unexpected violence. Do not hesitate to call for law enforcement support.

Opiates and Opioids

A **narcotic** is a drug that produces sleep or altered mental consciousness. An **opioid** is a type of narcotic medication used to relieve pain. An **opiate** is a subset of the opioid family, and refers to natural, non-synthetic opioids. Opioids are named for the opium in poppy seeds, from which the opiates codeine and morphine are derived. According to the National Institute on Drug Abuse (NIDA), prescription opioid drugs are among the most commonly abused drugs in the United States. Some people become physically dependent on opioids after taking an appropriate medical prescription. These drugs include a number of synthetic (laboratory-manufactured) opioids, such as meperidine, hydromorphone, oxycodone, hydrocodone, and methadone Table 21-2. In addition, according to the National Center for Health Statistics, the death rate from heroin overdoses (which is illegal in any amount or form) tripled between 2010 and 2013, for a total of nearly 44,000 deaths.

These agents are CNS depressants and can cause severe respiratory depression. When administered intravenously, however, they produce a characteristic "high" or "kick." Tolerance develops rapidly, so some users may require massive doses to experience the same high. In general, emergency medical conditions related to opioids are caused by respiratory depression, including a decreased volume of inspired air and decreased respirations. This can lead to respiratory and then cardiac arrest if not treated promptly. These drugs often cause nausea and vomiting and may lead to hypotension. Although seizures are uncommon, they can occur and an overdose can result in the patient entering a comatose condition. Patients typically appear sedated or unconscious and exhibit cyanosis with pinpoint pupils. Whereas all of these signs and symptoms may be present with other drugs, the pinpoint pupils are the most commonly accepted sign of opiate abuse.

Table 21-2 Common Opioids and Opiates

Butorphanol (Stadol)
Codeine
Fentanyl (Sublimaze)
Heroin
Hydrocodone (Vicodin)
Hydromorphone (Dilaudid)
Morphine
Methadone (Dolophine)
Oxycodone hydrochloride (OxyContin)
Oxymorphone (Opana)

Words of Wisdom

Some patients who abuse opioids or opiates may inject the substance intravenously and are at high risk for hepatitis C and human immunodeficiency virus. Be aware of your surroundings and practice bloodborne precautions. Be alert for improperly disposed needles.

Naloxone (Narcan) is an antidote that reverses the effects of opiate or opioid overdose. This medication can be given intravenously, intramuscularly, or intranasally. Ideally, naloxone is administered intravenously. In many instances, however, IV access is difficult to obtain in the chronic user of illicit intravenous drugs such as heroin. These patients have venous scarring, called track marks, from repeated use of needles on peripheral veins. Therefore, the intranasal route is becoming a preferred alternative route for the administration of naloxone. It is safer than giving an IM injection because a needle is not required to administer the medication.

Some EMS systems allow EMTs to administer naloxone by the intranasal route, in which the antidote is atomized through the nares into the nasal mucosa. Be aware that this drug can cause harm. This medication should only be used when the patient has agonal respirations or apnea. Place an oropharyngeal (oral) or nasopharyngeal (nasal) airway and ventilate the patient using a BVM prior to administering naloxone. Adequate ventilation while you prepare to administer naloxone decreases the risk of permanent brain damage related to hypoxia. Watch the patient closely; as the level of consciousness rises, the patient will no longer tolerate the oropharyngeal airway and you will have to remove it to prevent aspiration.

In some areas, lay people are permitted to administer naloxone. Be aware that it may have been administered prior to your arrival. Find out from bystanders what has occurred and who was given naloxone.

When a patient goes into cardiac arrest, follow the algorithm shown in Figure 21-9, including administration of naloxone if it is available. However, providing BVM ventilations is a critical treatment for these patients as well. Whether or not naloxone is available, provide ventilations and rapid transport.

Sedative-Hypnotic Drugs

Barbiturates and benzodiazepines have been a part of legitimate medicine for a long time. They are easy to obtain and relatively cheap. People sometimes solicit prescriptions from several physicians for the same hypnotics or a variety of sedative-hypnotics Table 21-3. These drugs are CNS depressants and alter the level of consciousness, with effects similar to those of alcohol so that the patient may appear drowsy, peaceful, or intoxicated. By themselves, these drugs do not relieve pain, nor do they produce a specific high, although users often take alcohol or an opioid at the same time to boost their effects.

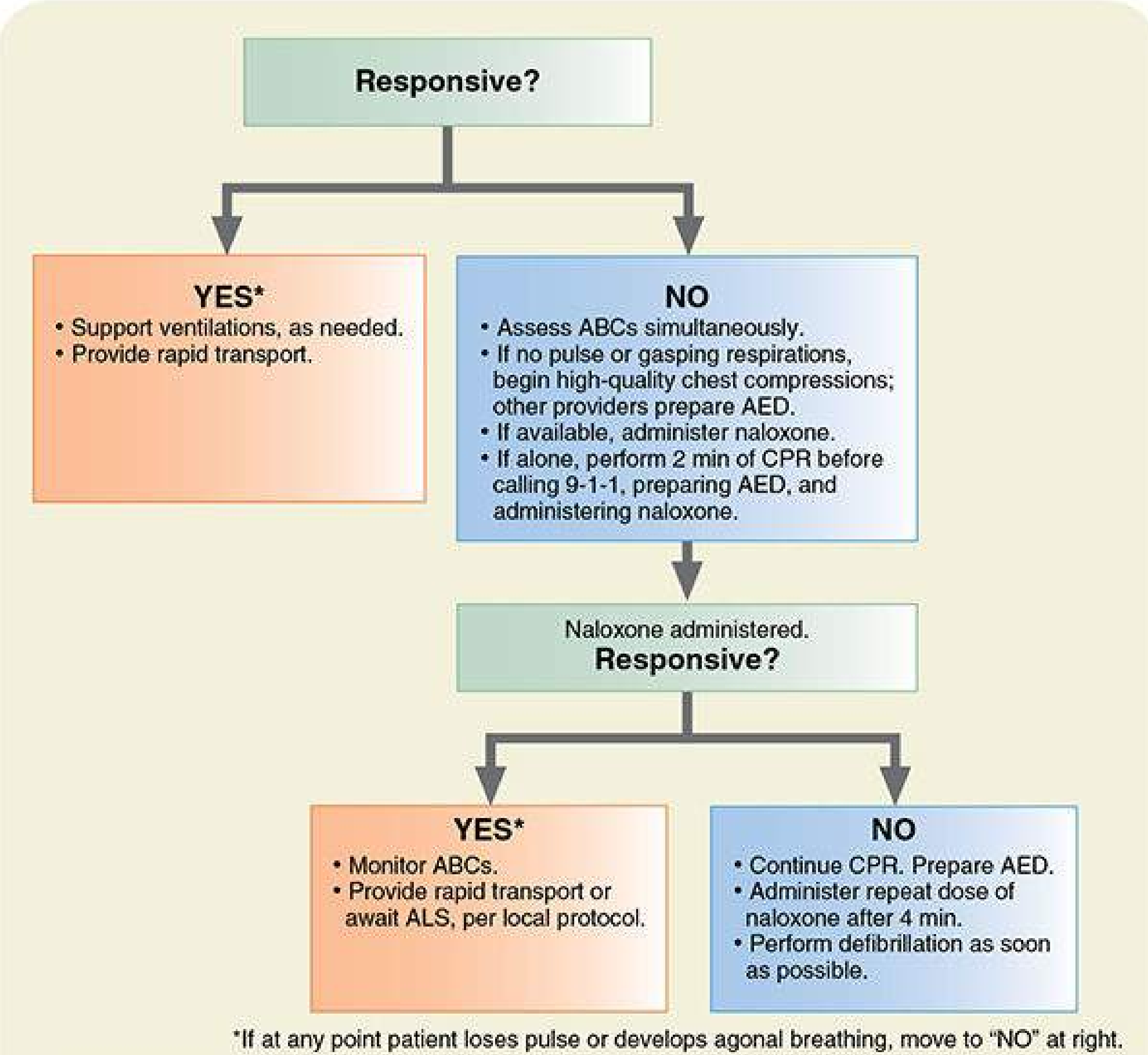

Figure 21-9 Opioid life-threatening overdose algorithm.

In general, these agents are taken by mouth. Occasionally, however, contents of capsules are suspended or dissolved in water and injected to produce a sudden state of ease and contentment. Use of IV sedative-hypnotic drugs quickly induces tolerance, so the person requires increasingly larger doses. You are less likely to be called on to treat an acute overdose in someone who chronically abuses these drugs; however, you may be called to a scene of an attempted suicide in which the patient has taken large quantities of these drugs. In these situations, patients will often have marked respiratory depression and may be in a coma.

Sedative-hypnotic drugs such as chloral hydrate may also be given to people as a "knock-out" drink, or "Mickey Finn," to incapacitate them without their knowledge. Date rape or club drugs such as flunitrazepam (Rohypnol or "roofies") and ketamine (Ketalar or "Special K") are often colorless, tasteless, and odorless. They cause an unwary person to become sedated and even unconscious, which may facilitate sexual assault or rape. The person later awakens, confused and unable to remember what happened. Chapter 23, *Gynecological Emergencies*, discusses this topic in more detail.

Table 21-3 Examples of Sedative-Hypnotic Drugs

Barbiturates	Benzodiazepines	Others
Amobarbital (Amytal)	Alprazolam (Xanax)	Carisoprodol (Soma)
Butabarbital (Butisol)	Chlordiazepoxide (Librium)	Chloral hydrate ("Mickey Finn"), eszopiclone (Lunesta)
Pentobarbital (Nembutal)	Diazepam (Valium)	Cyclobenzaprine (Flexeril)
Phenobarbital (Luminal)	Flunitrazepam (Rohypnol)	Ethchlorvynol (Placidyl)
Secobarbital (Seconal)	Lorazepam (Ativan)	Ethyl alcohol (drinking alcohol)
	Oxazepam (Serax)	Ketamine (ketalar)
	Temazepam (Restoril)	Isopropyl alcohol (rubbing alcohol)
		Meprobamate (Equagesic)

In general, your treatment of patients who have overdosed with sedative-hypnotics and have respiratory depression is to ensure the airway is patent, assist ventilations, and provide prompt transport. Give supplemental oxygen when appropriate and closely monitor the patient's mental status. You may attempt to stimulate the person by speaking loudly or gently shaking him or her; remember to watch for vomiting.

As multidrug use becomes more common, you may find it increasingly difficult to determine what agents patients have taken. Your best approach is to treat any obvious injuries or illnesses, keeping in mind that drug use may complicate the picture and make full life support necessary. Focus on the ABCs, especially the possibility of airway problems (relaxation of the tongue, causing obstruction), vomiting, respiratory depression, and, in severe cases, cardiac arrest.

Abused Inhalants

Many abused inhalants produce several of the same CNS effects as do other sedative-hypnotics, but these agents are inhaled instead of ingested or injected. This method of abuse is known as huffing. Some of the more common agents include acetone, toluene, xylene, and hexane, which are found in glues, cleaning compounds, paint thinners, and lacquers. Similarly, gasoline and various halogenated hydrocarbons, such as Freon, used as propellants in aerosol sprays, are also abused as inhalants. None of these inhalants are medications; rather, these substances briefly displace oxygen in the brain and cause a rush of euphoria. Because these are inexpensive products that can be bought in hardware stores, they are commonly abused by teenagers and curious adults seeking an alcohol-like high. The effective dose and the lethal dose are very close, making these extremely dangerous drugs. Long-term abuse can lead to permanent brain damage.

Take special care in dealing with a patient who may have used inhalants. Effects of inhalants range from mild drowsiness to coma, but unlike most other sedative-hypnotics, these agents may often cause seizures. The lack of oxygen to the brain may cause a loss of brain function. Also, halogenated hydrocarbon solvents can make the heart hypersensitive to the patient's own adrenaline, putting the patient at high risk for sudden cardiac death because of ventricular fibrillation; even the action of walking may release enough adrenaline to cause a fatal ventricular dysrhythmia. You must try to keep such patients from struggling with you or exerting themselves. Give supplemental oxygen for patients with respiratory distress or signs of hypoxia, and use a stretcher to move the patient. Prompt transport to the hospital is essential; monitor vital signs en route.

Hydrogen Sulfide

Hydrogen sulfide is a highly toxic, colorless, and flammable gas with a distinctive rotten-egg odor. Poisoning by hydrogen sulfide usually occurs by inhalation. Hydrogen sulfide affects all organs, but it has the most impact on the lungs and CNS.

Hydrogen sulfide occurs naturally in sewers, swamps, volcanoes, and crude petroleum. As discussed earlier, hydrogen sulfide poisoning is also a method used to commit suicide, referred to as chemical or detergent suicide. According to the Chemical Hazards Emergency Medical Management database, this method of self-inflicted exposure to toxic gas originated in Japan and has reached the United States via the Internet. The patient may obtain a warning sign to place near the area of the suicide, such as an enclosed vehicle, to warn responders of the deadly gas. If you approach an enclosed vehicle with an unconscious patient inside, be alert for warning signs, as well as containers, buckets, or pots. Remember, do not enter a scene where a toxic gas may be present. Be aware of your surroundings as you approach, and if you suspect the presence of a toxic gas, wait for a HazMat team to tell you the scene is safe.

Workers in industrial settings may experience low-level exposure to hydrogen sulfide over a long period of time, leading to eye, nose, and throat irritation, as well as headaches and bronchitis. Chronic exposure to this gas may cause an inability to smell the gas. When patients are exposed to high concentrations of the gas, they will experience nausea and vomiting, confusion, dyspnea, and a loss of consciousness. Seizures, shock, coma, and cardiopulmonary arrest may also result.

There is no antidote for hydrogen sulfide poisoning. Therefore, a HazMat team must quickly remove the patient from the contaminated area. Once the patient has been decontaminated, management is largely supportive. Monitor and assist the patient's respiratory and cardiovascular functions and provide rapid transport.

Sympathomimetics

Sympathomimetics are CNS stimulants that mimic the effects of the sympathetic (fight-or-flight) nervous system. These stimulants frequently cause hypertension, tachycardia, and dilated pupils. A **stimulant** is an agent that produces an excited state. Examples include amphetamine and methamphetamine (also called meth or ice), which are commonly taken by mouth. They are also injected by drug abusers in many cases. Sympathomimetic drugs are typically taken to make the user "feel good," improve task performance, suppress appetite, or prevent sleepiness. They may also produce irritability, anxiety, fear, lack of concentration, or seizures. Paranoia and delusions are common symptoms of sympathomimetic abuse. Other common examples include phentermine hydrochloride, an appetite suppressant, and amphetamine sulfate (Benzedrine), taken for weight control, narcolepsy, and chronic fatigue syndrome. Caffeine and phenylpropanolamine (a nasal decongestant) are mild sympathomimetics. So-called designer drugs such as 3,4-methylenedi-oxymethamphetamine (MDMA, known as ecstasy or Molly) are also frequently abused in the United States.

Sympathomimetic drugs are known by various street names that change often Table 21-4.

Cocaine, also called crystal, snow, freebase, rock, gold dust, blow, and lady, is one of the most addictive substances known. It may be taken in a number of different ways. Classically, it is inhaled into the nose and absorbed through the nasal mucosa, damaging tissue, causing nosebleeds, and ultimately destroying the nasal septum. It can also be injected intravenously or subcutaneously (skin popping). Cocaine can be absorbed through all mucous membranes and even across the skin. In any form, the immediate effects of a given dose, including excitement and euphoria, last less than an hour.

Table 21-4 Examples of Street Names for Sympathomimetics

Street Name	Drug Name
Adam	3,4-Methylenedioxy-methamphetamine (MDMA)
Angel Dust	Phencyclidine (PCP)
Bennies	Amphetamines
Coke	Cocaine
Crank	Crack cocaine, heroin, amphetamine, methamphetamine, methcathinone
DOM	4-Methyl-2,5-dimethoxyamphetamine
Ecstasy	MDMA
Eve	MDMA
Golden eagle	4-Methylthioamphetamine
Ice	Cocaine, crack cocaine, smokable methamphetamine, methamphetamine, MDMA, phencyclidine (PCP)
MDA	Methaqualone
Meth	Methamphetamine
Molly	MDMA
Speed	Crack cocaine, amphetamine, methamphetamine
Uppers	Amphetamines

Another method of abusing cocaine is by smoking it. Crack is pure cocaine. It melts at 93°F (33.9°C) and vaporizes at a slightly higher temperature. Therefore, crack is easily smoked. In this form, it reaches the capillary network of the lungs and can be absorbed into the body in seconds. The immediate outflow of blood from the heart speeds the drug to the brain, so its effect is felt at once. Smoked crack produces the most rapid means of absorption and, therefore, the most potent effect.

Acute cocaine overdose is a genuine emergency because patients are at high risk for seizures, cardiac dysrhythmias, and stroke. You may see blood pressure measurements as high as 250/150 mm Hg. Chronic cocaine abuse may cause hallucinations; patients with "cocaine bugs" think that bugs are crawling out of their skin.

Be aware patients who have been poisoned by a sympathomimetic may be paranoid, putting you and other health care providers in danger. Law enforcement officers should be at the scene to restrain the patient, if necessary. Do not leave the patient unattended and unmonitored during transport.

All of these patients need prompt transport to the emergency department. Give supplemental oxygen if necessary and be ready to provide suctioning. If the patient is already having a seizure, protect him or her against self-injury.

Synthetic Cathinones (Bath Salts)

Bath salts, or synthetic cathinones, refer to an emerging class of drugs similar to MDMA. The drug commonly includes the chemical methylenedioxypyrovalerone (MDPV). Bath salts should not be confused with products such as Epsom salt (magnesium sulfate), although selling it under this umbrella label has allowed its manufacturers and users to escape the legal restrictions imposed on illicit drugs. Brand names include Ivory Wave and Cloud Nine. Many states are working to make it illegal to manufacture or possess this drug.

Bath salts produce euphoria, increased mental clarity, and sexual arousal. Most users of this drug snort or insufflate the powder nasally. The effects reportedly last as long as 48 hours. Adverse effects include teeth grinding, appetite loss, muscle twitching, lip-smacking, confusion, gastrointestinal conditions, paranoia, headache, elevated heart rate, and hallucinations.

Keep the patient calm and transport. Consider ALS assistance; some of these patients may require chemical restraint to facilitate safe transport.

Marijuana

The flowering hemp plant, *Cannabis sativa*, called marijuana, is abused throughout the world. According to the Pew Research Center, nearly half (49%) of Americans say they have tried marijuana. Tetrahydrocannabinol, or THC, is the chemical in the marijuana plant that produces its high. Inhaling marijuana smoke from a cigarette or pipe produces euphoria, relaxation, and drowsiness. It also impairs short-term memory and the capacity to do complex thinking and work. In some people, the euphoria progresses to depression and confusion. An altered perception of time is common, and anxiety and panic can occur. With very high doses, some patients may experience hallucinations or become very anxious or paranoid. In these cases, keep the patient calm and provide transport. However, be aware that marijuana is often used as a vehicle to get other drugs into the body. For example, it may be laced with crack or PCP.

Several states have legalized the recreational use of marijuana, and many others allow for the medical use of marijuana and products that contain THC. As the move toward legalization continues and as people become more aware of the health risks associated with smoking, delivery methods have evolved. Many medical users opt against smoking marijuana and instead obtain THC in the form of "edibles" or baked goods, candies, and other food additives that have been infused with marijuana. However, the ingestion of marijuana can lead to *cannabinoid hyperemesis syndrome*, characterized by chronic marijuana use and extreme nausea and vomiting that is relieved only by a hot shower or bath. Bathing can become compulsive in these patients. The definitive treatment for this condition is to stop using marijuana; however, these users often believe that more marijuana will help the nausea and continue to consume it.

Synthetic marijuana or "Spice" refers to a variety of herbal incense or smoking blends that resemble THC and produce a similar high. Synthetic marijuana is often marketed as a "safe" alternative to that drug under brand names such as K2 and Skunk. However, according to NIDA, the chemicals commonly found in Spice products have no medical benefit and have a high potential for abuse. Therefore, powerful and unpredictable effects may result, ranging from simple euphoria to complete loss of consciousness.

Hallucinogens

Hallucinogens alter a person's sensory perceptions Table 21-5. The classic hallucinogen is lysergic acid diethylamide (LSD). Abuse of another hallucinogen, phencyclidine (PCP, or angel dust), is relatively uncommon among young adults. PCP is a dissociative anesthetic that is easily synthesized and highly potent. Its effectiveness by oral, nasal, pulmonary, and intravenous routes makes it easy to add to other street drugs. It is dangerous because it causes severe behavioral changes in which people often inflict injury on themselves.

All these agents cause visual hallucinations, intensify vision and hearing, and generally separate the user from reality. The user, of course, expects that the altered sensory state will be pleasurable. Often, however, it can be terrifying. At some point, you are bound to encounter patients who are having a "bad trip." They will usually have hypertension, tachycardia, anxiety, and paranoia.

Many hallucinogens have sympathomimetic properties. Your care for a patient who is having a bad reaction to a hallucinogenic agent is the same as that for a patient who has taken a sympathomimetic. Use a calm, professional manner, and provide emotional support. Do not use restraints unless you or the patient is in danger of injury. Follow the guidelines specified by local authorities. These patients may suddenly experience hallucinations or odd perceptions, so watch them carefully throughout transport. Never leave a patient who has taken a hallucinogen unattended and unmonitored. Request ALS assistance when appropriate.

Table 21-5 Commonly Abused Hallucinogens

Bufotenine (toad skin)
Dextromethorphan (DXM)
Dimethyltryptamine (DMT)
Hashish
Datura stramonium (jimsonweed)
LSD
Marijuana
Mescaline (peyote)
Morning glory
Nutmeg
PCP
Psilocybin (mushrooms)

▶ Anticholinergic Agents

Anticholinergic agents are medications that block the parasympathetic nerves. The classic picture of a person who has taken too much of an anticholinergic medication is "hot as a hare, blind as a bat, dry as a bone, red as a beet, and mad as a hatter." In other words, the patient will exhibit hypothermia, dilated pupils, dry skin and mucous membranes, reddened skin, and agitation or delirium. Common drugs with a significant anticholinergic effect include atropine, antihistamines such as diphenhydramine (Benadryl), *Datura stramonium* (jimsonweed), and certain tricyclic antidepressants such as amitriptyline (Elavil). With the exception of jimsonweed, these medications usually are not abused drugs but may be taken as an intentional overdose. It is often difficult to distinguish between an anticholinergic overdose and a sympathomimetic overdose. Both groups of patients may be agitated and have tachycardia and dilated pupils.

As newer, safer antidepressants are added to the market, you can expect to see fewer overdoses of tricyclic antidepressants. In addition to its anticholinergic effects, a tricyclic antidepressant overdose may cause more serious and life-threatening effects because the medication may block the electrical conduction system in the heart, leading to lethal cardiac dysrhythmias. Patients with acute tricyclic antidepressant overdose must be transported immediately to the emergency department; they may appear "normal," but seizure and death can occur within 30 minutes. The seizures and cardiac dysrhythmias caused by a severe tricyclic antidepressant overdose are best treated in the hospital. If you work in a tiered system, consider calling for ALS backup when you are en route to the scene.

▶ Cholinergic Agents

Cholinergic agents are medications that overstimulate the normal body functions controlled by the parasympathetic nervous system. These agents have been used for chemical warfare, such as during the sarin gas attack on the Tokyo subway system in 1995. These agents also occur in organophosphate insecticides, which are commonly used for lawn and garden care. A patient who has been poisoned by a cholinergic agent will exhibit excessive salivation or drooling; mucous membrane oversecretion, resulting in a runny nose (rhinorrhea); excessive urination; excessive tearing of the eyes; uncontrolled diarrhea; and an abnormal heart rate. The signs and symptoms of cholinergic drug poisoning are easy to remember using the mnemonic DUMBELS:

D Diarrhea

U Urination

M Miosis (constriction of the pupils), muscle weakness

B Bradycardia, bronchospasm, bronchorrhea (discharge of mucus from the lungs)

E Emesis (vomiting)

L Lacrimation (excessive tearing)

S Seizures, salivation, sweating

Alternatively, you can use the mnemonic SLUDGEM:

S Salivation, sweating

L Lacrimation (excessive tearing)

U Urination

D Defecation, drooling, diarrhea

G Gastric upset and cramps

E Emesis (vomiting)

M Muscle twitching/miosis (pinpoint pupils)

Patients who have been poisoned will have excessive body secretions. In addition, patients may have bradycardia.

The most important consideration in caring for a patient who has been exposed to a cholinergic agent is to avoid exposure yourself. Because these agents may cling to a patient's clothing and skin, decontamination will take priority over prompt transport to the emergency department. In many jurisdictions, the HazMat team will provide decontamination and contain the exposure chemical.

To care for the exposed patient, hospital staff or paramedics can use the anticholinergic drug atropine to dry up the patient's secretions, followed by the use of pralidoxime to reverse the nerve agent's effect on the patient's nervous system. In the meantime, your priorities after decontamination are to decrease the secretions in the mouth and trachea that threaten to suffocate the patient and provide airway support.

The military has developed antidotes to nerve gas agents that responders can self-administer if the agents are available. In some areas across the country, these kits are issued to emergency medical providers depending on local protocols. The most common kit is the DuoDote Auto-Injector. The Antidote Treatment Nerve Agent Auto-Injector (ATNAA) is the military form of the DuoDote Auto-Injector.

The DuoDote Auto-Injector is a single auto-injector containing 2 mg of atropine and 600 mg of pralidoxime. If a known exposure to nerve agents or organophosphates with manifestation of signs and symptoms has occurred, use the antidote kit only on yourself. If your service carries these antidote kits, you should receive training on their proper use prior to administering them.

Miscellaneous Drugs

Accidental or intentional overdose with cardiac medications has become common because there are so many patients who have these medications prescribed for them. For example, children may ingest these medications at their grandparent's house, thinking they are candy. Another common scenario is older patients who have forgotten they have already taken their medication and take a second dose. Occasionally people wanting to commit suicide will take an overdose of cardiac medications if that is all they have available. The signs and symptoms of cardiac medication overdose depend on the medication ingested. These drugs may cause bleeding, cardiac dysrhythmias, unconsciousness, and even cardiac arrest. Most of these medications are powerful, so contact the poison center as soon as possible. Depending on local protocol, you may be ordered to administer activated charcoal, but check with the poison center first.

Aspirin poisoning is a potentially lethal condition. Ingesting too many aspirin tablets, acutely or chronically, is an emergency that may result in nausea, vomiting, hyperventilation, and ringing in the ears. Patients with this condition frequently have anxiety, confusion, tachypnea, and hyperthermia, and are in danger of having seizures. Rapidly transport these patients to the hospital.

When consumed in excess, acetaminophen becomes toxic. Overdosing with acetaminophen and combination medications containing acetaminophen is also common. According to the US Food and Drug Administration, acetaminophen is among the top 25 substances with the largest number of fatalities due to poisoning.

It is essential to determine what medications the patient takes or has taken, including OTC medications. Acetaminophen overdose, unintentional or intentional, must be treated promptly and aggressively.

Accidental acetaminophen overdose is as serious as intentional overdose. In fact, its effects can be worse because the patient is unaware of the continuous exposure to the toxin. For example, massive liver failure may not be apparent for a full week. In addition, patients may not provide the information necessary for a correct diagnosis. For this reason, gathering information at the scene is very important. By finding an empty acetaminophen bottle, you may save a patient's life. If a specific antidote is given early enough (before liver failure occurs), liver damage may be prevented.

Some alcohols, including methyl alcohol and ethylene glycol, are even more toxic than ethyl alcohol (drinking alcohol). Methyl alcohol is found in dry gas products and stove kits (Sterno); ethylene glycol is found in some antifreeze products. Both cause a feeling of intoxication. Left untreated, both will also cause severe tachypnea, blindness (methyl alcohol), renal failure (ethylene glycol), and eventually death. Even ethyl alcohol can stop a patient's breathing if taken in too high a dose or too fast, particularly in children. Although methyl alcohol or ethylene glycol may be used as a substitute by a chronic alcoholic who is unable to obtain ethyl alcohol, they are more often taken by someone attempting suicide. In either case, prompt transport to the emergency department is essential. Table 21-6 lists the most common fatally ingested poisons.

Food Poisoning

The term *ptomaine poisoning* was coined in 1870 to indicate poisoning by a class of chemicals found in rotting food. It is still used today in many news accounts of food poisoning. Food poisoning is almost always caused by eating food that is contaminated by bacteria. The food may appear normal, with little or no decay or odor to suggest danger.

There are two main types of food poisoning. In one, the organism itself causes disease; in the other, the organism produces toxins that cause disease Table 21-7.

One organism that produces direct effects of food poisoning is the *Salmonella* bacterium. Salmonellosis is a condition characterized by severe gastrointestinal symptoms within 72 hours of ingestion, including nausea, vomiting, abdominal pain, and diarrhea. In addition, patients with salmonellosis may be systemically ill with fever and generalized weakness. Some people are carriers of certain bacteria; although they may not become ill themselves, they may transmit diseases, particularly if they work in the food services industry. Usually, proper cooking kills bacteria, and proper cleanliness in the kitchen prevents the contamination of uncooked foods.

Table 21-6 Examples of Fatally Ingested Poisons

Benzocaine
Calcium channel blockers (verapamil, nifedipine, diltiazem)
Camphor
Chloroquine
Hydrocarbon solvents
Diphenoxylate-atropine (Lomotil)
Methanol and ethylene glycol
Methylsalicylate (oil of wintergreen)
Phenothiazines (eg, Thorazine)
Quinine
Theophylline
Tricyclic antidepressants (amitriptyline [Elavil], imipramine [Tofranil], nortriptyline [Pamelor])

Data From: Olson, Kent R. *Poisoning & Drug Overdose*. 6th ed. New York: McGraw-Hill Medical, 2011.

YOU are the Provider PART 5

You begin transport to the hospital, which is located a short distance away. You and your partner watch the patient closely because she has been retching and her airway may become an issue if she vomits. You reassess the patient. Her IV line continues to flow and is patent, she is on the cardiac monitor, and her vital signs remain normal. You call in your radio report to the hospital. The estimated time of arrival is 6 minutes.

Recording Time: 17 Minutes	
Level of consciousness	Conscious, but sleepy
Respirations	14 breaths/min; adequate depth
Pulse	72 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	108/60 mm Hg
Spo_2	**97% (on oxygen)**

9. What additional treatment is required for this patient?
10. What information should you relay to the hospital staff during your verbal report?

Table 21-7 Common Causes of Food Poisoning
Campylobacter
Clostridium botulinum toxin
Clostridium perfringens
Cryptosporidium
Cyclospora
Escherichia coli
Giardia lamblia
Listeria monocytogenes
Norovirus
Rotavirus
Salmonella
Shigella
Staphylococcus toxin
Vibrio parahaemolyticus
Yersinia enterocolitica

The more common cause of food poisoning is the ingestion of powerful toxins produced by bacteria, often in leftovers. The bacterium *Staphylococcus*, a common culprit, is quick to grow and produce toxins in foods that have been prepared in advance and kept too long, even in the refrigerator. Foods left unrefrigerated are a common vehicle for the development of staphylococcal toxins. Usually, staphylococcal food poisoning results in sudden gastrointestinal symptoms, including nausea, vomiting, and diarrhea. Although time frames may vary from person to person, these symptoms usually start within 2 to 3 hours after ingestion or as long as 8 to 12 hours after ingestion.

The most severe form of toxin ingestion is botulism. This often-fatal disease usually results from eating improperly canned food, in which the spores of *Clostridium* bacteria have grown and produced a toxin. The symptoms of botulism are neurologic: blurring of vision, weakness, and difficulty in speaking and breathing. Botulism can also cause muscle paralysis and is typically fatal when it reaches the muscles of respiration. Symptoms of botulism may develop as long as 4 days after ingestion or as early as the first 24 hours.

In general, do not try to determine the specific cause of acute gastrointestinal conditions. After all, severe vomiting may be a sign of food poisoning, a bowel obstruction requiring surgery, or poisoning by substances such as copper, arsenic, zinc, cadmium, scombrotoxin (fish poison), or *Clitocybe* or *Inocybe* mushrooms. Instead, gather as much history as possible from the patient and transport him or her promptly to the hospital. When two or more people in one group have the same illness, take along some of the suspected food to the hospital. In advanced cases of botulism, you may have to assist ventilation and give basic life support.

Special Populations

Geriatric patients are susceptible to toxicity for a number of reasons. Consider the case of an accidental overdose or poisoning. The older patient may have forgotten that the medication had been taken and take repeated doses. Alcohol abuse can make a patient more likely to make medication mistakes. Many older patients take multiple prescriptions that may negatively interfere with each other, resulting in increased effects or unwanted drug interactions. The aging process may also impair the older patient's ability to metabolize or excrete the poison. The drug could quickly accumulate to toxic levels and become fatal in lesser doses than in a younger person. Chapter 35, Geriatric Emergencies, discusses these risk factors in more detail.

If an older person inhales a poison, even in tiny quantities, lung damage can be severe. Consider the decreased lung capacity and ability to exchange oxygen and carbon dioxide in an older patient's lungs. Pulmonary function could be worsened to potentially fatal levels with the inhalation of minute amounts of poison. For poisons that are absorbed by or injected into the skin, reduced circulation to the skin can decrease or delay absorption into the body. Watch for an increased reaction or irritation at the skin site.

A geriatric patient may also intentionally overdose in an attempt to commit suicide. Be alert for any indication of an intentional overdose or poisoning, even though the patient might deny an attempted suicide.

Special Populations

Small children or toddlers may experience accidental poisoning due to their natural curiosity. Children at this age commonly put objects in their mouth as a means to learn about them. When they gain access to toxic substances, they will almost always ingest them. Most parents and caregivers are aware of these dangers and properly secure cabinets or store substances out of reach, but often grandparents or older adults without children will store household chemicals in easy-to-reach, lower cabinets without locks. This creates a serious hazard when young children visit. It is fortunate that most accidental poisonings of children are not fatal. Avoid blaming the adults and focus instead on treating the child in the most appropriate manner.

Plant Poisoning

According to the National Poison Data System, tens of thousands of cases of poisoning from plants occur each year, some severe. Many household plants are poisonous if ingested; children have been known to nibble on the leaves **Table 21-8**. Some poisonous plants cause local irritation of the skin; others can affect the circulatory system, the gastrointestinal tract, or the CNS. It is impossible for you to memorize every plant and poison, let alone their effects **Figure 21-10**. You can and should do the following:

1. Assess the patient's airway and vital signs.
2. Notify the regional poison center for assistance in identifying the plant.
3. Take the plant to the emergency department.
4. Provide prompt transport.

Irritation of the skin and/or mucous membranes is a problem with the common houseplant called dieffenbachia, which resembles elephant ears. When chewed, a single leaf may irritate the lining of the upper airway enough to cause difficulty swallowing, breathing, and speaking. For this reason, dieffenbachia has been called Dumb Cane. In rare circumstances, the airway may be completely obstructed. Emergency medical treatment of dieffenbachia poisoning includes maintaining an open airway, giving oxygen when necessary, and transporting the patient promptly to the hospital for respiratory support. Assess the patient for airway difficulties throughout transport. If necessary, provide positive-pressure ventilation.

Table 21-8 Common Toxic Plants

Scientific Name	Common Name
Abrus precatorius	Jequirity bean/rosary pea
Cicuta species	Water hemlock/wild carrot
Colchicum autumnalel	Autumn crocus
Conium maculatum	Poison hemlock
Convallaria majalis	Lily of the valley
Datura species	Jimsonweed/stinkweed
Dieffenbachia	Dumbcane
Digitalis purpurea	Foxglove
Nerium oleander	Oleander or rose laurel
Nicotiana glauca	Tree tobacco
Phoradendron	Mistletoe
Phytolacca americana	Pokeweed
Rhododendron	Rhododendron or azalea
Ricinus communis	Castor bean
Solarium nigrum	Nightshade
Zygadenus species	Death camas

Data From: U.S. Food and Drug Administration. FDA Poisonous Plant Database. http://www.accessdata.fda.gov/scripts/plantox/textResults.cfm. Accessed 10/16/15.

Figure 21-10 The toxins in these common poisonous plants are often ingested or absorbed through the skin. **A.** Dieffenbachia. **B.** Mistletoe. **C.** Castor bean.

A: © Andriy Doriy/ShutterStock; B: © Robert Johnson/ShutterStock; C: Courtesy of Brian Prechtel/USDA.

Figure 21-10 **D.** Nightshade. **E.** Foxglove. **F.** Rhododendron. **G.** Jimsonweed. **H.** Death camas. **I.** Poison ivy. **J.** Poison oak. **K.** Pokeweed. **L.** Rosary pea. **M.** Poison sumac.

1. In addition to providing immediate lifesaving treatment, what else should you do when you arrive at this scene?

Never make assumptions about the scene. Although the home is located in an affluent neighborhood with law enforcement officers available at the scene, always remember that your safety is of the utmost importance. If possible, obtain information from family members or bystanders at the scene. This information is essential to the proper treatment of your patient. In this case, the father reported that he was awakened when the patient and her friends came home from a party and were making a lot of noise. A full secondary assessment may reveal other injuries that are not apparent. Since both parents are available, obtain a full SAMPLE history.

2. How can knowledge of various signs and symptoms caused by different types of medications improve the care you provide to a patient?

When you assess a patient who has overdosed on a medication or other substance, a careful assessment may help you identify a series of signs and symptoms that indicate a particular type of toxic exposure—thereby allowing you to direct your treatment accordingly.

3. On the basis of your initial assessment, what is the most appropriate treatment for this patient?

Your patient is sleepy and not responding without stimulation she has vomited but her airway is currently patent. Her ventilation status is inadequate and requires immediate attention.

With the help of your partner and the members of the fire crew, position the patient supine. Ensure the patient and other providers are not injured in the process. You have assigned a firefighter to manage her airway with a BVM and an airway adjunct as she does not have a gag reflex. An IV line will need to be established and a blood glucose level determined. This patient requires aggressive treatment and monitoring.

4. On the basis of the patient's initial presentation, what type of drug should you suspect that she overdosed on?

On the basis of the patient's initial presentation—unconsciousness, hypoventilation, and pinpoint pupils—you should suspect that she has overdosed on an opiate or opioid. As an EMT, your job is to recognize the signs and symptoms that are associated with these types of drugs, begin immediate treatment to support the ABCs, and transport the patient to the hospital without delay.

5. Would activated charcoal benefit this patient? Why or why not?

There are several reasons why activated charcoal is not indicated for this patient. First, the patient is unconscious, is unable to protect her own airway, and clearly cannot swallow. Pouring anything into her mouth would lead to aspiration, thus substantially increasing her chance of death.

On the basis of the patient's clinical presentation, it is clear that at least some of the medications she ingested are no longer in her stomach. She is now experiencing systemic effects that are causing compromise of her breathing and circulatory status.

6. Why is naloxone being given to this patient?

Naloxone blocks opiate receptors in the body and reverses the effects of an opioid overdose. The patient's presentation indicates that one (or many) of the unknown medications she ingested is a narcotic; therefore, naloxone is indicated.

7. What other issues about this patient should concern you?

Although the patient's condition has improved following the administration of naloxone, the fact remains that she also ingested an unknown quantity of unknown medications. By no means is she out of danger.

8. How would this patient's presentation have differed had she overdosed on a sympathomimetic?

Unlike CNS depressants, sympathomimetics are CNS stimulants. A sympathomimetic is any substance that mimics the effects of the sympathetic (fight or flight) nervous system. When the sympathetic nervous system is stimulated, it releases epinephrine and norepinephrine, resulting in hypertension, tachycardia, and restlessness or agitation.

Had the patient overdosed on a sympathomimetic, her clinical presentation would have been the exact opposite. Her vital functions, such as breathing, heart rate, and blood pressure, would have significantly increased. Furthermore, she would likely have experienced paranoia, delusions, and disorganized behavior.

9. What additional treatment is required for this patient?

Further treatment for this patient is mainly supportive; closely monitor her ABCs and be alert for the recurrence of CNS depression (eg, decreased level of consciousness, hypoventilation, hypotension). Monitor her vital signs at regular intervals.

Naloxone is a short-acting reversal agent when compared with most opiate/narcotics. Assisted ventilation and additional naloxone may be required if the patient lapses back into CNS depression. The paramedic who is monitoring the patient's cardiac rhythm may need to give additional medications if the patient develops a cardiac dysrhythmia.

10. What information should you relay to the hospital staff during your verbal report?

Your verbal (hand-off) report at the hospital should be more in-depth than what was provided over the radio. Advise the receiving nurse or physician of how you found the patient, what you initially did to treat her, and how she responded to your treatment.

Inform the hospital staff of the patient's condition en route to the hospital, and advise them of any changes—good or bad—that may have occurred after you gave your radio report.

EMS Patient Care Report (PCR)

Date: 12-04-16	**Incident No.:** 03188	**Nature of Call:** "Flulike symptoms"		**Location:** 1968 Holly Creek Place	
Dispatched: 0220	**En Route:** 0222	**At Scene:** 0226	**Transport:** 0240	**At Hospital:** 0249	**In Service:** 0301

Patient Information

Age: 17 **Sex:** F **Weight (in kg [lb]):** 49 kg (108 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** None **Chief Complaint:** Patient unconscious; mother reports one episode of vomiting

Vital Signs

Time: 0232	**BP:** 96/50	**Pulse:** 116	**Respirations:** 0	**Spo_2:** 91%
Time: 0237	**BP:** 108/52	**Pulse:** 84	**Respirations:** 12	**Spo_2:** 96%
Time: 0243	**BP:** 108/60	**Pulse:** 72	**Respirations:** 14	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** IV therapy, 2 mg Narcan cardiac monitoring, blood glucose assessment

Narrative

Medic 504 dispatched to a single-family home for "flulike symptoms." Accessed community through security gate and was escorted to scene with Engine 11 by community security guard. Law enforcement was also on scene. Found the patient, a 17-year-old girl, sitting slouched on a couch with her mother. Her mother reported the patient was "sleepy" and had vomited once. Vomit contained colored pill fragments. Assessment of the patient revealed she was unresponsive; her airway was clear of emesis. She had snoring respirations as we entered the home. Subsequently, all respirations ceased. Patient was moved to floor, her airway was secured manually, and an oral airway was inserted. Ventilation was provided via BVM and high-flow oxygen. Patient's pulse was weak and slow but increased as ventilations were assisted.

Obtained vital signs as partner established IV access. A bystander stated he and the patient went to a "skittle party," where the teenagers brought an assortment of pills from home and took as many as they wanted to get high. Bystander also stated they were drinking beer and liquor. Secondary assessment revealed pinpoint pupils, but was otherwise unremarkable. No medical alert bracelets were found on the patient. Blood glucose level was assessed and was noted to read 112 mg/dL.

After IV access was established, the paramedic administered naloxone by titration in 0.4 mg amounts until respirations were achieved. The total amount of naloxone given was 2 mg.

Reassessment of patient revealed that her level of consciousness, heart rate, blood pressure, and oxygen saturation had improved. She no longer tolerated the oral airway or BVM-assisted ventilation. The patient was placed on high-flow oxygen via nonrebreathing mask. Cardiac rhythm was monitored by the paramedic.

Patient was loaded into the ambulance. Departed the scene and continued treatment en route. Reassessment revealed the patient remained conscious but sleepy. Her airway was patent and her breathing and pulse were adequate. We continued oxygen therapy and monitored patient's vital signs for the duration of the transport. Patient was delivered to the emergency department staff without incident; her condition was improving. Gave verbal report to charge nurse. Medic 504 cleared the hospital and returned to service at 0301.**End of report**

Prep Kit

Ready for Review

- Poisons act acutely or chronically to destroy or impair body cells.
- If you believe a patient may have taken a poisonous substance, support the ABCs and notify medical control.
- Management of the patient also entails collecting any evidence of the type of poison that was used and taking it to the hospital; diluting and physically removing the poisonous agent; providing respiratory support; and transporting the patient promptly to the hospital.
- Emergency treatment may include administration of an antidote, usually at the hospital, if an antidote exists.
- A poison can be introduced into the body in one of four ways:
  - Inhalation
  - Absorption (surface contact)
  - Ingestion
  - Injection
- It is impossible to remove or dilute injected poisons from the body, a fact that makes these cases especially urgent.
- Always consult medical control before you proceed with the treatment of a patient who has been poisoned.
- Move patients who have inhaled poison to fresh air; be prepared to use supplemental oxygen via a nonrebreathing mask and/or ventilatory support via a BVM if necessary.
- With absorbed or surface contact poisons, be sure to avoid contaminating yourself. Remove all contaminated substances and clothing from the patient, and flood the affected part.
- Approximately 80% of all poisonings are by ingestion, including plants, contaminated food, and most drugs. If permitted by local protocol, give activated charcoal to these patients.
- People who abuse a substance can develop a tolerance to it or can develop an addiction.
- One of the most commonly abused drugs in the United States is alcohol. It can depress the CNS and can cause respiratory depression. You must support the airway in such cases, and be prepared for the patient to vomit.
- Opioids, opiates, sedative-hypnotic drugs, and abused inhalants can also depress the CNS and can cause respiratory depression.
- Naloxone is an antidote that reverses the effects of opiate or opioid overdose. Indications for this drug include agonal respirations or apnea. Ventilate the patient prior to administration to minimize hypoxia.
- Take special care with patients who have used inhalants because the drugs may cause seizures or sudden death.
- Sympathomimetics, including cocaine, stimulate the CNS, causing hypertension, tachycardia, seizures, and dilated pupils. Patients who have taken these drugs may be paranoid, as may patients who have taken hallucinogens.
- Anticholinergic medications, often taken in suicide attempts, can cause a person to become hot, dry, blind, red-faced, and mentally unbalanced. An overdose of tricyclic antidepressants can lead to cardiac dysrhythmias.
- The symptoms of cholinergic medications, which include organophosphate insecticides, can be remembered by the mnemonic DUMBELS, for excessive Diarrhea, Urination, Miosis/muscle weakness, Bradycardia/bronchospasm/bronchorrhea, Emesis, Lacrimation, and Seizures/salivation/sweating; or SLUDGEM, for Salivation/sweating, Lacrimation, Urination, Defecation/drooling/diarrhea, Gastric upset and cramps, Emesis, and Muscle twitching/ miosis.
- Two main types of food poisoning cause gastrointestinal symptoms.
  - In one type, bacteria in the food directly cause disease, such as salmonellosis; in the other, bacteria such as *Staphylococcus* produce powerful toxins, often in leftover food.
  - The most severe form of toxin ingestion is botulism; the first neurologic symptoms may appear as late as 4 days after ingestion.
- Plant poisoning can affect the circulatory system, the gastrointestinal system, and the CNS. Some plants, such as the dieffenbachia, irritate the skin or mucous membranes and may cause obstruction of the airway.
- Always remember the importance of scene safety.

Vital Vocabulary

addiction A state of overwhelming obsession or physical need to continue the use of a substance.

antidote A substance that is used to neutralize or counteract a poison.

delirium tremens (DTs) A severe withdrawal syndrome seen in alcoholics who are deprived of ethyl alcohol; characterized by restlessness, fever, sweating, disorientation, agitation, and seizures; can be fatal if untreated.

emesis Vomiting.

hallucinogen An agent that produce false perceptions in any one of the five senses.

hematemesis Vomiting blood.

hypnotic A sleep-inducing effect or agent.

ingestion Swallowing; taking a substance by mouth.

material safety data sheet (MSDS) A form, provided by manufacturers and compounders (blenders) of chemicals, containing information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal of a specific material; also known as a safety data sheet (SDS).

narcotic A drug that produces sleep or altered mental consciousness.

opiate A subset of the opioid family, referring to natural, non-synthetic opioids.

opioid A synthetically-produced narcotic medication, drug, or agent similar to the opiate morphine, but not derived from opium; used to relieve pain.

overdose An excessive quantity of a drug that, when taken or administered, can have toxic or lethal consequences.

poison A substance whose chemical action could damage structures or impair function when introduced into the body.

sedative A substance that decreases activity and excitement.

stimulant An agent that produces an excited state.

substance abuse The misuse of any substance to produce a desired effect.

tolerance The need for increasing amounts of a drug to obtain the same effect.

toxicology The study of toxic or poisonous substances.

toxin A poison or harmful substance produced by bacteria, animals, or plants.

Assessment *in Action*

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It is midmorning on a bright and sunny autumn day and your unit is dispatched to a park on East 14^{th} Street for an unknown medical emergency. As you arrive, you see three middle-aged men sitting on a park bench. A police officer is on scene and tells you it is safe to approach. You notice one of the men appears to be looking straight up. The man next to him grabs his head and repositions it so he is facing forward. You can see the man is not moving or breathing. While your partner opens the airway bag, you and the police officer move the patient from the park bench onto the ambulance cot. Once the patient is positioned, your partner begins assisting the man's respirations.

1. As you load the patient into the ambulance, what should you do to assist your partner?

   A. Prepare an IV setup.
   B. Place the patient on the cardiac monitor.
   C. Begin a detailed assessment.
   D. Take vital signs.

2. As you assess the patient, you notice he has pinpoint pupils. You suspect a drug overdose. What drug is the likely cause of this phenomenon?

   A. Cocaine
   B. Methamphetamine
   C. Heroin
   D. Alcohol

3. What is another sign of substance abuse that will make it difficult for your partner to establish IV access in this patient?

   A. Tachycardia
   B. Nausea and/or vomiting
   C. Venous scarring (track marks)
   D. Hypotension

4. What is the duration of action of naloxone?

   A. 30 minutes to 9 hours
   B. 30 minutes to 7 hours
   C. 30 minutes to 5 hours
   D. 30 minutes to 1 hours

5. You are dispatched to an address known for being a place where illicit drugs are purchased. You arrive at the scene prior to fire or police personnel and see several people outside the building. They are yelling and directing you and your partner inside, where the patient is located. What is the best course of action?

   A. Enter the building, find the patient, and begin assessment.
   B. Park the ambulance in front of the building and remain inside the vehicle.
   C. Stage around the corner and wait for police to declare the scene safe.
   D. Investigate the scene to determine whether it is safe.

6. Imagine a patient has taken 10 tablets of diazepam. He is sleepy and having trouble managing his airway while sitting up. You secure his airway by laying him down on your ambulance cot in a sniffing position with a nonrebreathing mask. Will the antidote naloxone work for this overdose?

   A. Yes
   B. No

7. Explain delirium tremens, including common symptoms and how to monitor the patient during transport.
8. Describe the four routes by which poisons can enter the body and provide examples of poisons for each route.
9. List and discuss two commonly abused hallucinogens.
10. Describe the safest method to administer naloxone to a patient who has overdosed on an injectable opioid drug and has no recognizable sites for IV access.

CHAPTER

22

Psychiatric Emergencies

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Psychiatric

Recognition of

› Behaviors that pose a risk to the EMT, patient, or others (pp 804, 810–811, 815–818)
› Basic principles of the mental health system (p 804)
› Assessment and management of
  - Acute psychosis (pp 806–811)
  - Suicidal/risk (pp 806–810, 816–818)
  - Agitated delirium (pp 806–811)

Knowledge Objectives

1. Discuss the myths and realities concerning psychiatric emergencies. (p 803)
2. Discuss general factors that can cause alteration in a patient's behavior. (p 804)
3. Define a behavioral crisis. (p 804)
4. Recognize the magnitude of mental health disorders in society. (p 804)
5. Know the main principles of how the mental health care system functions. (p 804)
6. Know the two basic categories of diagnosis that a mental health professional will use. (p 805)
7. Explain special considerations for assessing and managing a behavioral crisis or psychiatric emergency. (pp 806–810)
8. Define acute psychosis. (p 810)
9. Define schizophrenia. (p 810)
10. Explain the care for a psychotic patient. (pp 810–811)

11. Define excited delirium or agitated delirium. (p 811)
12. Explain the care for a patient with excited delirium. (p 811)
13. Describe methods used to restrain patients. (pp 811–815)
14. Know the main principles of care for the agitated, violent, or uncooperative patient. (pp 815–816)
15. Explain how to recognize the behavior of a patient at risk of suicide, including the management of such a patient. (pp 816–818)
16. Recognize issues specific to posttraumatic stress disorder (PTSD) and the returning combat veteran. (pp 818–820)
17. Discuss the medical and legal aspects of managing a psychiatric emergency. (pp 820–821)

Skills Objective

1. Demonstrate the techniques used to mechanically restrain a patient. (pp 814–815, Skill Drill 22-1)

Introduction

As an EMT, you will care for patients experiencing a behavioral crisis or psychiatric emergency. The crisis may be the result of an acute medical situation, mental illness, mind-altering substances, stress, or other causes. This chapter discusses various kinds of psychiatric emergencies and behavioral crises, including those involving drug overdoses, violent behavior, and different forms of mental illness. You will learn how to assess a person who exhibits signs and symptoms of a psychiatric emergency or a behavioral crisis and understand what kind of emergency care may be required in these situations. The chapter also covers legal concerns in dealing with psychiatric emergencies, the dangers of suicide, and issues related to posttraumatic stress disorder. Finally, you will learn how to identify and manage a potentially violent patient, including the use of restraints.

Myth and Reality

At some point, most people experience an emotional crisis, but only rarely does this crisis lead to mental illness. Otherwise healthy people may sustain acute or temporary mental health disorders. Therefore, you should not jump to the conclusion that a patient is mentally ill when exhibiting behaviors discussed in this chapter.

The most common misconception about mental illness is that if you are feeling bad or depressed, you must be “sick.” That is simply not true. There are many perfectly justifiable reasons for feeling depressed, including divorce or the death of a relative or friend. For a teenager who just broke up with his girlfriend of 12 months, it is altogether normal to withdraw from ordinary activities and to feel down for a while. This is a normal reaction to an acute crisis situation. However, when a person finds that the majority of his or her days are characterized by sadness, week after week, he or she may indeed have a mental health problem.

Some people believe anyone with a mental health disorder is dangerous, violent, or otherwise unmanageable. This is also not true. Only a small percentage of people with mental health problems fall into these categories. However, as an EMT, you may be exposed to a higher proportion of violent patients because you are seeing people who are, by definition, considered to be having a behavioral crisis; otherwise, you probably would not be seeing them. You have been called because family members or friends felt unable to manage the patient on their own. The situation may be a result of drug or alcohol use or abuse or medication noncompliance, or the patient may have a long history of mental illness and is reacting to a particularly stressful event.

It is easy to assume the patient having a behavioral crisis does not understand the situation or the message you are trying to convey. However, especially during an acute crisis, many patients still have awareness and understanding. Communication is key. Never make disparaging or inappropriate statements. It is not only poor patient care, but could escalate the situation. You may be able to calm the patient with reassurances and avoid restraints or other physical interactions that can be a danger to you or the patient. In some cases patients will de-escalate when a level of trust is established.

Although you cannot determine what has caused a person’s crisis, you may be able to predict whether the person will become violent. The ability to predict violence is one of your more important assessment tools.

YOU are the Provider — PART 1

At 1920 hours, you are dispatched to 517 East Bandera for a man who, according to a neighbor, is sitting in his yard “acting bizarre.” Law enforcement is en route to the scene but has not yet arrived. You and your partner acknowledge the call, get into the ambulance, and proceed to the scene. The weather is clear, the temperature is 70°F (21°C), and the traffic is moderate.

1. How should you and your partner proceed to this call?
2. Other than an underlying psychiatric condition, what other conditions can affect a person's behavior?

Words of Wisdom

Many people have psychological challenges later in life. They may suffer from the loss of a spouse, have serious health conditions that affect their quality of life, have financial troubles, and/or be worried about maintaining their independence. This should be considered in your interactions with older patients.

Defining a Behavioral Crisis

Behavior is what you can see of a person's response to the environment: his or her actions. Sometimes, it is obvious what is causing a person's response: A person is punched, and he or she runs away, bursts into tears, or hits back. Sometimes, it is less clear, such as when someone is depressed for very complex emotional or biological reasons.

Most of the time, people respond to the environment in reasonable ways. Over the years, people learn to adapt to a variety of situations in daily life, including stress. Stress is managed by the use of coping mechanisms. However, there are times when the stress is so great that the normal means of coping are not enough, or the person uses negative coping mechanisms like withdrawal or numbing with drugs and alcohol. In some cases the reaction is acute, but in other cases it develops over time. Both situations can create a crisis.

The change in behavior may be considered inappropriate or not normal by the person who calls 9-1-1. A **behavioral crisis** or psychiatric emergency includes patients of all ages who exhibit agitated, violent, or uncooperative behavior or who are a danger to themselves or others. EMS is called when behavior has become unacceptable to the patient, family, or community. EMS can be called for an older adult who lives alone and started a kitchen fire when he or she left the burner on or for a person who is in danger from hoarding behavior. In these instances a patient may have dementia or depression, behavior that may interfere with the **activities of daily living**. Chronic **depression** is a persistent feeling of sadness and despair. It may be a symptom of a mental health disorder. There may not be a medical or traumatic emergency but simply a request for a psychologic evaluation.

A person who experiences a panic attack after having a heart attack is not necessarily mentally ill. Likewise, you would expect a person who is fired from a job to have some sort of reaction, often sadness and depression. These problems are short-term and isolated events. However, when a person reacts with a fit of rage, attacking people and property, this behavior has gone beyond what society considers appropriate or normal. That person is likely undergoing a behavioral crisis. Usually, if an abnormal or disturbing pattern of behavior lasts for a month or more, it is regarded as a matter of concern from a mental health standpoint.

When a **psychiatric emergency** arises, patients may show agitation or violence or become a threat to themselves or others. This is more serious than a typical behavioral crisis that causes inappropriate behavior. A psychiatric emergency often leads to severe impairments in the ability to perform activities of daily living and may be accompanied by bizarre behavior.

When there is an immediate threat to the person involved or when a patient's behavior threatens you, family, friends, or bystanders, the situation should be considered a psychiatric emergency. For example, a person might respond to the death of a spouse by attempting suicide. Other patients might respond to an upsetting event by exhibiting bizarre behavior.

The Magnitude of Mental Health Disorders

According to the National Institute of Mental Health, mental disorders are common throughout the United States, affecting tens of millions of people each year. **Psychiatric disorders** are illnesses with psychological or behavioral symptoms that may result in impaired functioning. Anxiety disorders are among the most common mental health disorders and include generalized anxiety disorder, panic disorder, social and other phobias, posttraumatic stress disorder (PTSD), and obsessive-compulsive disorder.

The mental health system in the United States provides many levels of assistance to people with psychologic conditions. Common emotional issues such as marital conflict and parenting issues can often be resolved with the assistance of a professional counselor. More serious issues, such as clinical depression, are often handled by a psychologist who has specialized training dealing with more complex psychological conditions. For the treatment of the most severe conditions, like schizophrenia or bipolar disorder, a psychiatrist may need to prescribe medication. Most psychological disorders can be handled through outpatient visits; however, some people require hospitalization in psychiatric units.

Psychiatric disorders have many underlying causes. These include social and situational stress such as divorce or death of a loved one; psychiatric diseases such as schizophrenia; physical illnesses such as diabetic emergencies; chemical problems such as alcohol or drug use; or biologic disturbances such as electrolyte imbalances. Sometimes these conditions can be compounded by noncompliance with prescribed medication regimens.

Pathophysiology

As an EMT, you are not responsible for diagnosing the underlying cause of a behavioral crisis or psychiatric emergency. However, you should understand the two basic categories of diagnosis that a physician will use: organic (physical) and functional (psychological).

Organic

Organic brain syndrome is a temporary or permanent dysfunction of the brain caused by a disturbance in the physical or physiologic functioning of brain tissue. Causes of organic brain syndrome include sudden illness; traumatic brain injury; seizure disorders; drug and alcohol abuse, overdose, or withdrawal; and diseases of the brain, such as Alzheimer dementia or meningitis.

Altered mental status can arise from a physiological issue such as a hypoglycemia, hypoxia, impaired cerebral blood flow, and/or hyperthermia or hypothermia. In the absence of a physiologic cause, altered mental status may be an indicator of a psychiatric disorder such as bipolar disorder.

Functional

A **functional disorder** is a physiological disorder that impairs bodily function when the body seems to be structurally normal. Something has gone wrong, but the root cause cannot be identified. Schizophrenia, anxiety conditions, and depression are good examples of functional disorders. The chemical or physical basis of these disorders does not alter the appearance of the patient.

Words of Wisdom

A patient displaying bizarre behavior may actually have an acute medical illness that is the cause, or a partial cause, of the behavior. Behavioral changes may be the result or a symptom of a treatable medical condition such as diabetes or a stroke. They can also be the result of a head injury or drug or alcohol intoxication. Medical conditions presenting as psychological disorders must be identified. A patient with hypoglycemia presenting with altered behavior can face a life-threatening situation if the medical condition is not treated.

YOU are the Provider — PART 2

Law enforcement personnel arrive at the scene and inform you it is safe for you to enter. One of the police officers informs you the patient allowed them to check him for any weapons and that he does not have any.

You find the patient, a 44-year-old man, sitting on the lawn in front of his house; one of the police officers is trying to talk to him. He appears sad and withdrawn and is rocking back and forth. You introduce yourself to the patient and perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Sad withdrawn appearance
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Normal rate; adequate depth
Circulation	Normal pulse rate; skin is pink and moist; no obvious bleeding

The patient tells you he "has a lot of problems," but nobody will listen to him.

3. What should be your most immediate concern with this patient?
4. How should you proceed with your assessment of this patient?

Safe Approach to a Behavioral Crisis

All routine EMT skills—patient approach, assessment, patient communication, obtaining the history, and providing care—are used in a behavioral crisis. However, other management techniques are also involved. Follow the general guidelines listed in **Table 22-1** to ensure your safety at the scene of a behavioral crisis or psychiatric emergency.

Table 22-1 Safety Guidelines for a Behavioral Crisis or a Psychiatric Emergency

- **Assess the scene.** Immediately request law enforcement to secure and maintain scene safety. Do not attempt to enter or control a scene where physical violence or weapons are present.
- **Ensure you have a means of communication** if there is an unexpected problem. *Never* let the patient get between you and the door.
- **Know where the exits are.** Park your ambulance in a location that allows you a safe and easy way out if it becomes necessary.
- **Don personal protective equipment.**
- **Have a definite plan of action.** Decide who will do what. If restraint is needed, how will it be accomplished? Avoid restraint unless your safety is an issue. Ensure you have sufficient help if restraint is required.
- **Urgently de-escalate the patient's level of agitation.** This is imperative in the interest of patient safety as well as for you and others on the scene.
- **Calmly identify yourself.** Try to gain the patient's confidence. Ask questions in a low, calm voice, and be patient. Reassure the patient that you are there to help.
- **Be direct.** State your intentions and what you expect of the patient. Let the patient know what you are doing and maintain good eye contact.
- **Be prepared to spend extra time.** It may take longer than normal to assess, listen to, and prepare the patient for transport.
- **Stay with the patient.** Do not let the patient leave the area. You should not leave the area either unless law enforcement personnel can stay with the patient. Remove any stimulus that is distressing to the patient.
- **Do not get too close to a potentially volatile patient.** Patients may object to you invading their personal space, so avoid unnecessary physical contact. A squatting, 45-degree angle approach is usually not confrontational but the position may hinder your movements **Figure 22-1**. Prepare to move quickly if the patient becomes violent; otherwise do not make quick moves. Do not allow anything to hang around your neck like a tie or stethoscope.
- **Express interest in the patient's story.** Let the patient tell you in his or her own words what happened or what is going on now. Listening can be your best skill. Do not tell the patient he or she is not hearing voices; however, do not play along with auditory or visual disturbances, delusions, or hallucinations. Do not tell the patient you understand what he or she is going through. You do not know what he or she is feeling and this statement can trigger anger and escalate the patient's condition.
- **Avoid fighting with the patient.** Remember, the patient is not responding to you in a normal manner. He or she may be wrestling with internal forces over which neither of you has control. You and others may be stimulating these inner forces without knowing it. If you can respond with empathy to the feeling that the patient is expressing, whether the feeling is anger or fear or desperation, you may be able to gain his or her cooperation. If possible, try to involve a friend or family member whom the patient trusts. Always try to talk the patient into cooperating. Do not threaten the patient. Do not talk down to the patient or directly confront him or her. If the patient verbally attacks you, do not take it personally.
- **Be honest and reassuring.** If the patient asks whether he or she has to go to the hospital, the answer should be, "Yes, that is where you can receive help."
- **Do not judge.** Do not judge a patient by behavior over which she or he may not have control. Set aside personal feelings and concentrate on providing care. Always treat the patient with respect.

Figure 22-1 When working with a potentially volatile patient, position yourself at a 45-degree angle, but be aware this position could hinder your movements

Patient Assessment

Scene Size-up

The first things for you to consider at the scene of a behavioral crisis or psychiatric emergency are your safety and the patient's response to the environment. Is the situation potentially dangerous for you and your partner? Do you need immediate law enforcement backup? Should you stage until law enforcement personnel have secured the scene? Does the patient's behavior seem typical or normal for the circumstances? Are there legal issues involved (crime scene, consent, refusal)? Make sure to take appropriate standard precautions. Request any additional resources you may need (law enforcement, additional personnel) early. You can always send them away if they are not needed. Be vigilant, and avoid tunnel vision.

Determine the mechanism of injury and/or nature of illness. Remember, certain injuries and medical conditions can cause altered behavior that can be confused with a psychiatric emergency. Note any medications or substances that may contribute to the complaint or that may be for treatment of a relevant medical condition.

Words of Wisdom

Never leave a patient alone who may be experiencing a behavioral emergency.

Primary Assessment

Begin your assessment from the doorway or from a distance. How does the patient appear? Calm? Agitated? Awake or sleepy? Begin with an introduction of who you are, and let the patient know you are there to help. Allow the patient to tell you what happened or how he or she feels. Perform a rapid physical exam if the patient allows you. Look for trauma, especially head trauma.

Closely observe the patient. Does the patient answer slowly with single word answers or rapidly in long, rambling sentences? Is the patient sitting slumped in a chair, hunched and shuffling around the room, or rigid and standing perfectly still? Is the patient alert and oriented? Use the AVPU scale to check for alertness. To determine orientation, ask the patient, "Who are you?" "Where are you?" "What time is it?" and "What happened?" Asking these questions will allow you to begin to establish a rapport with the patient. This rapport is critical to the success of your interaction. Engage family members or loved ones to encourage the patient's cooperation, if their presence does not worsen the patient's agitation.

Most medical or trauma situations will include a behavioral component. Anyone experiencing an emergency will generally have some level of fear or anxiety. A patient with difficulty breathing will be anxious. The parent of a small child who fell out a second story window will most likely be hysterical and feeling guilty. An assault victim often experiences fear or anger. It is important to treat the whole patient: the behavioral component as well as the medical or traumatic issue.

If your patient is in physical distress, assess the airway to make sure it is patent and adequate. Next, evaluate the patient's breathing and obtain rate and effort. Use pulse oximetry if available. Provide the appropriate interventions based on your assessment findings. Some behavioral situations will involve a compromised airway or inadequate breathing if a patient has ingested prescription medications, drugs, or alcohol.

Next, you will need to assess the pulse rate, quality, and rhythm. Assessing a patient's circulation includes an evaluation for the presence of shock and bleeding. Assess the patient's perfusion by evaluating skin color, temperature, and capillary refill.

Unless your patient is unstable from a medical problem or trauma, prepare to spend time with your patient. It may take time and patience to gain the patient's trust if he or she is fearful or unwilling to cooperate with you.

History Taking

When a medical patient is conscious, the next step of your assessment is to investigate the chief complaint and then obtain a SAMPLE history. Obtain information about the patient and his or her medical history.

Determine the reason for the patient's behavior; your assessment should consider three major areas as possible contributors:

- Is the patient's central nervous system functioning properly? For example, the patient may be experiencing a diabetic emergency such as hypoglycemia. This situation could cause the patient to behave in an unusual or irrational manner.

- Are hallucinogens or other drugs or alcohol a factor? Does the patient see strange things? Is everything distorted? Do you smell alcohol on the patient's breath? Are there clues at the scene that suggest intoxication?
- Are significant life changes, symptoms, or illness (caused by mental rather than physical factors) involved? These might include the death of a loved one, severe depression, history of mental illness, threats of suicide, or some other major interruption of activities of daily living.

During the SAMPLE history, you may be able to elicit information not available to the hospital staff. Ask specifically about previous episodes, treatments, hospitalizations, and medications related to behavioral symptoms Table 22-2.

In geriatric patients, consider Alzheimer disease and dementia as possible causes of abnormal behavior. Determining the patient's baseline mental status will be essential in guiding your treatment and transport decisions and will also be extremely helpful to hospital personnel.

Family, friends, observers, and caregivers may be of great help in answering these questions. Together with your observations and interactions with the patient, they should provide enough data for you to assess the situation. This assessment has two primary goals: recognizing major threats to life and reducing the stress of the situation as much as possible.

Reflective listening is a technique frequently used by mental health professionals to gain insight into a patient's thinking. It involves repeating, in question form, what the patient has said, encouraging the patient to expand on his or her thoughts. Although it often requires more time to be effective than is available in an EMS setting, it may be a helpful tool for you to use when other techniques are unsuccessful at gathering the patient's history.

Table 22-2 **Questions to Ask in Evaluating a Mental Health Disorder**

- Does the patient appropriately answer your questions?
- Does the patient's behavior seem appropriate?
- Does the patient seem to understand you?
- Is the patient withdrawn or detached? Hostile or friendly? Happy or depressed?
- Are the patient's vocabulary and expressions what you would expect under the circumstances?
- Does the patient seem aggressive or dangerous to you or others?
- Is the patient's memory intact? Check orientation to time, place, person, and event: What day, month, and year is it? Who am I?
- Does the patient express disordered thoughts, delusions, or hallucinations?

Words of Wisdom

When assessing a patient in a behavioral crisis or psychiatric emergency, it can be very useful to gather information separately from a relative or caregiver. Splitting up the history-taking process in this way often yields valuable information and can help reduce the potential for violence when there is tension between the people involved. However, if the patient is threatening or uncontrollable, do not enter the room with the patient to obtain a more detailed history unless additional help, such as law enforcement personnel, is there.

Secondary Assessment

In an unconscious patient, begin with a physical exam to look for a reason for the unresponsiveness. Rule out trauma, especially to the head. Follow this rapid exam for hidden life threats with a detailed physical exam and obtain a complete set of vital signs. Obtain vital signs only if you are able to do so without worsening your patient's emotional condition. Make every effort to assess blood pressure, pulse, respirations, skin, and pupils. Then gather what history you can from others. Consider whether prior events such as physical agitation, use of stimulants, alcohol withdrawal, or TASER exposure may be contributing to the patient's condition. (Many law enforcement agencies use TASER devices to immobilize people who are behaving in a violent or aggressive manner.) When physically examining a patient with a history of behavioral crises, check for track marks indicating drug abuse and for signs of self-mutilation.

Sometimes even a conscious patient in a behavioral crisis or psychiatric emergency will not respond to your questions. In those cases, you may be able to tell a lot about the patient's emotional state from facial expressions, pulse rate, and respirations. Tears, sweating, and blushing may be significant indicators of state of mind such as sadness, nervousness, or embarrassment. Also, make sure you look at the patient's eyes; a patient who has a blank gaze or rapidly moving eyes may be experiencing central nervous system dysfunction **Figure 22-2**.

Figure 22-2 Making eye contact with a patient can provide useful clues about a patient's emotional state.

A behavioral crisis or psychiatric emergency puts tremendous stress on a person's coping mechanisms. The person is actually incapable of responding reasonably to the demands of the environment. This state may be temporary, as in an acute illness like drug-induced hallucinations, or more chronic, as in a complex, mental illness such as schizophrenia. The patient's perception of reality may be compromised or distorted.

When available, have law enforcement personnel or firefighters accompany you in the back of the ambulance during transport. This provides you with additional assistance should the patient's behavior change rapidly. If a police officer restrains the patient with handcuffs, the officer must ride in the back of the ambulance to release the cuffs in the case of an emergency. Always follow local protocols regarding the use of physical restraints.

There may be a specific facility to which patients with psychiatric emergencies are transported. Transport by ground rather than by air. If you feel transport may put you at risk, ask law enforcement personnel to accompany you or call for medical direction. Try to make the patient comfortable. Stretchers with foam padding around the head allow the patient to position his or her head for adequate airway patency. Placing the stretcher in Fowler or high Fowler position helps prevent aspiration and reduces physical exertion by relaxing the abdominal muscles.

Reassessment

Never let your guard down. Most patients you treat and transport with emotional complaints pose no danger to you or others, but it is not always possible to determine this while on scene. Remember, many patients experiencing a behavioral crisis will act spontaneously. Be prepared to intervene quickly. If restraints are necessary, reassess and document the patient's respirations, as well as pulse, motor, and sensory functions in all restrained extremities, every 5 minutes. Restraint is discussed later in this chapter.

In terms of interventions, as much as your heart may go out to an emotionally distressed patient, there often is little you will be able to do during the short time you will be treating the patient. Your job is to diffuse and control the situation and safely transport your patient to the hospital. The best treatment may be to be a good listener. Often these patients are happy if someone will listen to their problem. Intervene only as much as it takes to accomplish these tasks. Be caring and careful. Be aware of standard precautions. If the patient is spitting, place a surgical mask loosely over his or her mouth.

In many areas local protocol allows advanced life support (ALS) providers to administer medications to calm a combative patient. This will often make the situation safer for you and your patient. If you encounter a situation where you think pharmacologic restraint might be necessary, request ALS as early as possible.

Words of Wisdom

The medicolegal issues associated with responses to a behavioral crisis put added emphasis on the importance to provide thorough and specific documentation. Record detailed, objective findings that support the conclusion of abnormal behavior (eg, withdrawn, will not talk, crying uncontrollably) and quote the patient's own words when appropriate, for example, "Life isn't worth it any more," or "The voices are telling me to kill people." Avoid judgmental statements that may create the impression you based your care on personal bias rather than the patient's needs.

Give the receiving hospital advance warning when a patient experiencing a psychiatric emergency is coming in. Many hospitals require extra preparation to ensure the appropriate staff and rooms are available. Report whether restraints will be required when the patient arrives.

Thoroughly and carefully document. Think about what you are going to write before you write it, so that you can describe as clearly as possible what are often confusing scenes. Communicate to the hospital the things you observed at the scene that may help explain the patient's situation. These are important facts the hospital will not know unless you tell them. Include observed behaviors or items seen such as medications or weapons. Medications may have contributed to the crisis or may give you information about an otherwise undisclosed medical condition. Because psychiatric emergencies have few or no physical signs, you may have the only documentation clarifying the patient's distress. Because psychiatric emergencies are also fraught with legal dangers, document everything that occurred on the call, particularly situations that required restraint. When restraints are required to protect you or the patient from harm, include why and what type of restraints were used. This information is essential if the case is reviewed for medicolegal reasons.

Acute Psychosis

Psychosis is a state of delusion in which the person is out of touch with reality. Affected people live in their own reality of ideas and feelings. To the person experiencing a psychotic episode the line between reality and fantasy is blurred. That reality may make patients belligerent and angry toward others. Patients may become silent and withdrawn as they give all their attention to the voices and feelings within. Psychotic episodes occur for many reasons; the use of mind-altering substances is one of the most common causes, and that experience may be limited to the duration of the substance within the body. Other causes include intense stress, delusional disorders, and, more commonly, schizophrenia. Some psychotic episodes last for brief periods; others last a lifetime.

Schizophrenia

Schizophrenia is a complex disorder that is not easily defined or easily treated. The typical onset occurs during early adulthood, with symptoms becoming more prominent over time. Some people diagnosed with schizophrenia display signs during early childhood; their disease may be associated with brain damage or may have other causes. Other influences thought to contribute to this disorder include genetics and psychologic and social influences. Patients with schizophrenia may experience symptoms including delusions, hallucinations, a lack of interest in pleasure, and erratic speech.

Dealing with a psychotic patient is difficult. The usual methods of reasoning with a patient are unlikely to be effective because the psychotic person has his or her own rules of logic that may be quite different from nonpsychotic thinking. Follow these guidelines in dealing with a psychotic patient:

- Determine if the situation is a danger to yourself or others.
- Clearly identify yourself. ("I'm Gloria. I'm an EMT with the ambulance service, and this is my partner, Stan. We've come to see if we can help. Can you tell us what is happening?")

YOU are the Provider — PART 3

The patient tells you his wife was killed in a car accident 1 year ago today and he has been to numerous counseling sessions over the past year, but they have not seemed to help him. He further tells you his employer does not seem to care about his problems and has threatened to fire him unless he "snaps out of it." He allows your partner to take his vital signs but refuses to allow you to perform any other assessment or treatment.

Recording Time: 9 Minutes	
Respirations	16 breaths/min; adequate depth
Pulse	88 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	144/84 mm Hg
Oxygen saturation (Spo_2)	98% (on room air)

The patient denies chest pain, shortness of breath, or any other physical symptoms. He tells you it is extremely difficult for him to even get out of bed and face each day and he feels as though his life no longer serves any purpose.

5. What is your field impression of this patient?
6. What care can you provide to this patient in the field?

- Be calm, direct, and straightforward. Your composure and confidence can do a great deal toward calming the patient.
- Maintain an emotional distance. Do not touch the patient, and do not patronize the patient or be effusively reassuring.
- Do not argue. Do not challenge patients regarding the reality of their beliefs or the validity of their perceptions. Do not go along with their delusions simply to humor them, and do not make an issue of the delusions. Talk about real things.
- Explain what you would like to do. ("Let's walk downstairs to the ambulance.")
- Involve people the patient trusts, such as family or friends, to gain the patient's cooperation.

Excited Delirium

A problem sometimes encountered in an EMS response is excited delirium. **Excited delirium** is also known as agitated delirium or exhaustive mania. *Delirium* is a condition of impairment in cognitive function that can present with disorientation, hallucinations, or delusions. *Agitation* is a behavior characterized by restless and irregular physical activity. Although patients experiencing delirium are generally not dangerous, if they exhibit agitated behavior they may strike out irrationally. One of the most important factors to consider in these cases is your personal safety.

The symptoms of agitated delirium may include hyperactive irrational behavior with possible vivid hallucinations, which can create the potential for violent behavior. Common physical symptoms include hypertension, tachycardia, diaphoresis, and dilated pupils. Because hallucinations are erroneous perceptions of reality, the patient may perceive you as a threat.

Agitation is recognized as a biologic attempt to release nervous tension and can produce sudden, unpredictable physical actions in your patient.

If you think you can safely approach the patient, be very calm, supportive, and empathetic. Be an active listener by nodding, indicating understanding, and by limiting your interruptions of the patient's comments. It is extremely important to approach the patient slowly and purposefully and to respect the patient's personal space. Limit physical contact with the patient as much as possible. It is also imperative that you do not leave the patient unattended, unless the situation becomes unsafe for you or your partner.

Use careful interviewing to assess the patient's cognitive functioning. Try to indirectly determine the patient's orientation, memory, concentration, and judgment by asking simple questions such as "When did you first begin to notice these feelings?" Through interviewing, try to determine what the patient is thinking. Are the patient's thoughts disorganized? For example, does the patient begin to answer your question and then drift off only to begin discussing a childhood friend? Is the patient experiencing delusions or hallucinations? Does the patient have any unusual worries or fears? For example, does the patient express anxiety if you go too close to a pile of old newspapers?

Pay particular attention to the patient's ability to communicate clearly, and make notes on the patient's apparent mood. Is the patient anxious, depressed, elated (extremely happy or joyful), or agitated? Pay attention to the patient's appearance, dress, and personal hygiene.

If the patient appears to be experiencing a drug overdose, take all medication bottles or illegal substances with you to the medical facility. The patient should be transported to a hospital with psychiatric facilities capable of handling the condition. Whenever possible, refrain from using lights and siren because bright lights and loud sounds may aggravate the patient's condition.

If the patient's agitation continues, request ALS assistance so chemical restraint can be considered. Uncontrolled or poorly controlled patient agitation and physical violence can place the patient at risk for sudden cardiopulmonary arrest. Physical agitation can lead to sudden death, thought to result from metabolic acidosis. Physical control measures (including TASERs) can contribute to sudden death in these patients. Also, this condition can be worsened by stimulant drugs (eg, cocaine) or alcohol withdrawal. Finally, **positional asphyxia** occurs when a patient's physical position restricts chest wall movements or causes airway obstruction. It can also cause sudden death.

Restraint

In situations when a patient engages in combative behavior, your safety must be your top priority. Therefore, it may be necessary for the patient to be restrained.

Prehospital patient restraint reduces the possibility of patient injury, the potential for injury to EMS providers, and allows for safe and appropriate treatment of an uncooperative patient. The National Association of Emergency Medical Services Physicians (NAEMSP) recommends that every prehospital care transport provider create and follow a prehospital patient restraint protocol. Such protocols consider the appropriateness of restraint, the types of restraints, and care provided to the patient following restraint. Legislation regarding restraints ensures the safety of individuals who are an immediate threat to themselves or others. Your protocol must consider the laws of your state as they pertain to an individual's rights and processes for involuntarily restraining patients.

There is wide variation in prehospital patient restraint protocols throughout the country. Protocols should include only the use of restraint devices that have been approved by the state health department or local EMS agency. Restraints can be soft, leather, or cloth. Soft restraints can include sheets, wide wristlets, and chest harnesses. Hard restraints can include plastic ties, handcuffs, or leather restraints. EMS protocols should avoid the use of hard restraints if possible. If hard restraints are approved, they will most likely be limited to the use of leather wrist restraints.

The method of restraint chosen should be the least restrictive method that will ensure the safety of the patient and providers **Figure 22-3**.

Risks Associated With Patient Restraint

Personnel must be properly trained in the use of restraints. Improperly applied restraints can result in severe and potentially life-threatening complications, such as positional asphyxia, aspiration, severe acidosis, and sudden cardiac death.

If you restrain a person without authority in a non-emergency situation, you expose yourself to a possible lawsuit and to personal danger. Legal actions against you can involve charges of assault, battery, false imprisonment, and violation of civil rights. You may use restraints only to protect yourself or others from bodily harm or to prevent the patient from injuring himself or herself. In either case, you may use reasonable force only as necessary to control the patient, something that courts may define differently. For this reason, follow local protocol and your company prehospital restraint policy, and consult medical control if needed.

You should always involve law enforcement personnel if you are called to assist a patient in a severe behavioral crisis or psychiatric emergency, especially when restraining a competent individual against his or her will. Law enforcement will provide physical backup in managing the patient and serve as the necessary witnesses and legal authority for restraining the patient. A patient who is restrained by law enforcement personnel is in their custody.

Before you consider physical restraint, make a significant effort to use verbal de-escalation techniques to ease the situation and avoid the need for physical restraint. Also, consider asking the family to assist you in calming and reasoning with the patient. Verbal de-escalation is safest because it does not require any physical contact with the patient. Be honest and straightforward with the patient and talk in a calm and friendly tone.

Figure 22-3 Restraints should be used when necessary only to prevent injury and in the least restrictive manner that achieves the needed result.

The Process of Restraining a Patient

Once the decision has been made to restrain a patient, you should carry it out quickly. Make sure you have adequate help to safely restrain a patient. Ideally, five people should be present to carry out the restraint, each being responsible for one extremity and the head. There should also be a team leader who directs the restraining process. Before you begin, discuss the plan of action. As you prepare to restrain the patient, stay outside the patient's range of motion. Use the minimum force that is necessary to control a patient. Avoid acts of physical force that may cause injury to the patient. The level of force will vary, depending on the following factors:

- The degree of force that is necessary to keep the patient from injuring himself, herself, and others.
- A patient's sex, size, strength, and mental status including the possibility of drug-induced states. Phenylcyclohexylpiperidine (PCP) use may make the patient especially difficult to restrain.
- The type of abnormal behavior the patient is exhibiting.

Other important considerations include:

- Somebody, preferably you or your partner, should talk to the patient throughout the process.

- Remember to treat the patient with dignity and respect at all times.
- If possible, a provider of the same gender should attend to the patient.
- Wear appropriate barrier protection during patient restraint activities.
- Avoid direct eye contact and respect the patient's personal space until necessary.
- Never leave a restrained patient unattended.

Physically uncooperative patients should be restrained in the lateral decubitus position with one arm above the head and the other below the waist; however, four-point restraints (both arms and both legs) are preferred. Restraining the hips, thighs, and chest inhibits movement. Restraining the thighs just above the knees prevents kicking and is more effective than restraining the ankles. Do not place anything over the patient's face, head, or neck. If the patient is spitting, a surgical mask may be placed loosely over the patient's mouth. If the patient attempts to bite, a hard cervical collar may be placed on the patient's neck.

Patients should never be transported while hobbled, hog-tied, or restrained in a prone position with hands and feet behind the back, as positional asphyxia could occur. It is impossible to adequately monitor the patient in this position, and it may inhibit the breathing of an impaired or exhausted patient. Patients should never be transported while sandwiched between backboards or mattresses. Stretcher straps should be applied during transport as the standard procedure for all patients. Sheets can be used as additional stretcher straps if necessary. Stretcher straps and sheets should never restrict the patient's chest wall motion.

Respiratory and circulatory problems have been known to occur in combative patients who are restrained. A physically restrained patient struggling against restraints can experience severe acidosis or fatal dysrhythmia. Monitor the patient for vomiting, airway obstruction, respiratory status, circulatory status (blood pressure), and changes in level of consciousness. Drug or alcohol intoxication may initially cause violent behavior that may lead to physical deterioration. Reassess airway and breathing continuously. You should make frequent checks of circulation on all restrained extremities, regardless of patient position **Figure 22-4**.

If physical restraint is not effective or the patient still poses a danger to himself, herself, or others, chemical restraint administered by ALS personnel is an effective way to safely transport and treat the violent, combative, or agitated patient.

Words of Wisdom

For patients with key-locking restraint devices applied by another agency, consider the following options:

- Remove the restraint device and replace it with a restraint device that does not require a key.
- Transport the patient accompanied by a person who has the key for the device.
- Transport the patient in the vehicle of the person with the device's key if the medical condition of the patient is deemed stable, direct medical oversight so authorizes, and the law allows.

Restraints applied in the field should not be removed until the patient is evaluated at the receiving facility. Release the restraints only if necessary to provide emergency patient care and only if you have assistance. Be especially careful if a combative patient suddenly becomes calm and cooperative. This is not the time to relax but to be vigilant. The patient may suddenly become combative again and injure someone. Keep in mind that you may use reasonable force to defend yourself against an attack by an emotionally disturbed patient. It is extremely helpful to have (and document) witnesses in attendance, even during transport, to protect against false accusations. EMTs have been accused of sexual misconduct and other physical abuse in such circumstances. Also document the reason for the restraint, the type of restraint used, and the technique that was used.

Figure 22-4 Frequently assess circulation while a patient is restrained.

Performing Patient Restraint

The steps in **Skill Drill 22-1** show an example of four-point restraint technique.

1. Law enforcement officers should bring down the patient into the prone position.
2. Acting at the same time, secure the patient in the supine or left lateral position.
3. Secure the patient's extremities with wrist and ankle restraints Step 1.
4. Use stretcher straps or sheets to secure the legs Step 2.

Skill Drill 22-1 Restraining a Patient

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Step 1

Law enforcement officers should bring down the patient into the prone position. Then, acting at the same time, secure the patient in the supine or left lateral position with wrist and ankle restraints.

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Step 2

Use stretcher straps or sheets to secure the legs.

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Step 3

Fasten the remaining stretcher straps.

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Step 4

Continue to verbally reassure and calm the patient following chemical/physical restraints. Regularly check circulation to the extremities.

5. Fasten the remaining straps, including chest and pelvis straps if available Step 3. Do not use multiple knots.
6. Continue to verbally reassure and calm the patient following chemical/physical restraints.
7. Regularly check circulation to the extremities Step 4.

A two-point restraint technique is an option if allowed per local protocols. This technique is performed in the same way as four-point restraint, except instead of restraining all four extremities to the stationary frame of the stretcher, one arm is placed upward toward the head and the other is placed downward toward the waist Figure 22-5.

Once a patient has been restrained, reassess the airway and breathing. Document this information in your patient care report.

The Potentially Violent Patient

Violent patients make up only a small percentage of the patients undergoing a behavioral or psychiatric crisis. However, the potential for violence is always a critical consideration for you Figure 22-6.

Use the following list of risk factors to assess the level of danger:

- **History.** Has the patient previously exhibited hostile, overly aggressive, or violent behavior? Ask people at the scene, or request this information from law enforcement personnel or family.

Figure 22-5 In two-point restraint, one arm is placed upward while the other is placed downward.

- **Posture.** How is the patient sitting or standing? Is the patient tense, rigid, or sitting on the edge of his or her seat? Such physical tension is often a warning signal of impending hostility.
- **The scene.** Is the patient holding or near potentially lethal objects such as a knife, gun, glass, poker, or bat (or near a window or glass door)?
- **Vocal activity.** What kind of speech is the patient using? Loud, obscene, erratic, and bizarre speech patterns usually indicate emotional distress. Someone using quiet, ordered speech is not as likely to strike out as someone who is yelling and screaming.

YOU are the Provider — PART 4

The patient is initially reluctant to allow you to transport him to the hospital. However, after you express your concern about his safety and well-being, he consents to transport. Other than allowing you to reassess his vital signs, he tells you he would prefer to just be taken to the hospital; he does not want to be physically assessed.

Recording Time: 20 Minutes

Level of consciousness	Conscious and alert
Respirations	16 breaths/min; adequate depth
Pulse	76 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	**138/86 mm Hg**
Spo_2	98% (on room air)

7. Should you perform a physical assessment of this patient despite the fact that he requested you do not? Why or why not?

Figure 22-6 Watch for indicators of potential violence when approaching the scene.

Words of Wisdom

When working with a potentially hostile or violent patient, remove everyone from the scene who is not needed, such as family, friends, or bystanders. This will prevent injury or the likelihood of someone agitating the patient. Conversely, if a family member has a positive influence on the patient, you may consider allowing him or her to help.

- **Physical activity.** The motor activity of a person undergoing a psychiatric emergency may be the most telling factor of all. A patient who has tense muscles, clenched fists, or glaring eyes; is pacing; cannot sit still; or is fiercely protecting personal space requires careful watching. Agitation may predict a quick escalation to violence.

Other factors to consider in assessing a patient's potential for violence include the following:

- Poor impulse control
- A history of truancy, fighting, and uncontrollable temper
- History of substance abuse

- Depression, which accounts for 20% of violent attacks
- Functional disorder (If the patient tells you voices are telling him or her to kill, believe it.)

Special Populations

In general, children may experience behavioral crises as commonly as adults, but often the children's situations are managed by their parents or caregivers. If you are called to help with a child experiencing a behavioral crisis, it is imperative to listen to the caregiver and follow his or her lead on how to best approach the child. Aggressive behavior in children, especially when it seems to be a pattern, may be a symptom of an underlying medical or psychologic condition. As a precaution against them hurting themselves or others, children need a thorough evaluation from a mental health professional. Although some children with a behavioral crisis may be physically large, do not make the mistake of assuming you can treat them like adults.

One specific behavioral crisis that is common among teenagers is suicide. Teenagers are one of the largest age groups to attempt suicide. Although we sometimes tend to view a teenager's problems as minor, problems often appear insurmountable to them. Never discount a teenager's comments about suicide as being "just an attempt to get attention."

Common factors that lead to suicide attempts in adults are often also found in teenagers. One of them is dealing with the end of a relationship. Teenagers are just beginning to relate to others in an intimate way, so when a relationship ends, they often do not know how to handle the apparent rejection. Adults who attempt suicide may have a drug or alcohol addiction, and this is common among teenagers as well. Teenage suicide victims may have a history of disciplinary problems or may have a very unstable home life. Another factor that is sometimes involved with teenage suicide victims is social pressures. Peer approval is one of the most important aspects of a teenager's life, and teenagers who seem to have poor relationships with their peers may be at a higher risk for suicide. In other cases, teenagers can be influenced by peers to commit suicide either individually or as part of a pact. Another risk factor to consider is that children of parents who committed suicide are more likely to attempt it themselves.

Expression of thoughts of suicide and attempts at suicide by teenagers should always be taken seriously. Never disregard suicide comments, even if a parent insists the child "is faking." Take action to ensure that teenagers are treated for attempting or considering suicide because it is very important for their long-term emotional well-being.

Special Populations

Geriatric patients may be struggling with the loss of loved ones, health issues including the diagnosis of a serious illness like cancer or dementia, living on a fixed income, and fear of losing their independence. Depression is understandable and not uncommon. When you visit the home of a geriatric patient, especially one who lives alone, ensure he or she is living in a safe and healthy environment. If you have concerns, call adult protective services.

Suicide

The single most significant factor that contributes to suicide is depression. Any time you encounter an emotionally depressed patient, you must consider the possibility of suicide. The risk factors for suicide are listed in Table 22-3.

It is a common misconception that people who threaten suicide never commit it. Suicide is a cry for help. Threatening suicide is an indication that someone is in a crisis that he or she cannot handle alone. Immediate intervention is necessary.

Whether the patient has any of these risk factors, you must be alert to the following warning signs:

- Does the patient have an air of tearfulness, sadness, deep despair, or hopelessness that suggests depression?
- Does the patient avoid eye contact, speak slowly or haltingly, and project a sense of vacancy, as if he or she really is not there?
- Does the patient seem unable to talk about the future? Ask the patient whether he or she has any vacation plans. Suicidal people consider the future so uninteresting that they do not think about it; people who are seriously depressed consider the future so distant that they may not be able to think about it at all.
- Is there any suggestion of suicide? Even vague suggestions should not be taken lightly, even if presented as a joke. If you think that suicide is a possibility, do not hesitate to bring up the subject. You will not give the patient ideas if you ask directly, "Are you considering suicide?"
- Does the patient have any specific plans related to death? Has the patient recently prepared a will? Has the patient given

away significant possessions or told close friends what he or she would like done with them? Arranged for a funeral service? These are critical warning signs.

Table 22-3 Risk Factors for Suicide

- Depression at any age, feeling trapped or purposeless
- Previous suicide attempt (About 80% of successful suicides were preceded by at least one prior attempt.)
- Current expression of wanting to commit suicide or sense of hopelessness
- Specific plan for suicide
- Family history of suicide
- People older than 40 years, particularly if single, widowed, divorced, alcoholic, or depressed (Men who are older than 55 years have an especially high risk and are very often successful if they make an attempt.)
- Recent loss of spouse, significant other, family member, or support system
- Chronic debilitating illness or recent diagnosis of serious illness
- Feeling anxious, agitated, angry, reckless, or aggressive; also dramatic mood changes such as from depression to agitation
- Financial setback, loss of job, police arrest, imprisonment, or some sort of social embarrassment
- Alcohol and substance abuse, particularly with increasing use
- Children of an alcoholic or abusive parent
- Withdrawal from family and friends or a lack of social support, resulting in isolation
- Significant anniversaries of sentinel events
- Unusual collection or acquisition of things that can cause death, such as a gun, a large volume of pills

Consider also the following additional risk factors for suicide:

- Are there any unsafe objects in the patient’s hands or nearby (a sharp knife, glass, poisons, or a gun)?
- Is the environment unsafe (an open window in a high-rise building, a patient standing on a bridge or precipice)?
- Is there evidence of self-destructive behavior (partially cut wrists, excessive alcohol or drug use)?

- Is there an imminent threat to the patient or others?
- Is there an underlying medical problem?
- Are there cultural, religious, or social beliefs promoting suicide?
- Has there been trauma?

On the basis of your observations and conversations with the patient, you may need to determine if interventions such as restraints are needed. Remember, a suicidal patient may be homicidal as well. Do not jeopardize your life or the lives of your partners. If you have reason to believe that you are in danger, you must obtain police intervention. In the meantime, try not to frighten the patient or make him or her suspicious. Remember, the most important service you can provide for a suicidal patient is compassionate transportation to a medical facility where the patient can receive proper treatment.

Safety Tips

Patients with suicidal thoughts, especially patients who have made a threat or unsuccessful attempt, may not be thinking clearly and may behave in very unpredictable ways. Some recognize that if they get into the ambulance or enter the hospital, they will not have the opportunity to complete their threat or intent. Therefore, they may make a last effort to kill themselves. Suicidal/homicidal patients will not hesitate to hurt you or your partner. Be very careful how you assess the situation; make certain you, your team, and the patient are safe.

Posttraumatic Stress Disorder and Returning Combat Veterans

Posttraumatic stress disorder (PTSD) can occur after exposure to, or injury from, a traumatic event. Such events may include sexual or physical assault, child abuse, a serious accident, a natural disaster, war, loss of a loved one, or stressful life changes. People may have experienced fear of danger, helplessness, or a severe reaction during the event. The reaction could be to trauma that occurred long ago or may be the result of multiple traumatic events over time. It is not necessarily the result of one isolated or recent event.

It is estimated that 7% to 8% of the general population will experience signs of PTSD at some point in their lives. For health care workers returning from a warfare environment, which could include disaster workers, threat of personal harm is considered a predictive factor in determining in whom PTSD will develop.

Military personnel who experienced combat have a high incidence of PTSD. PTSD occurred in up to 20% of veterans of the Iraq and Afghanistan Wars, 10% of Gulf War veterans, and 30% of Vietnam veterans. Reminders of their experiences in the military such as news coverage or gatherings of veterans can also be triggers.

Signs and Symptoms of PTSD

Symptoms of PTSD include feelings of helplessness, anxiety, anger, and fear. People with PTSD may avoid things that remind them of the trauma, including loud noises or smells, and sometimes avoid interactions with other people. This emotional and physical distancing from others can have a negative impact on one’s quality of life. Memories of the trauma linger and continue to be disruptive. Symptoms of PTSD may be made worse in the context of other mental health challenges.

The sympathetic nervous system provides the protection of the “fight-or-flight” mechanism to help protect us in a perceived dangerous situation. It is not intended to last any longer than it takes to mitigate the threat. People with PTSD suffer nervous system arousal that continues and is not easily suppressed. Heart rate increases to channel blood into the heart, lungs, and brain; pupils dilate; and systolic blood pressure is increased. Senses are sharpened and mental acuity is heightened. The victim may be hypervigilant or display an exaggerated startle response to perceived danger.

People with PTSD can relive the traumatic event through intrusive thoughts, nightmares, or even flashbacks. *Flashbacks* are uncontrollable events triggered by a sound, sight, or smell. The patient may experience the same visceral response he or she did when he or she initially encountered the stress. These episodes can last seconds or hours and can occur at any time, even years after the exposure. The person fears his or her inability to control a flashback and that it will present as irrational behavior. Recent traumatic events may also trigger old memories and create a reflex reaction of preparing for the worst. A person who has experienced flashbacks may become preoccupied with the perception of danger. Hypervigilance and trouble sleeping are not unusual.

Dissociative PTSD occurs when the person attempts to find an escape from constant internal distress or a particularly disturbing event. His or her altered consciousness allows him or her to continue functioning under negative conditions. Some people may undergo an out-of-body experience. Others experience delusions. Other psychologic conditions such as personality disorders and increased functional impairment can develop in those with a dissociative subtype of PTSD.

Guilt, shame, paranoia, hostility, and depression are not uncommon for combat veterans. Alcohol and/or drug use is a common way to suppress the sympathetic nervous system activity and slow down the body. This attempt at anesthesia can easily become addictive. Suicide is sometimes sought to end the pain. Veterans are much more likely to harm themselves or try to harm themselves. They also sustain a host of physical conditions, some from injuries sustained in combat, and sometimes vague, unfocused pain not associated with any specific part of the body. This perception of physical pain may be a sign of their anguish. Combat veterans, in particular, may have heart disease earlier than expected, a higher incidence of type II diabetes, and a loss of brain gray matter. High cholesterol and hypertension are not uncommon and are often undiagnosed or misdiagnosed.

Another consideration for the combat veteran is the higher incidence of traumatic brain injury (TBI) sustained from trauma secondary to the explosion of an improvised explosive device (IED). In some cases the TBI may go undiagnosed due to similarities with the symptoms of PTSD or because the patient downplays the symptoms. People with TBI can sustain sensory dysfunction, confusion headaches, memory loss, and general disorientation. Memory loss can include retrograde and anterograde amnesia (before and after the event). Try to eliminate excess noise. Do not touch or do anything to the veteran without an explanation. Interestingly, diesel fumes can be a trigger for combat veterans. Keep your diesel equipment far enough away.

Caring for the Combat Veteran

How do you recognize returning veterans? They often continue to adhere to their military identity with short haircuts, wearing military clothing with combat patches, and often have tattoos. Their homes may have flags, memorials, commendations, and military photos. They may have a military appearance and use military vocabulary. They tend to show respect for authority but may be reluctant to talk to you about PTSD. They may not be aware that they have it, or do not want to be considered “mental.” They might have trouble asking for help. Asking, “How do you want me to help you?” or “What is it you need right now?” are good ways to open the conversation.

The returning combat veteran is a patient who will require a unique level of understanding, compassion, and specialized attention. These patients experience pain that is emotional as well as physical. You will need to take time to establish the history of this patient and listen to his or her concerns. Approach this patient with sensitivity and respect. Be careful how you phrase your questions. “Were you in combat?” is an appropriate question, but, in some cases, veterans may be in denial or do not believe they were in combat. A better question might be, “Were you shot at or under fire?” If you served in combat, you can create trust by letting the patient know. Ask questions about the patient’s service (branch, rank, etc.). You may get enough information out of that conversation to eliminate probing with specific questions.

YOU are the Provider — PART 5

You depart the scene and begin transport to a hospital located 8 miles away. The patient remains conscious and alert but is still withdrawn and sad. You ask him additional questions about his present situation, but he does not answer you; he briefly looks up at you and then looks back down. You reassess his vital signs and then call in your report to the receiving facility.

Recording Time: 30 Minutes	
Level of consciousness	Conscious and alert
Respirations	16 breaths/min; adequate depth
Pulse	72 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	130/80 mm Hg
Spo_2	99% (on room air)

You arrive at the destination hospital and give your verbal report to the charge nurse. After transferring patient care to the hospital staff, you return to service.

8. What factors should you consider before transporting a patient with an emotional crisis?
9. If the patient does not answer your questions, should you continue to encourage him to talk? Why or why not?

Use a calm, firm voice, but be in charge. Respect a veteran's personal space. Limit the number of people involved, or move to a private and quiet space. In some cases, supportive family or friends can be helpful. Ask about suicidal intentions. This might create an opportunity for the patient to reach out. Military veterans are trained to use weapons and are also resourceful in improvising weapons. If you are concerned about suicide, ensure there is nothing the patient can access and use as a weapon.

Physical restraint will not be effective with this population and may only escalate the problem. Even seat belts on the stretcher can aggravate a patient. If it is necessary to calm the patient, especially in the face of safety considerations, chemical restraints administered by ALS should be considered.

Medicolegal Considerations

The medical and legal aspects of emergency medical care become more complicated when the patient is undergoing a behavioral crisis or psychiatric emergency. Nevertheless, legal issues are greatly reduced when an emotionally disturbed patient consents to care. Gaining the patient's confidence is, therefore, a critical task for you.

Mental incapacity can take many forms: unconsciousness (as a result of hypoxia, alcohol, or drugs), temporary but severe stress, and depression. Once you have determined that a patient has impaired mental capacity, you must decide whether he or she requires immediate emergency medical care. A patient in a mentally unstable condition may resist your attempts to provide care. Nevertheless, you must not leave the patient alone. Doing so may result in harm to the patient and expose you to civil action for abandonment or negligence. In such situations, you should request that law enforcement personnel handle the patient. Another reason for seeking law enforcement support is for the patient who resists transport: such a patient often threatens you and others. Violent or dangerous people must be taken into custody by law enforcement before emergency care can be rendered.

Consent

When a patient is not mentally competent to grant consent for emergency medical care, the law assumes that there is implied consent. For example, the consent of an unconscious patient is implied if life or health is at risk. The law refers to this as the emergency doctrine: Consent is implied because of the necessity for immediate emergency treatment. In a situation that is not immediately life threatening, emergency medical care or transportation may be delayed until the proper consent is obtained.

In cases involving psychiatric emergencies, however, the matter is not always clear-cut. Does a life-threatening emergency exist or not? If you are not sure, you should request the assistance of law enforcement personnel. Medical control may also offer guidance.

Limited Legal Authority

As an EMT, you do not have legal authority to require a patient to undergo emergency medical care if the patient is competent and understands the risks and benefits of transport versus refusal. Patients have the right to refuse care. However, most states have legal statutes regarding the emergency care of mentally ill and drug-impaired people. These statutory provisions may permit law enforcement personnel to place the person in protective custody so that emergency care can be given. You should be familiar with your local and state laws regarding these situations.

The typical provision may state that:

> *Any police officer who has reasonable cause to believe that a person is mentally ill and dangerous to himself, herself, or others or gravely disabled ... may take such person into custody and take or cause such person to be taken to a general hospital for emergency examination ...*

The general rule of law is that a competent adult has the right to refuse treatment, even if life-saving care is involved. However, in psychiatric cases, a court of law would probably consider your actions in providing lifesaving care to be appropriate, particularly if you have a reasonable belief that the patient would harm himself, herself, or others without your intervention. If you decide a patient must be transported against his or her will, make sure you have the appropriate resources on scene to avoid unnecessary injury to the patient, you, or your partner. In addition, a patient who is impaired in any way, whether by mental illness, medical condition, or intoxication, may not be considered competent to refuse treatment or transportation. These situations are among the most perilous you will encounter from a legal standpoint. When in doubt, consult with your supervisor, police, or medical control. Always maintain a high index of suspicion regarding your patient's condition—assume the worst and hope for the best. Err on the side of treatment and transport. Carefully document the patient's statements and behavior to support your actions.

Special Populations

As the population ages, you will begin to see more patients older than 65 years. In responding to an increasing number of geriatric patients, you will probably notice some behavioral or psychiatric symptoms, including depression, dementia, and delirium. These changes in mental status can affect your ability to thoroughly assess and treat an ill or injured geriatric patient. Understanding the causes of altered behavior in geriatric patients will help you with patient care.

For example, consider a woman in her 80s who has suffered the loss of her spouse of 40 years and the loss of her parents, siblings, and friends. Her children may live far away. Her only income may be a small pension and social security. More than anything, she wants to stay in the home she shared with her husband. When she has medical concerns she does not call 9-1-1 because she is afraid she will be taken to the hospital and then forced into a care home.

When you visit the home of an older adult, especially one who lives alone, ensure the person is living in a safe and healthy environment. Does he or she have food and medications? Is the home sanitary or overrun with bugs or rodents? Is there hoarding behavior? Is the person's mental status in question? If you have concerns, call adult protective services.

Depression is one of the mental health symptoms that you will see in older adults. Depression has a number of causes. A diagnosis of major illness such as cancer or dementia can lead to depression. Medications can induce a feeling of depression, possibly because of an interaction with other drugs. In addition, changes in the endocrine system such as menopause can cause depression. Depression might also be caused by an imbalance in brain chemicals.

With all the possible causes of depression, an older adult can feel helpless and hopeless. A depressed person may be argumentative or passive. He or she might trivialize complaints, not wanting to be a bother to anyone. Someone who sees no way out of his or her situation may turn to suicide. Be alert for a suicidal gesture or ideation, even though it may not be obvious. As an EMT, your interaction with a depressed older person might prevent a suicide.

Although depression can create a behavioral crisis in geriatric patients, dementia is another cause of abnormal behavior. According to the Alzheimer's Association, more than 5 million people are afflicted with this condition; it is the sixth leading cause of death in the United States. Each year, 500,000 people die from it, and 1 in 3 older adults die from Alzheimer or some other dementia.

Currently, there is no cure for Alzheimer dementia, but there are medications that can slow the progression of the disease. Openly hostile behavior can develop in patients with Alzheimer dementia, including kicking, yelling, pinching, and hitting you, your partner, or the patient's caregiver. You might need to restrain a violent patient, but do so gently and only to the point at which the violent behavior stops.

As with any patient, you want to rule out medical causes for altered behavior, especially those you can treat. Causes of altered behavior include diabetic emergencies, heat- and cold-related illnesses, poisoning and overdose, strokes and transient ischemic attacks, infection, hypoxia, and head injury. Although the mechanism is not understood, urinary tract infection and constipation can alter an older person's behavior.

As the EMT responding to a call for help, you should accept the possibility of depression in a geriatric patient. Do not discount the patient's feelings or devalue his or her emotions. Be alert for a suicidal gesture, and pay attention to any statements about death. To get the patient's cooperation, you can elicit his or her help in providing care for the acute illness or injury. A smile and a touch can go a long way in alleviating fear in all of your patients, especially older patients.

YOU are the Provider — SUMMARY

1. How should you and your partner proceed to this call?

The patient's reported behavior, "acting bizarre," is a very broad description that could indicate any number of conditions. In the interest of your safety, you should assume that the patient is a danger to himself or others. This is not a scene that you should enter without the protection of law enforcement. Never approach a scene of actual or potential violence until law enforcement personnel have arrived and deemed the scene safe for you to enter. In this case, you and your partner should stage a few blocks away from the scene and wait for law enforcement personnel to arrive. Proceed to the scene *only* after they have notified you and given you the "all clear."

2. Other than an underlying psychiatric condition, what other conditions can affect a person's behavior?

A multitude of factors can affect a person's behavior; the presence of an underlying psychiatric condition is only one. Conditions such as hypoxemia, hypoglycemia, metabolic disorders, drug- or alcohol-related issues, stress-related issues, head trauma, and brain tumors (among others) can profoundly affect a person's behavior; these conditions may even cause the patient to become violent.

3. What should be your most immediate concern with this patient?

Personal safety should be your primary concern when caring for *any* patient. This is especially true when caring for patients who are displaying abnormal or bizarre behavior. When caring for a patient who is experiencing a behavioral crisis, you must always consider his or her potential for violence. There are certain behaviors and risk factors that you should look for when assessing a patient's potential for violence: patient history, posture, and verbal and physical activity. Does the patient have a history of hostile, overly aggressive, or violent behavior? Observe the patient's speech. Loud, obscene, erratic, or bizarre speech patterns are clear indicators of emotional distress.

Your patient is sitting on the ground, rocking back and forth; this could indicate a general state of nervousness or increasing agitation.

4. How should you proceed with your assessment of this patient?

The patient has something to say; he states he "has a lot of problems," but also notes that nobody will listen to him. Therefore, use the most important assessment tool you have: listening. Actively listen to what the patient is saying. It may give you clues as to the underlying cause of his behavior; it also reassures him that you *are* listening.

Express sincere interest in what the patient is saying. Let him tell you in his own words what happened or what is going on. Do not interrupt him. Allow him to finish what he is saying before you ask him any questions—just as you would with any other patient.

When you are caring for a patient with a behavioral crisis, you must be prepared to spend extra time with him or her. It often takes longer to assess, listen to, and prepare the patient for transport.

5. What is your field impression of this patient?

The field impression of the patient is based on a number of factors, including physical assessment, medical history, and chief complaint. On the basis of your field impression, you can begin treatment most appropriate for the situation.

Your patient is displaying clear signs of depression. Despite attending counseling sessions, he is unable to cope with the loss of his wife; this has brought him to the point of lacking the desire to even get out of bed in the morning. He no longer feels as though he has a purpose in life. He has experienced emotional distress for a year, and today—the anniversary of his wife's death—has precipitated an acute emotional crisis.

6. What care can you provide to this patient in the field?

Although the patient does not appear to be experiencing any physical problems, clearly, he is emotionally overwhelmed. The fact that your patient is severely depressed places him in a high-risk category for suicide. He should *not* be left alone! Patients who are experiencing a behavioral crisis require a great deal of emotional support and active listening.

7. Should you perform a physical assessment of this patient despite the fact that he requested you do not? Why or why not?

The patient—although severely depressed—still has decision-making capacity. He is conscious and alert, able to answer your questions appropriately, and is not displaying any psychotic behavior (eg, hallucinations, delusions). Therefore, he maintains the legal right to refuse a physical examination; touching him without his consent could lead to allegations of assault and battery against you.

Unless there is an accompanying physical complaint, a detailed physical exam is rarely indicated in a patient with an emotional crisis; in fact, it may be detrimental to your gaining the patient's trust.

8. What factors should you consider before transporting a patient with an emotional crisis?

On arriving at the scene of a patient with an emotional crisis, you must assess him or her for signs of potential violence. These observations should continue throughout the *entire* patient encounter. Even though this patient is calm right now, this could easily change and he could become acutely violent. The worst time for this to happen is in the back of the ambulance, where you will be the only EMT. Do not let your guard down when caring for a patient with an emotional crisis; continuously monitor his or her behavior. Stay attentive at all times.

If you have reason to believe that the patient is at an increased risk for becoming violent, you should have other authorized personnel, such as a police officer or firefighter, ride in the back of the ambulance. If it is necessary to restrain the patient, use just enough force to effectively accomplish the task. Unless it is absolutely necessary to provide patient care, do not release the restraints—regardless of any promises to calm down the patient makes. Never hesitate to call for ALS assistance if available for consideration of use of medications.

9. If the patient does not answer your questions, should you continue to encourage him to talk? Why or why not?

Some patients who are experiencing a behavioral crisis talk excessively, while others talk very little or not at all (as in depression). If the patient wants to talk, you should encourage him or her to do so. Many patients find relief—even if it is only temporary—by simply having someone to talk to. If the patient prefers not to talk, *do not force the issue.*

Depressed patients are typically withdrawn and are not very talkative. Instead of persistently encouraging a patient to talk, you should continue to monitor his or her behavior.

EMS Patient Care Report (PCR)

Date: 11-23-16	**Incident No.:** 012009	**Nature of Call:** Behavioral crisis		**Location:** 517 E. Bandera	
Dispatched: 1920	**En Route:** 1921	**At Scene:** 1937	**Transport:** 2000	**At Hospital:** 2011	**In Service:** 2021

Patient Information

Age: 44 **Sex:** M **Weight (in kg [lb]):** 79 kg (175 lb)	**Allergies:** No known drug allergies **Medications:** Paxil, Ambien **Past Medical History:** None **Chief Complaint:** Apparent emotional distress

Vital Signs

Time: 1946	**BP:** 144/84	**Pulse:** 88	**Respirations:** 16	**Spo_2:** 98%
Time: 1957	**BP:** 138/86	**Pulse:** 76	**Respirations:** 16	**Spo_2:** 98%
Time: 2007	**BP:** 130/80	**Pulse:** 72	**Respirations:** 16	**Spo_2:** 99%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Emotional support

Narrative

Medic 1780 dispatched to a residence for a man who is "acting bizarre." Staged at 5th Street and Elm until law enforcement arrived on scene and advised that it was safe to enter. On arriving at the scene, found the patient, a 44-year-old man, sitting on the lawn in front of his house, rocking back and forth. He was conscious and alert; however, he appeared sad and was clearly withdrawn. His airway was patent, and his breathing was adequate. A law enforcement official advised EMS that the patient had been checked for any weapons on his person and that none were found.

Introduced EMS crew to patient and performed primary assessment; no gross abnormalities noted during this examination. The patient advised that today is the anniversary of his wife's death and that he finds it extremely difficult to even get out of bed in the morning. He further advised he feels as though his life has no purpose anymore. According to the patient, he has been to several counseling sessions over the past year, but they have not seemed to help him.

He further said his employer does not seem to care about his problems and has threatened to fire him unless his depressed behavior improves. Patient would only consent to assessment of his vital signs; he would not consent to further assessment or treatment. Visual examination did not reveal any gross injuries or life-threatening conditions, and the patient continued to remain conscious, alert, calm, and oriented and was able to answer questions appropriately.

Because of the patient's significantly depressed state, it was advisable to transport him to the emergency department. Initially, he refused EMS transport; however, after explaining to him that there could be an underlying medical problem contributing to his depression, he consented to transport and vital sign monitoring only; he maintained his refusal of a physical examination. Careful assessment of the patient did not reveal any gross indicators of potential violence. Patient walked to the ambulance on his own accord and was safely secured to the stretcher. Began transport to the hospital and continued to monitor the patient's behavior and vital signs en route. No changes in the patient's status were noted en route, and he remained calm but did not want to talk.

Remainder of transport was uneventful. Delivered patient to ED staff and gave verbal report to charge nurse. After transferring patient care to the hospital staff, Medic 1780 returned to service.**End of report**

Prep Kit

Ready for Review

- A behavioral crisis is any reaction to events that interferes with the activities of daily living or has become unacceptable to the patient, family, or community.
- During a psychiatric emergency, a patient may show agitation or violence or become a threat to himself, herself, or others. This is more serious than the more typical behavioral crisis that causes inappropriate behavior such as interference with activities of daily living or bizarre behavior.
- According to the National Institute of Mental Health, mental disorders are common throughout the United States, affecting tens of millions of people each year. Psychiatric disorders are illnesses with psychologic or behavioral symptoms that may result in impaired functioning.
- Psychiatric disorders have many possible underlying causes including social or situational stress such as divorce or death of a loved one; psychiatric disorders such as schizophrenia; physical illnesses such as diabetic emergencies; chemical problems such as alcohol or drug use; or biologic disturbances such as electrolyte imbalances. Sometimes these conditions can be compounded by noncompliance with prescribed medication regimens.
- As an EMT, you are not responsible for diagnosing the underlying cause of a behavioral crisis or psychiatric emergency.
- Your job is to diffuse and control the situation and safely transport your patient to the hospital. Intervene only as much as it takes to accomplish these tasks. Be caring and careful.
- To the person experiencing a psychiatric emergency, the line between his or her reality and fantasy is blurred.
- The threat of suicide requires immediate intervention. Depression is the most significant risk factor for suicide.
- A patient with PTSD has experienced fear of danger, helplessness during the event, or has had a severe reaction during the event. In PTSD, memories of the trauma linger and continue to be disruptive. It can be made worse with the existence of current mental health issues.
- Patients experiencing delirium are generally not dangerous, but if they exhibit agitated behavior they may strike out irrationally. One of the most important factors to consider in these cases is your personal safety.
- A patient in a mentally unstable condition may resist your attempts to provide care. In such situations, request that law enforcement personnel handle the patient. Another reason for seeking law enforcement support is for a patient who resists treatment; such a patient often threatens you and others. Violent or dangerous people must be taken into custody by the police before emergency care can be rendered.
- Always consult medical control and contact law enforcement personnel for help before restraining a patient. If restraints are required, use the minimum force necessary. Assess the airway and circulation frequently while the patient is restrained.

Vital Vocabulary

activities of daily living The basic activities a person usually accomplishes during a normal day, such as eating, dressing, and bathing.

altered mental status A change in the way a person thinks and behaves that may signal disease in the central nervous system or elsewhere in the body.

behavior How a person functions or acts in response to his or her environment.

behavioral crisis The point at which a person's reactions to events interfere with activities of daily living; this becomes a psychiatric emergency when it causes a major life interruption, such as attempted suicide.

depression A persistent mood of sadness, despair, and discouragement; may be a symptom of many different mental and physical disorders, or it may be a disorder on its own.

excited delirium A serious behavioral condition in which a person exhibits agitated behavior combined with disorientation, hallucinations, or delusions; also called agitated delirium or exhaustive mania.

functional disorder A disorder in which there is no known physiologic reason for the abnormal functioning of an organ or organ system.

organic brain syndrome Temporary or permanent dysfunction of the brain, caused by a disturbance in the physical or physiologic functioning of brain tissue.

positional asphyxia Restriction of chest wall movements and/or airway obstruction; can rapidly lead to sudden death.

posttraumatic stress disorder A delayed stress reaction that develops after a horrifying ordeal that involved physical harm or the threat of physical harm.

psychiatric disorder An illness with psychological or behavioral symptoms and/or impairment in functioning caused by a social, psychological, genetic, physical, chemical, or biologic distur bance.

psychiatric emergency An emergency in which abnormal behavior threatens a person's own health and safety or the health and safety of another person, for example when a person becomes suicidal, homicidal, or has a psychotic episode.

psychosis A mental disorder characterized by the loss of contact with reality.

schizophrenia A complex, difficult-to-identify mental disorder whose onset typically occurs during early adulthood. Symptoms typically become more prominent over time and include delusions, hallucinations, a lack of interest in pleasure, and erratic speech.

Assessment *in Action*

It is July 10th and you are called for a 57-year-old man who is "acting strangely." An ALS fire engine has been called and you have been cleared to enter. Police and several bystanders are present in the area. The man is cowering against a wall in an alley. He is wearing a worn and dirty military uniform and boots that seem out of place in this hot weather. His head is bleeding. The patient watches your approach with skepticism and fear in his eyes.

Police tell you some kids were blowing up post 4th of July fireworks nearby. According to bystanders, the patient started running around and yelling about an IED. He started fighting with police when they encountered him, but they confirmed he doesn't have any weapons. The patient pulled away from them and cowered against the wall.

A woman comes forward to tell you the patient's name is Charlie and he got back from Afghanistan about 6 months ago. He was in the Army but was medically discharged. He was having problems adjusting to civilian life and his wife said he has had frequent angry outbursts. She threw him out of the house a few weeks ago. You ask if she is aware of any medical conditions. She states he takes medications for a few conditions but she isn't sure what.

Charlie allows you to approach but still seems very afraid. You ask him if you can look at the wound on his head and ask him how it happened. He tells you it was from shrapnel from the IED. You ask him if he has any medical problems, takes medication, or has any allergies. He tells you he's allergic to sulfa and has high blood pressure and diabetes, but he has had no medication available. He complains of a headache. You ask him what happened today. He tells you the IED scared him and killed his friend, Nate. You ask him where he is and he tells you, "Afghanistan."

1. Which of the following points given by the neighbor is the most important to your care?

   A. He got back from Afghanistan about 6 months ago.
   B. He was in the Army but was medically discharged.
   C. His wife said he has had constant angry outbursts.
   D. She threw him out of the house a few weeks ago.

2. What is the significant concern in his story about the IED?

   A. His friend died.
   B. It was in Afghanistan.
   C. The IED explosion scared him.
   D. He believes it was an IED rather than fireworks.

3. What is the most likely psychologic condition?

   A. Alzheimer disease
   B. Depression
   C. Posttraumatic stress disorder
   D. Hypertension

4. Which of the following statements may help you provide care for Charlie?

   A. I know how you feel.
   B. I'm sorry about your loss.
   C. Come with me, and let's go to a place where they can help you.
   D. It wasn't an IED, it was just fireworks.

5. Which of the following treatments would be appropriate for Charlie?

   A. Sedative medication
   B. Oxygen by mask
   C. Glucose, if his blood glucose level is low
   D. High blood pressure medication

6. Would it be wise to restrain this patient to the stretcher?

   A. Yes, he is potentially violent.
   B. Yes, it is best to restrain psychiatric patients.
   C. No, restraint is unethical.
   D. No, it may only aggravate the situation.

7. Which of the following statements is true regarding the returning veteran?

   A. A person's altered consciousness can allow him or her to continue functioning under negative conditions.
   B. Guilt, shame, paranoia, and hostility are rare with combat veterans.
   C. Alcohol and/or drug use is a common way to activate the sympathetic nervous system.
   D. Suicide is rare in these patients.

8. What scene safety issues should you consider?

9. What medical issues could be the cause of Charlie’s emergency?
10. What are some techniques you could use when approaching him?

CHAPTER 23

Gynecologic Emergencies

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Gynecology

› Recognition and management of shock associated with
- Vaginal bleeding (pp 833, 835–836)

› Anatomy, physiology, assessment findings, and management of
- Vaginal bleeding (pp 829–830, 832–836)
- Sexual assault (to include appropriate emotional support) (pp 837–839)
- Infections (pp 829–837)

Knowledge Objectives

1. Describe the anatomy and physiology of the female reproductive system; include the developmental changes that occur during puberty and menopause. (pp 829–830)
2. Discuss the special, age-related patient management considerations EMTs should provide for both younger and older female patients who are experiencing gynecologic emergencies. (pp 830–831)
3. List three common examples of gynecologic emergencies; include the causes, risk factors, assessment findings, and patient management considerations. (pp 831–832)
4. Explain how an EMT would recognize conditions associated with hemorrhage during pregnancy. (p 832)
5. Discuss the assessment and management of a patient who is experiencing a gynecologic emergency; include a discussion of specific assessment findings. (pp 832–835)
6. Explain the general management of a patient who is experiencing a gynecologic emergency in relation to privacy and communication. (pp 833–835)
7. Give examples of the personal protective equipment EMTs should use when treating patients with gynecologic

emergencies. (p 836)

8. Discuss the special considerations and precautions EMTs must observe when arriving at the scene of a suspected case of sexual assault or rape. (pp 837–838)
9. Discuss the assessment and management of a patient who has been sexually assaulted or raped; include the additional steps EMTs must take on behalf of the patient. (pp 837–839)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

The most obvious difference between men and women is that women are uniquely formed to conceive and give birth. This difference makes women susceptible to a number of conditions that do not occur with men. This chapter examines a few of those conditions. Female anatomy is discussed first, followed by conditions that may be encountered in the prehospital setting. Vaginal bleeding is always an important consideration. Health concerns specific to the very young and the very old are discussed. The principles of managing a woman who has been the victim of sexual assault or rape, as well as recognizing the potential use of date rape drugs, are also discussed.

Anatomy and Physiology

The female reproductive system includes internal and external structures. The external female genitalia consist of the vaginal opening just posterior to the urethral opening **Figure 23-1**. The **labia majora** and **labia minora** are folds of tissue that surround the urethral and vaginal openings. At the anterior end of the labia is the clitoris, and at the posterior end is the anus. The **perineum** is the area of tissue between the vagina and the anus. The labia are extremely vascular and can be injured, but because of their location, they seldom are except in cases of sexual abuse.

In terms of internal structures, the **ovaries** are the primary female reproductive organ **Figure 23-2**. The ovaries are located on each side of the lower abdomen and produce an ovum, or egg, that, if fertilized, will develop into a fetus. The **fallopian tubes** connect each ovary to the uterus. The **uterus** is the muscular organ where the fetus grows during pregnancy. The narrowest portion of the uterus, the **cervix**, opens into the vagina. The **vagina** is the outermost cavity of a woman's reproductive system and forms the lower part of the birth canal.

When a female reaches puberty, she begins to ovulate and experience menstruation. **Ovulation** is the cycle in which the ovum is released. The onset of menstruation is called *menarche* and usually occurs between the ages of 11 and 16 years, although it can occur earlier or later. Any female who has reached menarche is capable of becoming pregnant. Women continue to experience the cycle of ovulation and menstruation until they reach *menopause*, which marks the end of menstrual activity. Women reach menopause at widely varying ages, but it commonly occurs around the age of 50 years.

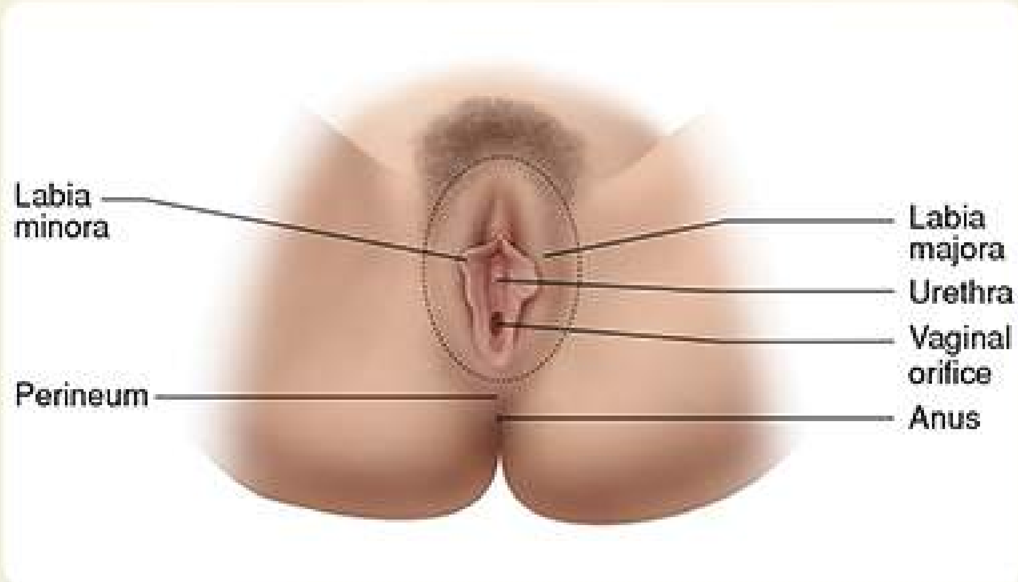


Figure 23-1 The external genitalia of the female reproductive system.

YOU are the Provider — PART 1

At 0555 hours, law enforcement personnel request your assistance at 4300 West Avenue for a young woman who was assaulted. You and your partner respond to the scene, which is located about 4 miles away. While you are en route, an on-scene law enforcement officer radios you over a private channel and informs you the patient has been sexually assaulted and that the scene is safe. The weather is overcast, the temperature is 78°F (26°C), and the traffic is light.

1. What factors should you consider while responding to this call?
2. What are some unique aspects about assessing and treating a woman who has been sexually assaulted?

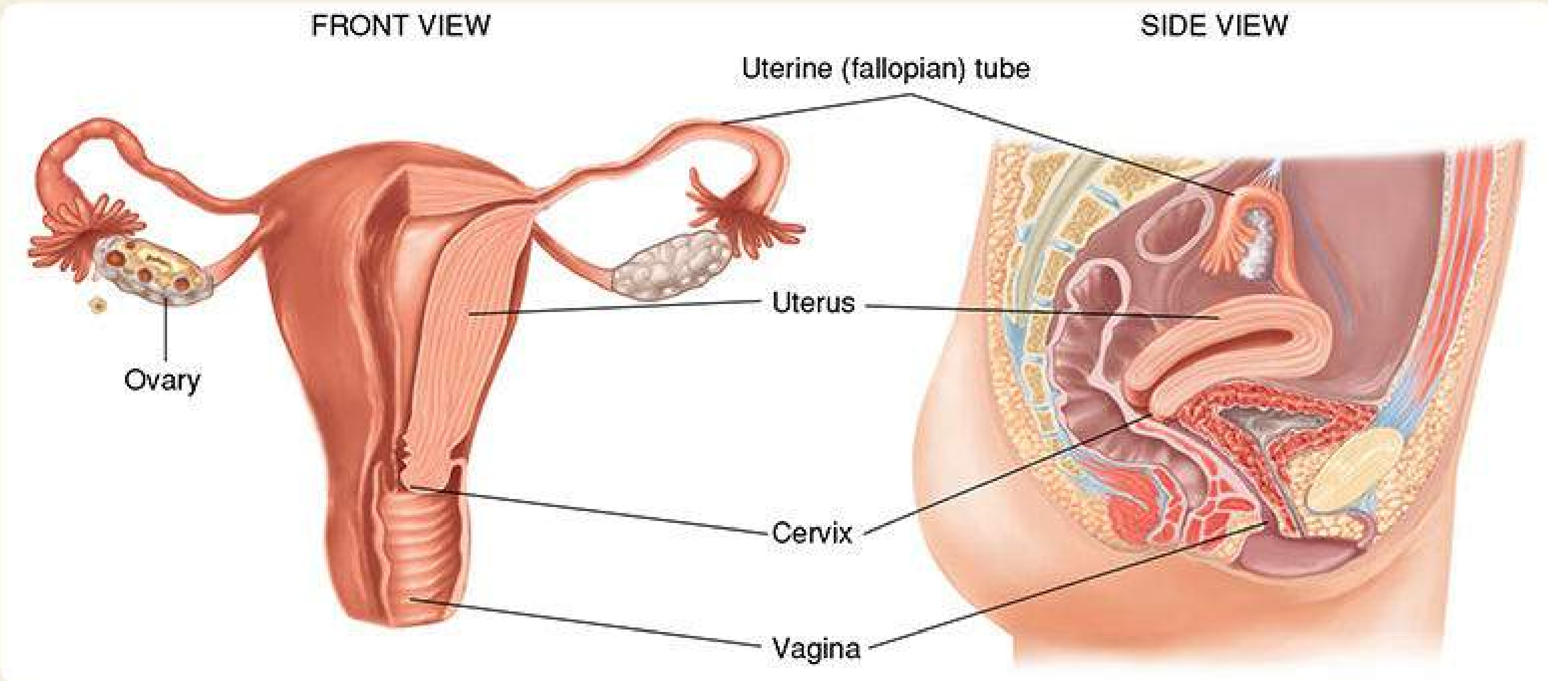


Figure 23-2 Front and side views of the female reproductive system.

Each ovary produces an ovum in alternating months and releases it into the fallopian tube. Some women experience minor cramping pain during ovulation when an ovum is released. The pain is sometimes described as a dull pain on one side of the lower abdomen. For some women the pain is severe enough to keep them bedridden during this time. The quality and severity of the pain vary for each woman.

The process of fertilization begins in the vagina, where sperm from the male penis are deposited in the female reproductive tract. The sperm pass through the cervix into the uterus and eventually up the fallopian tubes. As the ovum moves slowly down the fallopian tube, sperm moving up the tube can surround it, and one sperm fertilizes it. When an ovum is fertilized in the fallopian tube, the developing embryo travels into the uterus where the lining of the walls of the uterus has become engorged with blood in anticipation of receiving a fertilized ovum. Here, the embryo attaches to the uterine wall and continues to grow.

If the ovum is not fertilized in the fallopian tube, it continues to travel into the uterus. Because fertilization has not occurred within about 14 days of ovulation, the lining of the uterus begins to separate and menstruation occurs. The menstrual flow consists of blood from the separated lining of the uterus and lasts about 1 week. Female hormones produced primarily in the ovaries control the process of ovulation and menstruation.

Special Populations

The onset of menarche in girls can be an emotionally and physically disturbing event. It is not uncommon for this event to be preceded by cramping pain that can be misinterpreted by the girl who has not yet experienced menstruation. Most girls have learned about the menstrual process from their parents or from health classes at school, but some are still unprepared when it finally occurs. Girls who have led a very sheltered life or who do not have a female parent in the home are more likely to be surprised by the onset of their menstruation. Parents may also be in denial, insisting that their little girl is too young to be experiencing menstruation.

Approach the patient (and her parents) in the most professional manner possible. Empathize with their concerns, and provide transport to the hospital to help ease the parents' concerns and also to help determine if some other condition is causing or contributing to the situation. Whenever possible, have a female EMT or a female family member accompany the patient.

Pathophysiology

The causes of gynecologic emergencies are varied and range from sexually transmitted diseases to trauma. You should recognize and properly manage female patients with any kind of abdominal or pelvic pain and consider problems that could be potentially life threatening.

Pelvic Inflammatory Disease

Pelvic inflammatory disease (PID) is an infection of the upper female reproductive organs—specifically, the uterus, ovaries, and fallopian tubes—that occurs almost exclusively in sexually active women. Disease-causing organisms enter the vagina during sexual activity and migrate through the opening of the cervix and into the uterine cavity. The infection may then expand to the fallopian tubes (producing scarring that can increase the risk of life-threatening ectopic pregnancy or sterility), eventually involving the ovaries (leading to the development of a life-threatening abscess). *Ectopic pregnancy* is a pregnancy that develops outside the uterus, most often in the fallopian tube. Although PID itself is seldom a threat to life, it can lead to an ectopic pregnancy or an abscess, which can cause death. The most common presenting sign of PID is generalized lower abdominal pain. Other signs and symptoms include an abnormal and often foul-smelling vaginal discharge, increased pain during sexual intercourse, fever, general malaise, and nausea and vomiting.

Special Populations

Menopause is the end of a woman's menstrual cycle. The process of menopause is a complicated one. As menopause approaches, menstrual periods may become irregular and vary in severity. It is not uncommon for women at this stage to continue to have irregular menstrual periods for several months to a year as the process progresses. It is important to recognize that during this time it is still possible for women to become pregnant. If a woman and her partner no longer use birth control methods because they believe they can no longer become pregnant, they may be in denial when the signs of pregnancy occur. Treat patients with compassion and reassure them, but also transport them for examination by a physician to determine if this or something else (such as a tumor or cyst) is causing the problem.

Sexually Transmitted Diseases

Sexually transmitted diseases can lead to more serious conditions. For example, untreated gonorrhea and chlamydia often progress to PID.

YOU are the Provider — PART 2

You arrive at the scene and find the patient, a 25-year-old woman, sitting on the ground near her car. She is conscious and alert but is crying. Her shirt is torn, and she is nude from the waist down. A police officer covered her with a blanket. After introducing yourself and your partner, you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Obvious emotional distress
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Normal rate; adequate depth
Circulation	Radial pulses, normal rate and strong; skin is pink, warm, and moist; no obvious bleeding

A police officer informs you the patient was apparently assaulted in her vehicle and the last thing she remembered was talking to a young man she met while listening to music and drinking a margarita with her friends at a local nightclub at about 2100 hours last night.

3. What immediate medical treatment, if any, does this patient require?
4. On the basis of the police officer's report, what should you suspect regarding the events that preceded the patient's assault?

Chlamydia is caused by the bacterium *Chlamydia trachomatis*. According to the Centers for Disease Control and Prevention (CDC), chlamydia is currently the most commonly reported sexually transmitted disease in the United States. Although the symptoms of chlamydia are usually mild or absent, some women may report lower abdominal pain, low back pain, nausea, fever, pain during sexual intercourse, and/or bleeding between menstrual periods. Chlamydial infection of the cervix can spread to the rectum, leading to rectal pain, discharge, or bleeding. If it is left untreated, the disease can progress to PID. In rare cases, chlamydia causes arthritis that may be accompanied by skin lesions and inflammation of the eye and urethra.

Bacterial vaginosis is the most common vaginal infection in women age 15 to 44, according to the CDC. In this infection, normal bacteria in the vagina are replaced by an overgrowth of other bacterial forms. Symptoms may include itching, burning, or pain and may be accompanied by a “fishy,” foul-smelling discharge. Pregnant women with bacterial vaginosis may have premature babies or babies born with low birth weight. If it is left untreated, bacterial vaginosis can lead to more serious infections, or result in PID.

Gonorrhea is caused by *Neisseria gonorrhoeae*, a bacterium that can grow and multiply rapidly in the warm, moist areas of the reproductive tract, including the cervix, uterus, and fallopian tubes in women and in the urethra in women and men. The bacterium can also grow in the mouth, throat, eyes, and anus. Symptoms, which are generally more severe in men than in women, appear approximately 2 to 10 days after exposure. Women may be infected with gonorrhea for months but not have any symptoms, or only mild ones, until the infection has spread to other parts of the reproductive system. When symptoms do appear in women, they generally present as painful urination, with associated burning or itching; a yellowish or bloody vaginal discharge, usually with a foul odor; and blood associated with vaginal sexual intercourse. More severe infections may present with cramping and abdominal pain, nausea and vomiting, and bleeding between menstrual periods; these symptoms indicate that the infection has progressed to PID. Rectal infections generally present with anal discharge and itching and occasional painful bowel movements with fecal blood spotting. Infection of the throat (for which oral sex is the introducing factor) usually results in mild symptoms consisting of painful or difficult swallowing, sore throat, swollen lymph glands, and fever. Headache and nasal congestion may also be present. If the infection is not treated, the bacterium may enter the bloodstream and spread to other parts of the body, including the brain.

Vaginal Bleeding

Because menstrual bleeding occurs monthly in most women, vaginal bleeding that is the result of other causes may initially be overlooked. Some possible causes of vaginal bleeding include abnormal menstruation, vaginal trauma, ectopic pregnancy, spontaneous abortion (miscarriage), cervical polyps, and even cancer. Trauma to the internal female genitalia from any cause other than vaginal penetration is rare because these organs are located deep within the pelvis. Injuries to the vagina and external genitalia are very painful and serious because of the large quantity of nerves and blood vessels in this area. In contrast, internal bleeding from polyps or cancer, while also very serious, may be relatively painless.

Ectopic pregnancy and spontaneous abortion are two conditions that can cause vaginal bleeding in women who do not appear to be pregnant and who may not realize they are pregnant. These potentially life-threatening conditions are covered in Chapter 33, *Obstetrics and Neonatal Care*. All cases of vaginal bleeding should be taken seriously, and the patient should be transported to the hospital for a thorough gynecologic examination.

Patient Assessment

Obtaining an accurate and detailed patient assessment is critically important when dealing with gynecologic issues. You will be able to gain only a primary impression of the problem in the field, yet a thorough patient assessment will help determine just how sick the patient is and whether you should initiate life-saving measures. This is especially true when dealing with abdominal pain.

Women have many of the same conditions that cause abdominal pain in men, for example, ulcers and appendicitis. In addition, there are numerous gynecologic causes of abdominal pain. An old medical axiom states, “Anyone who neglects to consider a gynecologic cause in a woman of childbearing age who reports abdominal pain will miss the diagnosis at least 50% of the time.” Missing the diagnosis may be fatal for the patient.

Scene Size-up

Every emergency call—including calls involving gynecologic emergencies—begins with a thorough scene size-up. Is the scene safe? Will you need assistance? How many patients do you have? What is the nature of illness (NOI)? Have you taken standard precautions? Gynecologic emergencies can be very messy, sometimes involving significant amounts of blood and body fluids contaminated with organisms that can potentially cause communicable diseases.

Where and in what position is the patient found **Figure 23-3** ? If she is at home, what is the condition of the residence? Is it clean or dirty? Do you see evidence of a fight? Is alcohol, tobacco products, or evidence of drug use present? Are there photos of loved ones or is there a noticeable absence of photos? Does the patient live alone or with other people? All of the information you obtain contributes to your assessment of the patient’s overall health and the safety of the scene. In the case of a crime scene, you may also be required to testify in court regarding the conditions on your arrival. Your documentation needs to be accurate and thorough. Involve law enforcement if any type of assault is suspected. In cases of sexual assault, it is important to have a female EMT provide patient care, so consider calling for one early if you and your partner are men.

Often the NOI or mechanism of injury (MOI) in patients with gynecologic emergencies will be understood from the dispatch information, such as in cases of sexual assault. In other patients, the exact nature of the condition will not emerge until you gather patient history information. For example, your patient may present with vague symptoms such as abdominal pain, and you will not be able to determine the exact nature of the problem until you gather more information during the patient history.

Figure 23-3 Note the position of the patient during your assessment.

Primary Assessment

The general impression is an important aspect of all patient assessments. As you approach the patient, you should quickly determine if her condition is stable or unstable. Use this information to help you as you proceed further with the assessment. Use the AVPU scale to determine the patient's level of consciousness.

Always evaluate the airway and breathing immediately to ensure they are adequate, and treat any airway or breathing problem that is identified according to established guidelines and local protocol. Identifying and treating life threats takes precedence over all other assessment and treatment.

It is important to carefully assess the circulation in all patients. Palpate a pulse and evaluate skin color, temperature, and moisture to help identify the patient who might have blood loss. If the patient has experienced significant blood loss because of vaginal bleeding, she may not demonstrate obvious signs of shock but may still be hypovolemic. If the patient has a weak or rapid pulse or has pale, cool, or diaphoretic skin, place the patient in a supine position. Cover the patient to keep her warm, and then transport to the nearest appropriate receiving facility for treatment.

Most cases of gynecologic emergencies are not life threatening; however, if signs of shock exist because of bleeding, then rapid transport is necessary. The remainder of the assessment can be performed en route to the hospital.

History Taking

Begin by asking about the patient's chief complaint, but realize some of the questions you must ask may be considered extremely personal. Be sensitive to the patient's feelings and ensure her privacy and dignity are protected. Gynecologic emergencies can be highly embarrassing for the patient, and many women may be extremely uncomfortable with discussing their sexual history in front of strangers or even close family members. An adolescent girl may want to keep her sexual history from her parents.

For a report of abdominal pain, ask specific questions about onset, duration, quality, and radiation. Provoking or relieving factors and associated symptoms such as syncope, light-headedness, nausea, vomiting, and fever are also relevant. For a report of vaginal bleeding ask about onset, duration, quantity (number of sanitary pads soaked), and associated symptoms such as syncope and light-headedness.

Obtain a SAMPLE history beginning with her current symptoms. Make note of any allergies she has or any over-the-counter or prescription medications she is taking, such as birth control pills and any birth control devices she uses. Ask the patient about medical conditions, and ask specifically about her last menstrual period. This will help determine if the patient is possibly pregnant. Ask about the possibility of sexually transmitted diseases and the possibility of pregnancy. Find out when she last ate or drank and what events led up to her calling for EMS. Use her NOI, her chief complaint, and her answers to your other questions to lead further questioning. For example, if she answers that she is sexually active, ask her about birth control and also about symptoms of pregnancy. If she has vaginal bleeding, ask how many sanitary pads she is using per hour. This information can help create an estimate of blood loss.

Secondary Assessment

The secondary assessment may be performed on scene, en route to the emergency department (ED), or, in some instances, not at all. If the patient is critically ill or injured or the transport time is short, you may not have time to conduct this part of the patient assessment process.

Pertinent secondary assessment findings should include:

- **Vital signs:** blood pressure, pulse, skin color, orthostatic vital signs
- **Abdomen:** distention and tenderness
- **Genitourinary:** visible bleeding
- **Neurologic:** mental status

Your physical examination of a gynecologic patient should be limited and professional. Only examine the genitalia if it is necessary to do so to treat the patient. Protect the woman's privacy during the physical examination. Few women are comfortable with having their body exposed to a crowd of family, neighbors, EMTs, police officers, or firefighters. Limit the personnel present to only those required to perform the necessary tasks; show the patient you respect her by being an advocate for her modesty. You also serve as a role model for other EMS providers when you act this way.

The population of women over the age of 65 is growing and, even though they are past their childbearing years, many will have other gynecologic problems. They may have concerns specific to hormone replacement therapy, have an increased risk of cancer, or could be suffering from internal physical changes in the female organs caused by age, for example pelvic floor prolapse and urinary incontinence. Although these problems cannot be treated in the prehospital environment, perform and record a thorough assessment and treat any of the patient's immediate needs.

YOU are the Provider — PART 3

The patient remains conscious and alert but is still in obvious emotional distress. She gives you consent to take her vital signs. A female police officer is present when you ask the patient if she is injured. She tells you she is experiencing vaginal pain but denies vaginal bleeding. The only obvious injuries you can see are minor abrasions to her forearms.

Recording Time: 8 Minutes	
Respirations	14 breaths/min; adequate depth
Pulse	72 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	110/70 mm Hg
Oxygen saturation (Spo_2)	98% (on room air)

The patient tells you she wants to take a shower and change her clothes. She also tells you she needs to urinate. She asks a police officer to call a friend of hers and ask the friend to come to the scene.

5. What additional assessment should you perform on this patient?

6. How should you respond to the patient's request to take a shower, change her clothes, and use the washroom?

Focus your physical examination on the NOI and the patient's chief complaint. If vaginal bleeding is the NOI, you should visualize the bleeding and ask about its quality and quantity. Use external sanitary pads to control the bleeding, and keep the possibility of hypoperfusion or shock in mind. Always ask if there is pain associated with the vaginal bleeding or discharge. Never insert anything into the vagina to control bleeding, including a tampon.

Vaginal discharge is another condition that should be observed if possible. Make observations about the discharge, and ask the patient about any qualities she noticed and the history of the discharge.

Fever, nausea, and vomiting are common with many medical conditions but should be considered especially significant with gynecologic emergencies. Fever should always be considered a sign of an infectious process. Any report of syncope on the part of the patient, especially if she reports vaginal bleeding, is considered significant. Treat the patient reporting this symptom as being in shock until proven otherwise.

Words of Wisdom

During the assessment, explain to the patient what you are about to do and why. This will help gain her trust and confidence.

Assess the patient's vital signs, including heart rate, rhythm, and quality; respiratory rate, rhythm, and quality; skin color, temperature, and condition; capillary refill time; and blood pressure. Consider obtaining orthostatic vital signs if bleeding is known or suspected. Pay special attention to the presence of tachycardia and hypotension, which could indicate hemorrhagic shock.

Use the appropriate monitoring devices, such as pulse oximetry, to track the patient's condition. Also consider using noninvasive blood pressure monitoring to continuously track the patient's blood pressure. Assess the patient's first blood pressure manually with a sphygmomanometer (blood pressure cuff) and stethoscope. Remember, pulse oximetry readings may not be accurate in the setting of hypovolemia.

Reassessment

Repeat the primary assessment. Reassess the patient's vital signs and the chief complaint. Reassess the patient's vital signs every 5 minutes to identify hypoperfusion from excessive blood loss. If the patient shows signs of shock, begin treatment and rapid transport.

How is the patient's condition improving with the interventions? Identify and treat any changes in the patient's condition. For example, if the patient appears to be losing consciousness, position her in the supine position, and perform a reassessment. Finally, pay specific attention to the needs of your patient, and respect her desire for conversation or silence. Provide her with calm reassurance. Explain to her that the hospital staff will be sympathetic to her condition and will be well qualified to treat her.

There are very few interventions that can or should be done for a patient with a gynecologic emergency. If the patient has vaginal bleeding, treat her for hypoperfusion or shock. Keep her warm, place her in a supine position, and provide her with supplemental oxygen even if she is not experiencing difficulty breathing. Consider advanced life support intercept for fluid replacement, then transport to the nearest appropriate receiving facility.

Notify staff at the receiving hospital of all relevant information, including the possibility of pregnancy, so a proper response can be prepared. Carefully document the patient's condition, her chief complaint, the scene, and all interventions, especially in cases of sexual assault.

Words of Wisdom

Gynecologic emergencies can occur at any age during a woman's lifetime. As an EMT, there is little you can do in this type of emergency; therefore, you should focus on assessing and correcting the patient's ABCs and consider rapid transport as an important part of the call.

Emergency Medical Care

Whenever you care for patients with gynecologic emergencies, you must maintain the patient's privacy as much as possible. If the patient is in a public place, move her to the ambulance. Gain the patient's confidence by communicating appropriately. Have a female EMT participate in the patient's care if possible.

Excessive internal vaginal bleeding can have many causes and can possibly lead to hypoperfusion or shock. Determining the cause of the bleeding should be less important than treating for shock and transporting the patient to an appropriate facility. Use sanitary pads on the external genitalia to absorb the blood. Most women will use sanitary pads before you arrive, so you may continue that approach. Document the number of sanitary pads that were saturated with blood. If the woman has a tampon in place, it is not necessary to have her remove it. Vaginal bleeding is rarely significant enough to cause hemorrhagic shock, but the patient should be treated for shock nevertheless. Apply oxygen, keep the patient supine and warm, and promptly transport to the hospital.

The genitals have a rich nerve supply, making injuries very painful. Treat any external lacerations, abrasions, and tears with sterile compresses, using local pressure to control bleeding and a diaper-type bandage to hold the dressings in place. Leave any foreign bodies in place after stabilizing them with bandages. Under no circumstances should you pack or place dressings inside the vagina. Continue to assess the patient while transporting her to the ED. Contusions and other blunt trauma will require careful in-hospital evaluation.

Words of Wisdom

Gynecologic emergencies may involve significant blood and body fluids. Personal protective equipment (PPE), including gloves, eye protection, and a mask, must be considered.

Assessment and Management of Specific Conditions

Pelvic Inflammatory Disease

A patient with PID will report abdominal pain. The pain generally starts during or after normal menstruation, so inquiring about the date of the patient's last menstrual period is an important detail of the patient's history. The pain may be described as "achy" and may be made worse by walking. Other symptoms may include vaginal discharge, fever and chills, and pain or burning on urination. Patients often present with a distinctive gait that appears as a shuffle when they walk.

Safety Tips

Remember that many sexually transmitted diseases can also be transmitted by contact with blood. Some examples of these diseases include syphilis, many types of hepatitis, and human immunodeficiency virus (HIV).

YOU are the Provider — PART 4

The patient refuses to go to the hospital and tells you all she wants to do is take a shower and change her clothes. Her friend arrives at the scene and asks if she can talk to the patient alone. After a brief conversation, the patient tells you she will go to the hospital, but only if her friend can come with her. You tell her that will be fine. You secure her to the stretcher, reassess her vital signs, and begin transport.

Recording Time: 28 Minutes	
Level of consciousness	Conscious and alert
Respirations	14 breaths/min; adequate depth
Pulse	80 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	118/68 mm Hg

Spo_2	99% (on room air)

7. How should you respond to the patient's refusal to go to the hospital?
8. Whose responsibility is it to determine why the patient was sexually assaulted?

Prehospital treatment is limited, and nonemergency transport is usually recommended. As stated earlier, PID itself is seldom life threatening, but it is serious enough to require transport and evaluation in the hospital.

Sexual Assault and Rape

Unfortunately, **sexual assault** and **rape** are all too common occurrences. According to a government survey, approximately 18% of women (or 1 in 5) in the United States reported being raped during their lifetime, and 1 in every 4 have been sexually abused in some form, often before the age of 12 years. EMTs called to treat a victim of sexual assault, sexual abuse, or actual or alleged rape face many complex issues, ranging from obvious medical ones to serious psychologic and legal issues. You may be the first person the victim has contact with after the encounter, and how you manage the situation from first contact throughout treatment and transport may have a lasting effect for the patient and you. Being professional, respectful, and sensitive is very important.

When performing your assessment, be aware of information suggesting the potential use of date rape or "club" drugs. The patient may or may not be aware of the use of drugs in her assault but an inability to remember the event should create suspicion. Drugs such as Rohypnol (flunitrazepam), known as "roofies"; GHB (gamma-hydroxybutyric acid), known as "Liquid Ecstasy"; Ketalar (ketamine), known as "Special K"; Klonopin (clonazepam); MDMA, known as "Ecstasy"; Xanax (alprazolam); and alcohol are drugs typically used during sexual assault and rape for the intended purpose of incapacitating a person.

These drugs can be put into a person's drink and may go undetected because they often do not have a color, smell, or taste. The effects may be immediate and are made more active with alcohol. The patient may become weak and confused and may even have a loss of consciousness. These drugs cause muscle relaxation and loss of muscle compliance, which may make the victim more compliant during a sexual assault. If these drugs are still in the patient's system during your assessment you may see hypotension, bradycardia, abdominal complaints, difficulty breathing, seizures, coma, and even death.

Because sexual assault and rape are crimes, you can generally expect law enforcement to be involved early in the situation. In many cases, EMS may be called by law enforcement. Police officers generally have basic medical training, since many states require at least basic training at the first responder (emergency medical responder) level. Nevertheless, primary training for police officers focuses on crime investigation, not patient care.

A rape victim has just experienced a major trauma of her body and mind. The last thing she wants to do is give a concise, detailed report of what she has just experienced. If you attempt to gather patient information in this manner it will most likely cause her to "shut down." Whenever possible, a female rape victim should be given the option of being treated by a female EMT, because the patient may be experiencing mixed feelings toward men; these feelings will hinder the patient assessment and the patient's well-being.

The job of law enforcement is to solve the crime, arrest the perpetrator, and see justice served. Your job, as the EMT, is to handle the medical and psychological aspects of the case and to act as the patient advocate. In this capacity, it is important for you to focus on several key components.

The first component is the medical treatment of the patient. Is she physically injured? Are any life-threatening injuries present? Does the patient report any pain?

The second component is your psychologic care of the patient. Do not cross-examine the patient or attempt to obtain information for the benefit of the police. These issues will be handled later by the hospital staff and police. Do not pass judgment on the patient, and protect her from the judgment of others on the scene. A crime may have been committed, and you need to remain aware of that fact. Many women report feeling violated when subjected to interrogation, criticism, or disbelief.

Last, remember that you are at a crime scene. Although your job is to treat the medical aspects of the incident and not to collect evidence, you still have a responsibility to preserve evidence. Do not cut through any clothing or throw away anything from the scene. Place bloodstained clothing and anything else that could be evidence in separate paper (not plastic) bags. Obtain evidence bags from the police if necessary. Paper bags allow wet items to dry naturally, whereas plastic allows mold to grow and may destroy biologic evidence.

It may be necessary to gently discourage the patient from cleaning herself. Victims tend to want to "wash away" the humiliation and embarrassment of the assault. Valuable evidence can be destroyed in this process. Also discourage the patient from urinating, changing clothes, moving her bowels, or rinsing out her mouth. She will be photographed and examined by nurses trained in sexual assault examination and management (sometimes called Sexual Assault Nurse Examiners [SANE nurses]) or law enforcement personnel as well, and the evidence needs to be as accurate as possible. If you cannot discourage the patient from taking these actions, respect her feelings. Some patients may refuse transport altogether, and they have the right to do so. In such cases, follow your system's refusal of treatment policy or procedure for sexual assault victims without judging or talking down to the patient. Your compassion is the best tool you have to gain the patient's confidence and encourage her to get help.

If the patient refuses transport, offer to call the local rape crisis center for her. Many communities have rape crisis centers with victim advocacy hotlines. Having a professional advocate at the scene may help the patient deal with the trauma, and the advocate can better explain in more compassionate detail the necessity of preserving evidence. Many victim advocates are rape-trauma survivors themselves. They can provide support to the patient in the hospital during any additional physical examinations.

Take the patient's history, and limit any physical examination to a brief survey for life-threatening injuries. Treat all other injuries such as contusions or lacerations according to the appropriate procedures and protocols for your EMS system. Follow standard precautions. Expose and examine the vaginal area only if there is evidence of bleeding that needs to be treated. Cover and protect the patient from curious onlookers. Examine and interview the patient with a minimum of people present; move her to the ambulance if necessary.

The patient report is a legal document and, should the case result in an arrest and subsequent trial, may be subpoenaed. Keep the report concise, and record only what the patient stated in her own words. Use quotation marks to indicate you are reporting the patient's version of events. Do not insert your own "opinion" as to whether the patient was sexually assaulted or raped or offer any conclusions that would prove or disprove the patient's account of the event. Focus on the facts. Record all of your observations during the physical examination—the patient's emotional state, the condition of her clothing, obvious injuries, and so forth. Remember that rape is a legal diagnosis, not a medical diagnosis. The medical team can establish only whether sexual intercourse occurred; a court must decide whether sexual intercourse was forcibly inflicted against her will. Table 23-1 lists the treatment principles you should use when dealing with a victim of sexual assault.

Often the most important intervention for sexual assault patients is comforting reassurance and transport to a facility that has employees who are certified to perform the proper physical examination in this type of case. Reminding the patient that she is safe with you and that the hospital staff and the police will take good care of her may help reassure her. Sometimes just the presence of a female EMT can be emotionally helpful. Do not insist the patient talk to you, but listen carefully and do not be judgmental if she does want to talk. Remember that victims of sexual assault also need medical assistance; therefore, treat the medical injuries, but also remember to ensure the patient's privacy and provide her emotional support.

YOU are the Provider — PART 5

You reassess the patient en route to the hospital; her mental status and vital signs indicate that she is stable. Her friend provides emotional support to her and assures her what happened was not her fault. You call your radio report to the receiving facility and give them your estimated time of arrival.

Recording Time: 38 Minutes	
Level of consciousness	Conscious and alert
Respirations	16 breaths/min; adequate depth
Pulse	76 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	122/72 mm Hg
Spo_2	98% (on room air)

9. Why is it important to transport a sexual assault victim to the hospital, even if she does not have any obvious injuries?

Table 23-1 Treatment Principles for Sexual Assault

In addition to the usual treatment principles that apply to all victims, follow these special steps when treating patients who have been sexually assaulted:

1. Document the patient's history, assessment, treatment, and response to treatment in detail because you may have to appear in court as long as 2 to 3 years later. Do not speculate. Record only the facts.
2. Complete the SAMPLE history objectively.
3. Follow any crime scene policy established by your system to protect the scene and any potential evidence for police, particularly policies regarding evidence collection. If the patient will tolerate being wrapped in a sterile burn sheet, this may help investigators find any hair, fluid, or fiber from the alleged offender.
4. Do not examine the genitalia unless there is major bleeding. If an object has been inserted into the vagina or rectum, do not attempt to remove it.
5. Whenever possible, reduce the patient's anxiety by using an EMT who is the same gender as the patient.
6. Discourage the patient from bathing, voiding, or cleaning any wounds until after the hospital staff has completed an assessment. Handle the patient's clothes as little as possible, placing clothing and any other evidence in paper bags. If the patient insists on urinating, ask the patient to do so in a sterile urine container (if available). Also, deposit the toilet paper in a paper bag. Seal and label the bag for law enforcement. This can be critically important evidence.
7. If possible, transport the patient to a hospital with specialized staff such as sexual assault nurse examiners (SANE) who can fully evaluate these patients, perform medical and forensic examinations, and provide all aspects of medical and supportive care for these patients.

YOU are the Provider — SUMMARY

1. What factors should you consider while responding to this call?

As with any call, your first priority should be to ensure the scene is safe for you to enter; this is especially true when you respond to an assault or any other call that has a higher than usual risk for violence. Although an on-scene law enforcement officer has informed you that the scene is safe, you must still remain aware of your surroundings when you arrive. While the scene may initially be safe, it can quickly turn violent.

Your next consideration should be for the patient. Although you should avoid asking specific questions over the radio regarding a sexual assault, you should determine if the patient is conscious and if she appears to have any life-threatening injuries or major bleeding. As with any patient, the more information you obtain while en route to the scene, the better prepared you will be to provide immediate care when you arrive.

Last, you should consider the fact that you are responding to a crime scene. While your job is to treat the *medical* aspects of the incident and not to collect evidence, you still have a responsibility to preserve evidence, to the extent possible, without sacrificing patient care.

2. What are some unique aspects about assessing and treating a woman who has been sexually assaulted?

The medical treatment you provide to a sexual assault victim follows the same principles as with any other patient—identify and treat life-threatening injuries. However, it is important to remember that the emotional effects on the patient are devastating.

When you are called to treat victims of sexual assault, you face many challenges that range from obvious medical concerns to serious psychologic and legal matters. Be professional and sensitive at all times.

You should expect she will not want to talk about the details of what happened. Do not force the victim to talk about her experience if she does not want to talk.

Whenever possible, a female sexual assault victim should be assessed and treated by a female EMT. If this is not an option, ask the patient if there is a female friend that you can call; if there is, she should be present during your assessment and treatment of the patient. Another option is to request a female police officer, if available, to respond to the scene.

3. What immediate medical treatment, if any, does this patient require?

Your primary assessment has not revealed any obvious immediately life-threatening injuries or conditions; therefore, immediate emergency medical treatment is not indicated *at this point*.

The patient is conscious and alert, although she is emotionally distressed. Her airway is patent, and her breathing is adequate. Her radial pulses are strong and a normal rate. There is no obvious bleeding that requires your attention, and her skin is pink, warm, and moist.

4. On the basis of the police officer's report, what should you suspect regarding the events that preceded the patient's assault?

Sexual assault is an acutely overwhelming emotional and dramatic event, and some patients experience amnesia as an involuntary emotional protective reflex. However, this type of amnesia is typically limited to the sexual assault itself, not several hours before the assault occurred. It is now 0555 hours, and the patient has absolutely no recollection of the events that occurred after 2100 hours the night before. You should be suspicious that the patient was unknowingly given a drug by the person who perpetrated this crime; this may have been the young man she met at the nightclub or a random person—man or woman.

5. What additional assessment should you perform on this patient?

As with any patient, the extent of your secondary assessment is based on your suspicion of injuries or conditions that may not have been grossly apparent during the primary assessment. In sexual assault victims, it is unlikely patients will consent to a physical examination of their entire body. Therefore, you should limit any physical examination of the patient to a brief survey for life-threatening injuries.

The patient in this scenario reports vaginal pain but denies vaginal bleeding. The external genitalia should not be exposed and examined—whether the EMT is a man or woman—unless there is evidence of severe bleeding that requires immediate treatment. Asking the patient questions rather than performing a hands-on examination will be enough for your assessment.

6. How should you respond to the patient's request to take a shower, change her clothes, and use the washroom?

It is very common for victims of sexual assault to want to take a shower, change their clothes, rinse their mouth out, or douche. These actions stem from the desire to "wash away" the humiliation and embarrassment of the assault.

However, remember that valuable evidence may be lost if the patient takes any measures to clean up; therefore, you should discourage—*not disallow*—her from doing so. The patient should also be discouraged from urinating or moving her bowels; doing so may destroy any DNA evidence that may remain from vaginal or anal penetration. Make every attempt to explain to the patient that she has potential evidence on or inside of her body that may be used to identify the perpetrator. If, despite your best efforts, you cannot convince the patient not to clean herself, you must respect her feelings and avoid forcing the issue.

7. How should you respond to the patient's refusal to go to the hospital?

In many cases, sexual assault victims will refuse EMS transport, and some of them will refuse *any and all* assessment and treatment. Provided the patient has decision making capacity, she has the legal right to refuse transport.

If the patient refuses EMS transport, do not simply accept the refusal and leave. You must still ensure she is aware of the potential consequences of refusing treatment. She reports vaginal pain; this could indicate a significant internal injury that could be potentially fatal. She *must* be made aware of this fact.

Although the patient in this case does not recall being sexually assaulted, her signs and symptoms (eg, vaginal pain) and the way she presents—torn shirt and nude from the waist down—are clear indicators that she was sexually assaulted. Patients who recall being sexually assaulted often benefit from being removed from the scene where the assault occurred because it keeps them from having to be subjected to the environment where the assault occurred. The best way to do this is to convince her to go to the hospital; doing so will remove her from the scene *and* allow her to be examined by a physician.

8. Whose responsibility is it to determine why the patient was sexually assaulted?

It is law enforcement's responsibility to investigate the incident, arrest the perpetrator, and see justice served. Police officers will want to ask questions pertaining to the incident; however, the prehospital setting is not the appropriate place for this. As an EMT, your role is to address the physical and emotional needs of the patient and to serve as a patient advocate.

9. Why is it important to transport a sexual assault victim to the hospital, even if she does not have any obvious injuries?

Sexual assault victims should be transported to the hospital for several reasons. First, the patient should have a medical examination by a physician to rule out injuries or conditions that were not detected or not present in the field. Injuries such as internal abdominal bleeding can have a delayed onset of symptoms for up to several hours. Furthermore, the patient will need initial and follow-up screening for any sexually transmitted diseases.

EMS Patient Care Report (PCR)

Date: 11-11-16	**Incident No.:** 211109	**Nature of Call:** Assault		**Location:** 4300 West Avenue	
Dispatched: 0555	**En Route:** 0557	**At Scene:** 0602	**Transport:** 0632	**At Hospital:** 0642	**In Service:** 0650

Patient Information

Age: 25 **Sex:** F **Weight (in kg [lb]):** 50 kg (110 lb)	**Allergies:** None **Medications:** No known drug allergies **Past Medical History:** None **Chief Complaint:** Vaginal pain; amnesia

Vital Signs

Time: 0610	**BP:** 110/70	**Pulse:** 72	**Respirations:** 14	**Spo_2:** 98%
Time: 0630	**BP:** 118/68	**Pulse:** 80	**Respirations:** 14	**Spo_2:** 99%
Time: 0640	**BP:** 122/72	**Pulse:** 76	**Respirations:** 16	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Limited assessment, emotional support

Narrative

Medic 86 was requested by law enforcement to respond to a residence for a young woman who was assaulted. While en route to the scene, law enforcement informed that the patient had evidently been sexually assaulted. Arrived on scene and found the patient, a 25-year-old woman, sitting on the ground next to her car with a blanket wrapped around her. She was conscious and alert, although clearly emotionally upset. Her airway was patent, her breathing was adequate, and no obvious bleeding was noted. Prior to EMS arrival, the patient informed law enforcement personnel she did not recall the events that occurred after 2100 the night before, when she was at a nightclub with her friends. She was found with her shirt torn and was nude from the waist down, so law enforcement personnel wrapped her with a blanket before EMS arrival. The patient reports vaginal pain but denies vaginal bleeding. The only obvious injuries noted were several small abrasions to her forearms. The patient would not consent to a secondary assessment or treatment; she would allow only assessment of her vital signs. She denied significant medical history and medication allergies. The patient stated she did not want to go to the hospital, via EMS or any other method of transportation. She further stated she wanted to take a shower and change her clothes. Advised patient this was not recommended because of the possibility of destroying potential evidence; however, she stated she did not care and only wanted to clean herself. Further advised the patient of the need for a physical examination at the hospital because hidden injuries, some of which could be life threatening, could not be ruled out in the prehospital setting. The patient requested law enforcement to summon a friend of hers to the scene. After talking to her friend, she consented only to EMS transport; she further requested her friend accompany her in the back of the ambulance. Began transport to the hospital and monitored the patient en route. She remained conscious and alert, and her vital signs remained stable. Provided emotional support, with the assistance of her friend, until delivery at the emergency department. Delivered patient to hospital and gave verbal report to staff nurse. Medic 86 cleared the hospital and returned to service at 0650.**End of report**

Prep Kit

Ready for Review

- A woman's body is uniquely formed to conceive and give birth. This difference makes women susceptible to a number of conditions that do not occur in men.
- If fertilization of the ovum does not occur within about 14 days of ovulation, the lining of the uterus begins to separate, and menstruation occurs and lasts for about 1 week.
- When a girl reaches puberty, she begins to ovulate and experience menstruation.
- Women continue to experience the cycle of ovulation and menstruation until they reach menopause.
- The causes of gynecologic emergencies are varied and range from sexually transmitted diseases to trauma.
- Pelvic inflammatory disease is an infection of the upper female reproductive organs: the uterus, ovaries, and fallopian tubes. PID can lead to an ectopic pregnancy or an abscess, which can cause death.
- Sexually transmitted diseases can lead to more serious conditions, such as pelvic inflammatory disease.
- Because menstrual bleeding occurs every month in most women, vaginal bleeding that is the result of other causes may initially be overlooked. Some possible causes of vaginal bleeding include abnormal menstruation, vaginal trauma, ectopic pregnancy, spontaneous abortion, cervical polyps, ectopic pregnancy, miscarriage, and even cancer.
- There are very few interventions that can or should be done in the prehospital setting to treat a gynecologic emergency.
- Whenever you deal with patients who have a gynecologic emergency, you must maintain the patients' privacy as much as possible.
- EMTs called to treat a victim of sexual assault, sexual abuse, or actual or alleged rape face many challenges, ranging from obvious medical ones to serious psychologic and legal issues. You may be the victim's first contact after the encounter, and how the situation is managed from first contact throughout treatment and transport may have lasting effects for the patient and you. It is very important to always be professional, sensitive, and kind.

Vital Vocabulary

bacterial vaginosis An overgrowth of bacteria in the vagina; characterized by itching, burning, or pain, and possibly a "fishy" smelling discharge.

cervix The lower third, or neck, of the uterus.

chlamydia A sexually transmitted disease caused by the bacterium *Chlamydia trachomatis*.

fallopian tubes The tubes that connect each ovary with the uterus and are the primary location for fertilization of the ovum.

gonorrhea A sexually transmitted disease caused by *Neisseria gonorrhoeae*.

labia majora Outer fleshy "lips" covered with pubic hair that protect the vagina.

labia minora Inner fleshy "lips" devoid of pubic hair that protect the vagina.

ovaries The primary female reproductive organs that produce an ovum, or egg, that, if fertilized, will develop into a fetus.

ovulation The process in which an ovum is released from a follicle.

pelvic inflammatory disease (PID) An infection of the fallopian tubes and the surrounding tissues of the pelvis.

perineum The area of skin between the vagina and the anus.

rape Sexual intercourse forcibly inflicted on another person, against that person's will.

sexual assault An attack against a person that is sexual in nature, the most common of which is rape.

uterus The muscular organ where the fetus grows, also called the womb; responsible for contractions during labor.

vagina The outermost cavity of a woman's reproductive tract; the lower part of the birth canal.

You respond to the home of a married 27-year-old woman reporting abdominal pain and vaginal bleeding. The bleeding is moderately heavy and she had her regular menstrual period 2 weeks prior. She denies trauma and has a history of miscarriage. She has soaked three sanitary pads in the past 2 hours.

Her airway is patent and she is alert and oriented to person, place, time, and event, although she feels dizzy. She does not have a fever. You ask her to lie supine and obtain her vital signs. Her blood pressure is 104/62 mm Hg; pulse rate, 104 beats/min; and respirations, 16 breaths/min.

She agrees to go to the hospital but fears her husband will be upset because they do not have medical insurance.

1. What is an initial consideration specific to this case?

   A. Ensure the scene is safe.
   B. Don appropriate PPE.
   C. Call for a female EMT.
   D. Confirm police have been called.

2. The primary assessment of the patient should include:

   A. quickly identifying any life-threatening injuries.
   B. an extensive trauma examination.
   C. an extensive medical examination.
   D. an extensive trauma and a medical examination.

3. The husband arrives and is very upset that you are considering transport. What is the best thing you can do?

   A. Call for police backup.

B. Inform him his wife has a potentially life-threatening condition.
C. Ignore him because the patient gave you legal consent.
D. Obtain on-line medical consultation for assistance.

4. What is your primary impression of this patient's emergency?

A. Pelvic inflammatory disease
B. Ectopic pregnancy
C. Sexually transmitted disease
D. Bleeding of unknown origin

5. The patient tells you she feels blood coming from her vaginal area. She gives you permission to look and you observe moderate bleeding from the vagina. What should you do to manage the bleeding?

A. Apply direct pressure using trauma dressings.
B. Pack the vagina with trauma dressings.
C. Ask the patient to insert a tampon.
D. Place a sanitary pad over the vaginal opening.

6. What is your most important treatment option?

A. Low-flow oxygen
B. Psychologic support
C. Transport to the hospital
D. Supine positioning

7. Careful documentation is always important. What information should NOT be included in your patient care report?

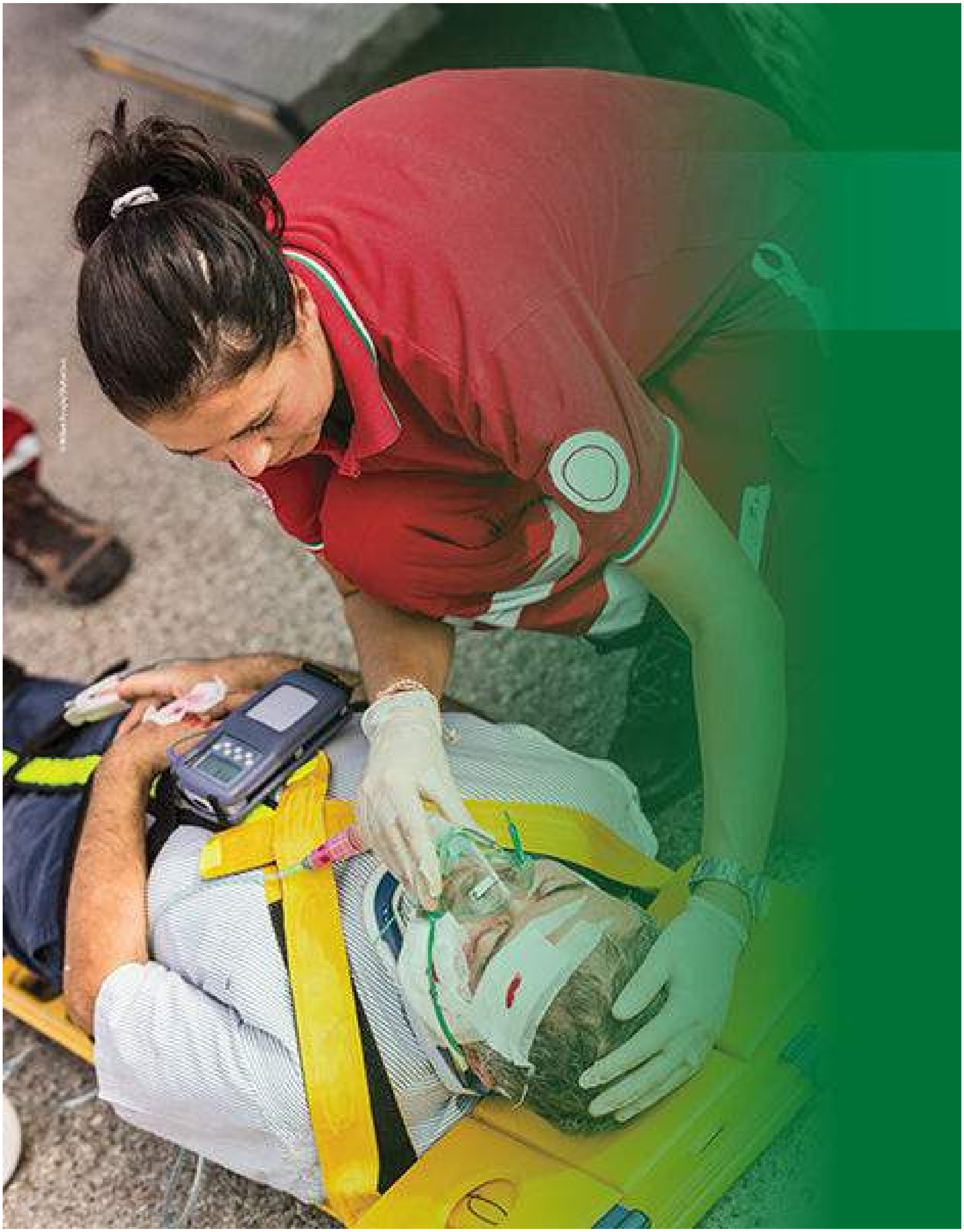
A. Patient condition
B. Description of the scene
C. Interventions performed
D. Diagnosis

8. What further assessment or treatment would you perform en route to the hospital?v

A. Distract her from the pain.
B. Administer high-flow oxygen.
C. Reassess vital signs and primary assessment.
D. Start an IV line.

9. Other than trauma, what are some of the causes of vaginal bleeding?

10. What are important parts of an assessment for abdominal pain?



SECTION
7

Trauma

CHAPTER
24

Trauma Overview

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National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Trauma Overview

Pathophysiology, assessment, and management of the trauma patient
› Trauma scoring (p 869)
› Rapid transport and destination issues (pp 867–869)
› Transport mode (p 867)

Multisystem Trauma

Recognition and management of
› Multisystem trauma (p 864)

Pathophysiology, assessment, and management of
› Multisystem trauma (p 864)
› Blast injuries (pp 862–864)

Knowledge Objectives

1. Define the terms mechanism of injury (MOI), blunt trauma, and penetrating trauma. (pp 847, 850)
2. Explain the relationship of the MOI to potential energy, kinetic energy, and work. (pp 847–849)
3. Provide examples of the MOI that would cause blunt and penetrating trauma to occur. (pp 850–861)
4. Describe the five types of motor vehicle crashes, the injury patterns associated with each one, and how each relates to the index of suspicion of life-threatening injuries. (pp 853–856)
5. Discuss the three specific factors to consider during assessment of a patient who has been injured in a fall, plus additional

considerations for pediatric and geriatric patients. (pp 858–859)
6. Discuss the effects of high-, medium-, and low-velocity penetrating trauma on the body and how an understanding of each type helps EMTs form an index of suspicion about unseen life-threatening injuries. (pp 859–861)
7. Discuss primary, secondary, tertiary, and miscellaneous blast injuries and the anticipated damage each one will cause to the body. (pp 862–864)
8. Describe multisystem trauma and the special considerations that are required for patients who fit this category. (p 864)
9. Explain the major components of trauma patient assessment; include considerations related to whether the method of injury was significant or nonsignificant. (p 865)
10. Discuss the special assessment considerations related to a trauma patient who has injuries in each of the following areas: head, neck and throat, chest, and abdomen. (pp 865–866)
11. Explain a general overview of multisystem trauma patient management. (pp 867, 869)
12. Explain trauma patient management in relation to scene time and transport selection. (p 867)
13. List the Association of Air Medical Services criteria for the appropriate use of emergency air medical services. (p 867)
14. List the American College of Surgeons' Committee on Trauma classification of trauma centers. (pp 867–868)
15. Explain the American College of Surgeon's Committee on Trauma and the Centers for Disease Control and Prevention field triage decision scheme as it relates to making an appropriate destination selection for a trauma patient. (pp 869–870)

Skills Objective

There are no skills objectives for this chapter.

Introduction

According to the National Center for Injury Prevention and Control, traumatic injuries and unintentional injuries are the leading causes of death in the United States among people younger than age 44. Proper prehospital evaluation and care has the ability to reduce a patient's suffering, long-term disability, and death from trauma. As discussed in Chapter 14, *Medical Overview*, patients who need EMS assistance are generally categorized as either a medical or trauma emergency, although one may result from the other or both may exist.

Trauma emergencies occur as a result of physical forces applied to the body. **Medical emergencies** include illnesses or conditions; these are not caused by an outside force. Traumatic injuries may be caused by underlying medical conditions (a patient has a stroke and veers off the road, striking a tree). Similarly, medical illnesses may result from recent or remote traumatic injuries (pneumonia develops in a patient a few days after a fall that fractures the patient's ribs). This chapter introduces the basic physical concepts that dictate how traumatic injuries occur and how they affect the human body. When you understand these concepts, you will be better prepared to size up a vehicular crash scene and assess a patient.

This chapter begins with a basic discussion of energy and trauma. Next, different types of vehicle crashes and their impact on the body are explained. By assessing a vehicle that has crashed, you can often determine what happened to the passengers at the time of impact, which may allow you to predict what injuries the passengers sustained at the time of impact. Evaluation of the mechanism of injury (MOI) for the trauma patient will provide you with an index of suspicion for different types of serious and/or life-threatening underlying injuries. Certain injury patterns occur with certain types of injury events. The **index of suspicion** is your awareness and concern for potentially serious underlying and unseen injuries.

Energy and Trauma

Traumatic injury occurs when the body's tissues are exposed to energy levels beyond their tolerance **Figure 24-1**. The **mechanism of injury (MOI)** is the way in which traumatic injuries occur; it describes the forces (or energy transmission) acting on the body that cause injury. Three concepts of energy are typically associated with injury (not including thermal energy, which causes burns): potential energy, kinetic energy, and the energy of work. When considering the effects of energy on the human body, it is important to remember that energy can be neither created nor destroyed, but can only be converted or transformed. It is not the objective of this section to help you reconstruct the scene of a motor vehicle crash. Rather, you should have a sense of the effects of the event on the human body and understand, in a broad sense, how that event is related to potential and kinetic energy.

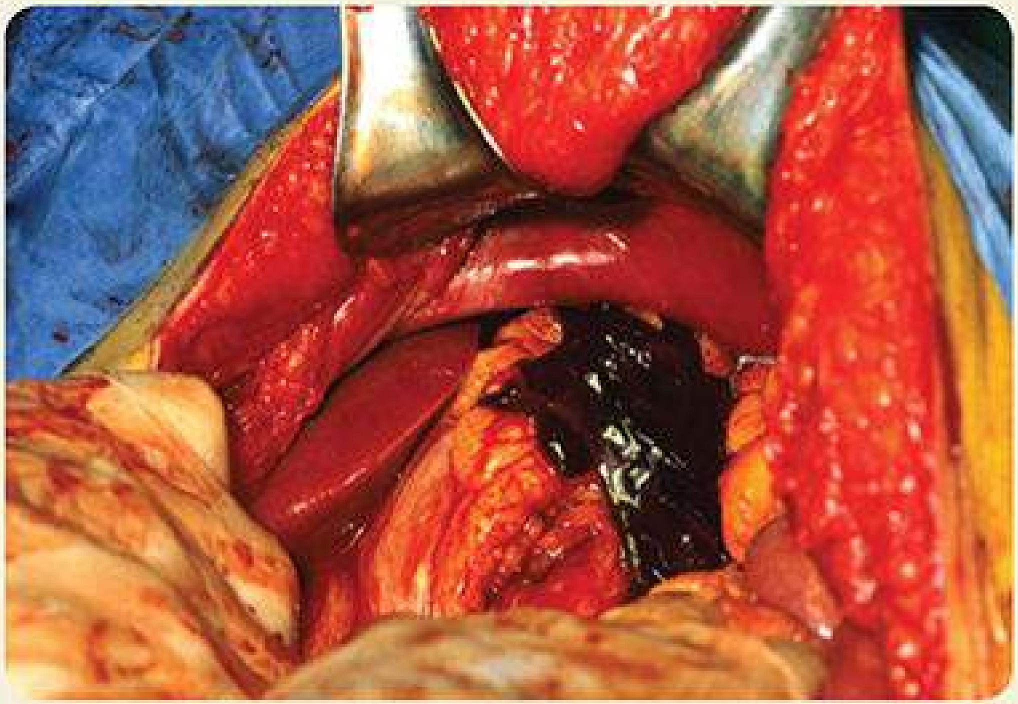

Figure 24-1 Traumatic injury occurs when the body's tissues are exposed to energy levels beyond their tolerance. This photo shows a ruptured spleen.

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YOU are the Provider PART 1

At 1520 hours, you and your partner are dispatched to a motor vehicle crash, in which a passenger vehicle reportedly struck a tree head-on at an unknown rate of speed. The dispatch operator reports that the patient is still in the vehicle, but it is unknown if the person is trapped. Law enforcement personnel and two engine companies have also been dispatched to the scene. Your response time is 8 minutes, the weather is clear, and the traffic is heavy.

1. On the basis of the information provided by the dispatch operator, can you predict the potential types of injuries the patient may have? If so, how?
2. Why is it important to determine the speed at which a vehicle was traveling at the time of impact?

For example, when assessing a patient who fell, you need not calculate the speed at which the person hit the ground. Instead, focus on the factors of the impact and how those relate to the potential for injury. For example, it is important to estimate the height from which the patient fell, as well as the surface he or she landed on, to fully appreciate the injury potential of the fall.

Work is defined as force acting over a distance. For example, the force needed to bend metal multiplied by the distance over which the metal is bent is the work that crushes the front end of a vehicle that is involved in a frontal impact. Similarly, forces that bend, pull, or compress tissues beyond their inherent limits result in the work that causes injury.

The energy of a moving object is called **kinetic energy**. Kinetic energy reflects the relationship between the mass (weight) of the object and the velocity (speed) at which it is traveling. Kinetic energy is expressed as:

Kinetic energy = ½ mass × velocity^2 or, $KE = \frac{1}{2} m \times v^2$

Remember, energy cannot be created or destroyed, only converted. In the case of a motor vehicle crash, the kinetic energy of the speeding vehicle is converted into the work of stopping the vehicle, usually by crushing the vehicle's exterior **Figure 24-2**. Similarly, the passengers of the vehicle have kinetic energy because they were traveling at the same speed as the vehicle. Their kinetic energy is converted to the work of bringing them to a stop. It is this work on the passengers that results in injury. Notice that, according to the equation for kinetic energy, the energy that is available to cause injury *doubles* when an object's weight doubles but *quadruples* when its speed doubles. When a car's speed increases from 50 to 70 mph, the energy that is available to cause injury doubles. This point is even clearer when considering gunshot wounds. The speed of the bullet (high-velocity compared with low-velocity) has a greater impact on producing injury than the mass (size) of the bullet. This is why it is so important to report to the hospital the type of firearm that was used in a shooting. The amount of kinetic energy that is converted to do work on the body dictates the severity of the injury. High-energy injuries often produce such severe damage that patients require immediate transport to an appropriate facility to have any hope of survival.

Words of Wisdom

Newton's Laws

Newton's First Law

Newton's first law states that objects at rest tend to stay at rest and objects in motion tend to stay in motion unless acted on by some force. The first part of the law is fairly clear. An object such as an empty soda can will not move spontaneously unless some force, such as a gust of wind, acts on it. An example will help to illustrate the second part. In a car going 30 mph, the passengers and the car are moving at 30 mph. The passengers do not feel as though they are moving because they are not moving relative to the car. However, when the car strikes a concrete barrier and comes to a sudden stop, the passengers continue to travel at 30 mph. They stay in motion until they are acted on by an external force—most likely the windshield, steering wheel, or dashboard. To appreciate the severity of the impact, think of the driver as sitting motionless while a steering wheel rams into his or her chest at 30 mph. Now consider that the same thing happens to the driver's internal organs. They also are in motion, traveling at 30 mph relative to the ground, until they are acted on by an external force, in this case the sternum, rib cage, or other body structure. This scenario illustrates the three collisions that are associated with blunt trauma.

Newton's Second Law

Newton's second law states that force (F) equals mass (M) times acceleration (A), that is, $F = M \times A$, in which acceleration is the change in velocity (speed) that occurs over time. Therefore, it is not so much that "speed kills" but that the change in velocity with respect to time generates the forces that cause injury. Simply put, it is not the fall, but the sudden stop at the bottom, that causes the injury.

In the example of the car traveling at 30 mph, it takes about 3 seconds for the car to decrease its speed from 30 mph to 0 mph when the driver applies the brakes smoothly. If he or she is properly restrained by well-adjusted seat belts, the driver slows, or decelerates, at the same rate as the car. But if the car is stopped not by braking but by hitting a large tree and the driver is not restrained, his or her body will continue to stay in motion at 30 mph until it is stopped by an external force, in this case, the steering wheel. Although the change in the body's velocity is the same as when the car was braking smoothly in 3 seconds (30 to 0 mph), that change now takes place in about 0.01 second. Because the period of deceleration is 300 times less, the average force of impact is 300 times greater. This means that the force is approximately 150 times the force of gravity. Imagine a force 150 times your body weight slamming into your chest.

Now consider the same car striking the same tree, but this time, the driver is restrained with a shoulder and lap belt. The driver is essentially tied to the car and stops during the same period the car stops. It takes some time, although brief, to crush the front of the car and bring it to a halt. The car comes to a stop in approximately 0.05 second. The change in the driver's velocity is the same (30 to 0 mph), but the longer period of deceleration results in a g force of 30 times that of gravity (one g force is the normal acceleration due to gravity). This is still a substantial force, but it is much less than the force experienced by the unrestrained driver. More to the point, it is survivable.

In a final example, the car and driver, as before, are traveling at 30 mph, and the driver is properly restrained with a three-point seat belt. In this case, however, the car is also equipped with an air bag. When the car hits the tree and suddenly stops, the driver's upper body initially continues forward at 30 mph. The body is partially slowed by the lap and shoulder belts but is finally brought to rest by the air bag. The upper body compresses the air bag, which stops the body's forward motion in about 0.1 second. Thus, the air bag stretches the duration of impact by 0.05 second, buying the body even more time, and the force on the upper body drops to approximately 15 times that of gravity.

The air bag has another advantage. The force of its impact is applied over a much larger area than the area affected by the steering wheel or the shoulder belt, shrinking the force per unit area. This point can be illustrated by an analogy. A person standing on one toe on a sheet of ice applies a concentrated load in a very small area, thus breaking the ice and falling through. If the person lies flat on the ice, he or she greatly expands the contact area and reduces the stress on the ice, which, depending on conditions, should not break. The dual action of the air bag (distributing the force of impact over a greater area and increasing the duration of impact) results in less severe injuries.

Newton's Third Law

Newton's third law states that for every action, there is an equal and opposite reaction. Therefore, if you push on a door, the door pushes back (reacts) with an equal force but in the opposite direction. In the case of a dented A-pillar, the force of the driver's head was sufficient to dent the strong metal. But in terms of patient assessment, the more important point is the reaction force of the pillar on the head. Newton's third law states that the two forces are equal but occur in opposite directions. In other words, the head was essentially hit by an A-pillar traveling at 30 mph. Similarly, it takes a substantial force to collapse a steering wheel. When you notice a collapsed steering wheel during scene size-up, suspect serious chest injuries even if the driver initially has no visible signs of chest injury. Often, reading the scene and understanding the basic principles of energy transfer will give you as clear a picture of the patient's potential injuries and injury severity as the actual physical patient assessment.

Figure 24-2 The kinetic energy of a speeding car is converted into the work of stopping the car, usually by crushing the car's exterior and damaging the point of impact.

Courtesy of Mark Woolcock.

Words of Wisdom

Constantly and consistently reevaluate the MOI to rule out the possibility that the patient has a more significant injury than initially suspected or identified during the initial phases of care provided at the scene.

Potential energy is the product of mass (weight), force of gravity, and height and is mostly associated with the energy of falling objects. A worker on a scaffold has potential energy because he or she is some height above the ground. If the worker falls, potential energy is converted into kinetic energy. As the worker hits the ground, the kinetic energy is converted into work, that is, the work of bringing the body to a stop and thereby fracturing bones and damaging tissues.

Mechanism of Injury Profiles

Different types of MOIs will produce many types of injuries. Examples of nonsignificant injuries include injury to an isolated body part or a fall without the loss of consciousness. Examples of significant MOIs include injury to more than one body system (**multisystem trauma**), falls from heights, motor vehicle and motorcycle crashes, car versus pedestrian (or bicycle or motorcycle), gunshot wounds, and stabbings. Whether one body system or more than one system is involved, maintain a high index of suspicion for serious unseen injuries.

Blunt and Penetrating Trauma

Traumatic injuries can be considered in two categories: blunt trauma and penetrating trauma. **Blunt trauma** is the result of force (or energy transmission) to the body that causes injury without anything penetrating the soft tissues or internal organs and cavities. **Penetrating trauma** results in injury by objects that pierce and penetrate the surface of the body and injure the underlying soft tissues, internal organs, and body cavities. Either type of trauma may occur from a variety of MOIs. It is important to consider unseen as well as visible, obvious injuries with either type of trauma. Damage to the underlying deeper tissues is often more significant.

Words of Wisdom

According to the Centers for Disease Control and Prevention (CDC), in the United States, nearly 180,000 people die from violence and injuries each year. That means one person dies as a result of trauma almost every 3 minutes.

Blunt Trauma

Blunt trauma results from an object making contact with the body. Any object, for example a baseball bat, can cause blunt trauma if it is moving fast enough. Motor vehicle crashes and falls are two of the most common MOIs for blunt trauma. When providing care for your patient, be alert to signs of skin discoloration or reports of pain because these may be the only signs of blunt trauma. During assessment, maintain a high index of suspicion for hidden (internal) injuries in patients with blunt trauma.

Vehicular Crashes

Motor vehicle crashes are classified traditionally as frontal (head-on), rear-end, lateral (T-bone), rollovers, and rotational (spins). The principal difference among these crash types is the direction of the force of impact; also, with spins and rollovers, there is the possibility of multiple impacts. Motor vehicle crashes typically consist of a series of three collisions. Understanding the events that occur during each one of these three collisions will help you be alert for certain types of injury patterns.

Words of Wisdom

Even though today’s cars are designed and built to crumple upon impact, in the presence of vehicle damage, you should maintain a high index of suspicion that the patient’s MOI was substantial.

The three collisions in a typical impact are as follows:

1. The collision of the car against another car, a tree, or some other object. Damage to the car is perhaps the most dramatic part of the collision, but it does not directly affect patient care, except possibly to make extrication difficult **Figure 24-3**. However, it does provide information about the severity of the collision and, therefore, has an indirect effect on patient care. The greater the damage to the car, the greater the energy that was involved and, therefore, the greater the potential to cause injury to the patient. By assessing the vehicle that has crashed, you can often determine

the MOI, which may allow you to predict what injuries may have happened to the passengers at the time of impact according to forces that acted on their bodies. When you arrive at the crash scene and perform your scene size-up, quickly inspect the severity of damage to the vehicle(s). If there is significant damage to a vehicle, your index of suspicion for the presence of life-threatening injuries should automatically increase. A great amount of force is required to crush and deform a vehicle, cause intrusion into the passenger compartment, tear seats from their mountings, and collapse steering wheels. Such damage suggests the presence of high-energy trauma.

Figure 24-3 The first collision in a typical impact is that of the vehicle against another object (in this case, a utility pole). The appearance of the vehicle can provide you with critical information about the severity of the crash. The greater the damage to the vehicle, the greater the energy that was involved.

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2. The collision of the passenger against the interior of the car. Just as the kinetic energy produced by the vehicle's mass and velocity is converted into the work of bringing the vehicle to a stop, the kinetic energy produced by the passenger's mass and velocity is converted into the work of stopping his or her body **Figure 24-4**. Just like the obvious damage to the exterior of the car, the injuries that result are often dramatic and usually immediately apparent during your scene size-up or primary assessment. Common passenger injuries include lower extremity fractures (knees into the dashboard), rib fractures (rib cage into the steering wheel), and head trauma (head into the windshield). Such injuries occur more frequently if the passenger is not restrained. But even when the passenger is restrained with a properly adjusted seat belt, injuries can occur, especially in lateral and rollover impacts.
3. The collision of the passenger's internal organs against the solid structures of the body. The injuries that occur during the third collision may not be as obvious as external injuries, but they are often the most life threatening. For example, as the passenger's head hits the windshield, the brain continues to move forward until it comes to rest by striking the inside of the skull. This results in a compression injury (or bruising) to the anterior portion of the brain and stretching (or tearing) of the posterior portion of the brain **Figure 24-5**. This is an example of a **coup-contrecoup brain injury** **Figure 24-6**. Similarly, in the thoracic cage, the heart may slam into the sternum, which may rupture the aorta and cause fatal bleeding.

Figure 24-4 The second collision in a typical impact is that of the passenger against the interior of the car. The appearance of the interior of the car can provide you with information about the severity of the patient's injuries.

Courtesy of Rhonda Hunt.

Understanding the relationship among the three collisions will help you make the connections between the amount of damage to the exterior of the vehicle and potential injury to the passenger. For example, in a high-speed crash that results in massive damage to the vehicle, you should suspect serious injuries to the passengers, even if the injuries are not readily apparent. A number of potential physical problems may develop as a result of traumatic injuries. Your initial general impression of the patient and evaluation of the MOI can help direct lifesaving care and provide critical information to the hospital staff. Therefore, if you see a contusion on the patient's forehead and the windshield is starred and pushed out, you should strongly suspect an injury to the brain. After you inform medical control about the damage to the windshield, hospital staff can prepare for the patient by being ready to perform a CT scan of the brain. Without your input, the physician might have found the brain injury anyway, but it might not have been detected until the brain had swollen sufficiently to cause clinical signs of the injury. Whenever there is a significant impact to the head, also suspect a spinal injury and take cervical spine precautions if indicated.

Figure 24-5 The discolored spots show injuries (contusions) in this brain.

Figure 24-6 The third collision in a typical impact is that of the passenger's internal organs against the solid structures of the body. A coup-contracoup injury occurs when the brain continues its forward motion and strikes the inside of the skull, resulting in a compression injury to the anterior portion of the brain and stretching of the posterior portion.

Words of Wisdom

When you are assessing trauma incidents, the MOI is a crucial element of history taking. Be alert to the extent of damage to the interior and exterior of the vehicles involved in crashes. Use this observation to paint a picture of the scene in written and verbal communication.

The amount of damage considered significant varies, depending on the type of crash, but any substantial deformity of the vehicle should be enough cause for you to consider transporting the patient to a trauma center. Significant mechanisms of injury are suggested by the following findings:

- Death of an occupant in the vehicle
- Severe deformity of the vehicle or intrusion into the vehicle
  - Severe deformities of the frontal part of the vehicle, with or without intrusion into the passenger compartment
  - Moderate intrusions from a lateral (T-bone) type of accident
  - Severe damage from the rear
  - Crashes in which rotation is involved (rollover and spins)
- Ejection from the vehicle

Damage to the vehicle that was involved and information obtained during the scene size-up are not the only clues you can use to determine crash severity. Clearly, if one or more of the passengers are dead, you should suspect that the other passengers have sustained serious injuries, even if the injuries are not obvious. Therefore, focus on treating life-threatening injuries and providing rapid transport to a trauma center, because these passengers have likely experienced the same amount of force that caused the death of the others. Digital photos of the crash scene may provide valuable information to the staff and treating physicians at the trauma center; however, photos should never be shared over social media. Photos containing patient images or other identifiable patient information may become part of the medical record or may need to be deleted after review by the receiving health care providers, depending on policies.

Words of Wisdom

Items in the passenger compartment (including unrestrained passengers) can become flying objects during a crash and have the potential to cause injury to the patient, resulting in injury patterns that do not match the expected MOI.

Frontal Crashes

Understanding the MOI after a frontal crash first involves evaluation of the supplemental restraint system, including seat belts and air bags. Determine whether the passenger was restrained by a full and properly applied three-point restraint. Also determine whether the air bag was deployed. Identifying the types of restraints used and whether air bags were deployed will help you identify injury patterns related to the supplemental restraint systems.

When properly applied, seat belts are successful in restraining the passengers in a vehicle and preventing a second collision inside the motor vehicle. According to the CDC, between the years 1975 and 2008 seat-belt use saved an estimated 255,000 lives. Seat belts may also decrease the severity of the third collision, that of the passenger's organs with the chest or abdominal wall. The protective abilities of seat belts are further enhanced by deployment of the air bags. Air bags provide the final capture point of the passengers and decrease the severity of **deceleration** injuries by allowing seat belts to be more compliant and by gently cushioning the occupant as the body slows, or decelerates.

Remember that air bags decrease injury to the chest, face, and head very effectively. However, you should still suspect that other serious injuries to the extremities (resulting from the second collision) and to internal organs (resulting from the third collision) have occurred. Most new motor vehicles are manufactured with air bag safety systems. These safety devices enhance the safety and survival of forward-facing occupants inside the vehicle during a crash. In an emergency braking event, or crash, the air bag inflates very quickly. Because a rear-facing car seat is in proximity to the dashboard, rapid inflation of the air bag could cause serious injury or death to an infant. All children who are shorter than 4 feet 9 inches (145 cm) should ride in the rear seat or, in the case of a pickup truck or other single-seated vehicle, the air bag should be turned off.

When providing care to an occupant inside a motor vehicle, it is important to remember that if the air bag did not inflate during the accident, it may deploy during extrication. If this occurs, you may be seriously injured. Extreme caution must be used when extricating a patient in a vehicle with an air bag that has not deployed.

YOU are the Provider — PART 2

When you arrive at the scene, fire and law enforcement personnel are already present. An air transport helicopter has been placed on standby. The front of the vehicle has been crushed all the way up to the windshield. The driver, a young man, was unrestrained and is still in the driver's seat; he appears to be unconscious and his face is covered with blood. As your partner accesses the patient from the backseat and manually stabilizes his head, you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Bleeding from the head, face, and mouth; pale skin; labored breathing
Level of consciousness	Responsive only to pain
Airway	Blood in the nasopharynx and oropharynx
Breathing	Rapid and labored
Circulation	Radial pulses, weak and rapid; skin is cool, pale, and clammy

Despite the severity of exterior damage to the vehicle, the patient is not entrapped and there is no interior intrusion into the passenger compartment. You suction the patient's mouth, apply a cervical collar, and prepare to rapidly extricate him from the vehicle. Responders from one of the engine companies have prepared a backboard, straps, and a lateral head immobilizer.

3. Where will you most likely find damage to the vehicle's interior based on the patient's signs and symptoms?

Supplemental restraint systems can also cause harm whether they are used properly or improperly. For example, some older vehicle models have seat belts that buckle automatically at the shoulder but require the passengers to buckle the lap portion; these can cause the occupant to travel down and under the shoulder strap as the body continues forward, resulting in the lower body striking the dashboard. This movement of the body can cause the lower extremities and the pelvis to crash into the dashboard because that part of the body is unrestrained. Seat belts may also cause unseen abdominal injuries, particularly in pediatric patients. Seat belts are designed to be worn over the iliac crests of the pelvis to distribute the force over the bony surface. Hip dislocations may result if seat belts are worn too low. Internal injuries can occur when the belt is worn too high, resulting in damage to abdominal organs **Figure 24-7**. Lumbar spine fractures are also possible, particularly in children and older patients.

When passengers are riding in vehicles equipped with air bags but are not restrained by seat belts, they are often thrown forward in the act of emergency braking. As a result, they come into contact with the air bag and/or the doors at the time of deployment. This MOI is also responsible for some severe injuries to children who are riding unrestrained in the front seats of vehicles, unrestrained passengers, and those sitting too close to the air bag. Today's motor vehicles often have multiple air bags and side curtains. These are designed to protect the occupants of the vehicle, but can also alter injury patterns. Certain areas of a vehicle's body may have air bags that will deploy when impacted. Pushing on or using extrication tools in those areas may cause air bags to unexpectedly deploy. This can happen even after the car battery has been disengaged.

In addition, some passengers may pass out before impact, and you may find them lying against the deployed air bag. When you encounter these types of situations, look for abrasions and/or traction-type injuries on the face, lower part of the neck, and chest **Figure 24-8**.

Contact points are often obvious as you perform a simple quick evaluation of the interior of the vehicle. If there is no intrusion into the passenger compartment, you might see that an unrestrained front-seat passenger in a frontal crash has come into contact with the dashboard or the instrument panel at the knees, thus transferring loads from the knees through the femur to the pelvis and hip joint **Figure 24-9A**. The chest and/or abdomen may also hit the steering wheel **Figure 24-9B**. In addition, the passenger's face often hits the steering wheel, or the passenger may launch forward and up, hitting the windshield and/or the roof header in the area of the visors **Figure 24-9C**. Signs of most of these injuries can be found by inspecting the interior of the vehicle during extrication of the patient.

Figure 24-7 Injuries can result if the seat belt is worn too high or too low across the waist. Although less common, they can also result from seat belts worn in the correct position across the torso.

Courtesy of ED, Royal North Shore Hospital/NSW Institute of Trauma & Injury.

Figure 24-8 Air bags can cause injury in frontal crashes, specifically, abrasions, contusions, and traction-type injuries to the face, neck, chest, and inner arms.

Figure 24-9 Mechanism of injury and condition of the vehicle interior suggest likely areas of injury. **A.** The knees can strike the dashboard, resulting in a hip fracture or dislocation. **B.** Serious chest and abdominal injuries can result from striking the steering wheel. **C.** Head and spinal injuries can result when the face and head strike the windshield.

Rear-End Crashes

Rear-end impacts are known to cause whiplash injuries, particularly when the passenger's head and/ or neck is not restrained by an appropriately placed headrest **Figure 24-10**. On impact, the passenger's body and torso move forward. As the body is propelled forward, the head and neck are left behind because the head is relatively heavy, and they appear to be whipped back relative to the torso. As the vehicle comes to rest, the unrestrained passenger moves forward, striking the dashboard. In this type of crash, the cervical spine and surrounding area may be injured. The cervical spine is less tolerant of damage when it is bent back. Headrests decrease extension of the head and neck during a crash and, therefore, help reduce injury. Other parts of the spine and the pelvis may also be at risk for injury. In addition, the patient may sustain an acceleration injury to the brain, that is, the third collision of the brain within the skull. Passengers in the backseat wearing only a lap belt might have a higher incidence of injuries to the thoracic and lumbar spine.

Lateral Crashes

Lateral or side impacts (commonly called T-bone crashes) are a very common cause of death associated with motor vehicle crashes. When a vehicle is struck from the side, it is typically struck above its center of gravity and begins to rock away from the side of the impact. This results in the passenger sustaining a lateral whiplash injury **Figure 24-11**. The movement is to the side, and the passenger's shoulders and head whip toward the intruding vehicle. This action may thrust the shoulder, thorax, and upper extremities, and, more important, the skull against the doorpost or the window. The cervical spine has little tolerance for lateral bending.

Figure 24-10 Rear-end impacts often cause whiplash injuries, particularly when the head and/ or neck is not restrained by a headrest.

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Figure 24-11 In a lateral crash, the car is typically struck above its center of gravity and begins to rock away from the side of impact. This causes a type of lateral whiplash in which the passenger's shoulders and head whip toward the intruding vehicle.

If there is substantial intrusion into the passenger compartment, suspect your patient to have lateral chest and abdomen injuries on the side of the impact, as well as possible fractures of the lower extremities, pelvis, and ribs. In addition, the organs within the abdomen are at risk because of a possible third collision. According to the Journal of Safety Research, lateral crashes cause approximately 25% of all severe injuries to the aorta and approximately 30% of all fatalities that occur in motor vehicle crashes.

Rollover Crashes

Certain vehicles, such as large trucks and some sport utility vehicles, are more prone to rollover crashes because of their high center of gravity. Injury patterns that are commonly associated with rollover crashes differ, depending on whether the passenger was restrained or unrestrained. The most unpredictable types of injuries are caused by rollover crashes in which an unrestrained passenger may have sustained multiple strikes within the interior of the vehicle as it rolled one or more times. The most common life-threatening event in a rollover is ejection or partial ejection of the passenger from the vehicle **Figure 24-12**. Passengers who have been ejected may have struck the interior of the vehicle many times before ejection. The passenger may also have struck several objects, such as trees, a guardrail, or the vehicle's exterior, before landing. Passengers who have been partially ejected may have struck both the interior and exterior of the vehicle and may have been sandwiched between the exterior of the vehicle and the environment as the vehicle rolled. Ejection and partial ejection are significant mechanisms of injury; in these cases, prepare to care for life-threatening injuries.

Figure 24-12 Passengers who have been ejected or partially ejected may have struck the interior of the car many times before ejection.

Even when restrained, passengers can sustain severe injuries during a rollover crash, although the patterns of injury tend to be more predictable, and when the restraint system is properly used, ejection from the vehicle is prevented. A passenger on the outboard side of a vehicle that rolls over is at high risk for injury because of the centrifugal force (the patient is pinned against the door of the vehicle). Rollover crashes can also cause injury when the roof of the vehicle hits the ground during the rollover; a passenger who is restrained can still move far enough toward the roof to make contact and sustain a spinal cord injury. Therefore, rollover crashes are dangerous for both restrained and, to a greater degree, unrestrained passengers because these crashes provide multiple opportunities for second and third collisions.

Rotational Crashes

Rotational crashes (spins) are conceptually similar to rollovers. The rotation of the vehicle as it spins provides opportunities for the vehicle to strike objects such as utility poles. For example, as a vehicle spins and strikes a pole, the passengers experience not only the rotational motion, but also a lateral impact.

Car Versus Pedestrian

Car-versus-pedestrian crashes often result in patients who have graphic and apparent injuries, such as broken bones; however, this type of crash can cause serious unseen injuries to underlying body systems. Therefore, you must maintain a high index of suspicion for unseen injuries. A thorough evaluation of the MOI is critical. First, estimate the speed of the vehicle that struck the patient; next, determine whether the patient was ejected, what surface the patient landed on, and at what distance or whether the patient was struck and pulled under the vehicle. Evaluate the vehicle that struck the patient for structural damage that might indicate contact points with the patient and alert you to potential injuries. Multisystem injuries are common after this type of event. Summon advanced life support (ALS) backup for any patients who have or are thought to have sustained a significant MOI.

Car Versus Bicycle

In a car-versus-bicycle crash, evaluate the MOI in much the same manner as car-versus-pedestrian crashes. However, additional evaluation of damage to and the position of the bicycle is warranted. If the patient was wearing a helmet, inspect the helmet for damage and suspect potential injury to the head **Figure 24-13**. Presume that the patient has sustained an injury to the spinal column, or spinal cord, until proven otherwise at the hospital. Initiate and maintain spinal immobilization during the encounter. When practical, roll the patient on to his or her side to allow for an appropriate assessment of the posterior side of the body.

Figure 24-13 If the patient's bike helmet is damaged, suspect head and spine injuries.

Car Versus Motorcycle

In a motorcycle crash, any structural protection afforded to the victim is not derived from a steel cage, as is the case in an automobile, but from protective devices worn by the rider, that is, helmet, leather or abrasion-resistant clothing, and boots. While helmets are designed to protect against impact forces to the head, they do not protect from cervical injury. Patients who have experienced a motorcycle crash should undergo cervical spine assessment and have cervical collars placed if indicated. Leather and synthetic gear worn over the body was initially designed to protect professional riders in competition, where falls tend to be controlled and result in long sliding mechanisms on hard surfaces rather than multiple collisions against road objects and other vehicles. Leather clothing will protect mostly against road abrasion but offers no protection against blunt trauma from secondary impacts. In a street crash, collisions usually occur against other larger vehicles or stationary objects.

When assessing the scene of a motorcycle crash, look for deformity of the motorcycle, the side of most damage, the distance of skid in the road, the deformity of stationary objects or other vehicles, and the extent and location of deformity in the helmet. These findings can be helpful in estimating the extent of trauma in a patient.

Words of Wisdom

If possible bring the helmet to the hospital for the trauma staff to see. This will provide them with critical information as to the type and extent of potential head injury.

There are four types of motorcycle impacts.

- **Head-on crash:** The motorcycle strikes another object and stops its forward motion while the rider and parts of the motorcycle that are broken off continue their forward motion until stopped by an outside force, such as drag from the road or another opposing force from a secondary collision.
- **Angular crash:** The motorcycle strikes an object or another vehicle at an angle so that the rider sustains direct crushing injuries to the lower extremity between the object and the motorcycle. This usually results in severe open and comminuted lower extremity injuries with severe neurovascular compromise, often requiring surgical amputation.
- **Ejection:** The rider will travel at high speed until stopped by a stationary object, another vehicle, or by road drag. Severe abrasion injuries (road rash) down to bone can occur with drag. An unpredictable combination of blunt injuries can occur from secondary collisions.
- **Controlled crash:** A technique used to separate the rider from the body of the motorcycle and the object to be hit is referred to as laying the bike down. It was developed by motorcycle racers and adapted by street bikers as a means of achieving a controlled crash. As a crash approaches, the motorcycle is turned flat and tipped sideways at 90 degrees to the direction of travel so that one leg is dropped to the grass or asphalt. This slows the occupant faster than the motorcycle, allowing the rider to become separated from the motorcycle. If properly protected with leather or synthetic abrasion-resistant gear, injuries should be limited to those sustained by rolling over the pavement and any secondary collision that may occur. When executed properly, this maneuver prevents the rider from being trapped between the bike and the object. However, a rider unable to clear the bike will continue into the vehicle, often with devastating results.

Falls

The injury potential of a fall is related to the height from which the patient fell. Falls are common MOIs for blunt trauma. The greater the height of the fall, the greater the potential for injury. A fall from more than 20 feet (6 m) is considered significant. The patient lands on the surface just as an unrestrained passenger smashes into the interior of a vehicle. The internal organs travel at the speed of the patient's body before it hits the ground and stop by smashing into the interior of the body. Again, as in a motor vehicle crash, it is these internal injuries that are the least obvious during assessment but pose the gravest threat to life. Therefore, suspect internal injuries in a patient who has fallen from a significant height, just as you would in a patient who has been in a high-speed motor vehicle crash. Always consider syncope or other underlying medical causes of the fall.

Patients who fall and land on their feet may have less severe internal injuries because their legs may have absorbed much of the energy of the fall Figure 24-14. However, as a result, they may have very serious injuries to the lower extremities and pelvic and spinal injuries from energy that the legs did not absorb. Patients who fall onto their heads, as in diving accidents, will likely have serious head and/or spinal injuries. In either case, a fall from a significant height is a serious event with great injury potential, and the patient should be evaluated thoroughly. Take the following factors into account:

Special Populations

When your patient is a child, the following constitute a significant MOI:

1. Falls of greater than 10 feet (3 m) (or 2 to 3 times the height of the child)
2. Medium- to high-speed vehicle crash (>25 mph)

Also note that young children are top-heavy, so they tend to land on their heads even from short falls. Triage children to a pediatric trauma center if possible.

Figure 24-14 When a patient falls and lands on his or her feet, the energy is transmitted to the spine, sometimes producing a spinal injury in addition to injuries to the legs and pelvis.

- The height of the fall
- The type of surface struck
- The part of the body that hit first, followed by the path of energy displacement

Many falls, especially those sustained by older patients, are not the result of high-energy trauma, even though broken bones may result. Older patients often have osteoporosis, a condition in which the musculoskeletal system can fail under relatively low stress because the bones are structurally weakened. Because of this condition, an older patient can sustain a fracture as a result of a fall from a standing position. These cases do not constitute true high-energy trauma unless the patient fell from a significant height.

Penetrating Trauma

Penetrating trauma is the second leading cause of trauma death in the United States after blunt trauma. In 2011, the CDC reported just over 32,000 deaths from firearms, which is just under the number of deaths related to motor vehicles. Low-energy penetrating trauma may be caused accidentally by impalement or intentionally by a knife, ice pick, or other weapon **Figure 24-15**. Many times it is difficult to determine entrance and exit wounds from **projectiles** in a prehospital setting. First determine the number of penetrating injuries and then combine that information with the important things you already know about the potential pathway of penetrating projectiles to form an index of suspicion about unseen life-threatening injuries. With low-energy penetrations, injuries are caused by the sharp edges of the object moving through the body and are, therefore, close to the object's path. Weapons such as knives, however, may have been deliberately moved around internally, causing more damage than the external wound might suggest. Try to determine the length of the penetrating object.

Special Populations

Many older patients are seriously injured from falls. Completely assess older patients for all possible injuries, even from low-impact falls.

In medium- and high-velocity (speed) penetrating trauma, the path of the projectile (usually a bullet) may not be as easy to predict. This is because the bullet may flatten out, tumble, or even ricochet within the body before exiting. The path the projectile takes is referred to as a **trajectory**. Fragmentation, especially frangible bullets that are designed to disintegrate into tiny particles on impact, will increase damage as multiple fragments increase the likelihood of multiple organs/ vessels sustaining injury. Full metal jacket bullets cause less damage than fragmented rounds because of their tendency to pass through the body's tissues. The bullet's speed is another factor in the resulting injury pattern; there is often additional damage caused by the object moving inside the body, but not along the suspected pathway. This phenomenon, called **cavitation**, which results from the rapid changes in tissue and fluid pressure that occur with the passage of the projectile, can result in serious injury to internal organs distant to the actual path of the bullet **Figure 24-16**. Consequences of cavitation can be temporary or permanent. Temporary cavitation injury results from a stretching of the tissues that occurs with the pressure changes. Permanent cavitation injury results closer to the bullet path where the pressure fluctuations are greatest and remains after the projectile has passed through the tissue. Remain alert during assessment because patients will exhibit various signs and symptoms depending on the organ(s) affected.

YOU are the Provider — PART 3

The patient is removed from the vehicle onto the backboard, and you perform a quick secondary assessment. Your partner applies high-flow oxygen via a nonrebreathing mask while one of the EMTs from one of the engine companies obtains the patient's vital signs.

Recording Time: 5 Minutes	
Respirations	22 breaths/min; labored
Pulse	120 beats/min; weak radial pulses
Skin	Cool, clammy, and pale
Blood pressure	84/64 mm Hg
Oxygen saturation (Spo_2)	97% (with supplemental oxygen)

The patient's level of consciousness is still markedly decreased; he only responds to pain. He has a large hematoma and laceration to his forehead, which is covered with a sterile dressing. He also has crepitus and bruising to his chest. A Level I trauma center is 30 miles away, but there is a Level III trauma center only 15 miles away.

4. Should the patient be transported to the Level I trauma center or the Level III trauma center? Why?
5. What other transport factors should you consider with this patient?

Words of Wisdom

Do not waste time trying to determine whether a penetrating wound is an entrance or exit wound; this can be difficult. Instead, focus on finding all of the wounds and providing appropriate care.

Figure 24-15 Injuries from low-energy penetrations, such as a stab wound, are caused by the sharp edges of the object moving through the body.
Andrew Pollak, MD. Used with permission.

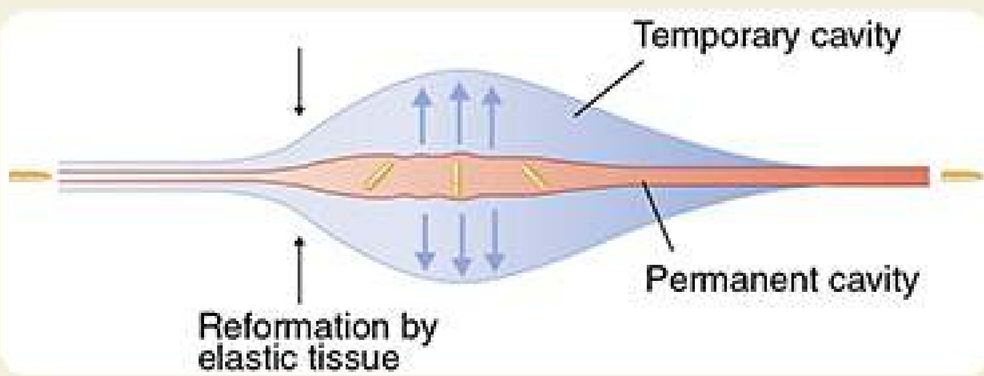

Figure 24-16 There are two types of injury caused by cavitation—temporary and permanent.
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Figure 24-17 The area damaged by high-velocity projectiles, such as bullets, can be many times larger than the diameter of the projectile itself.

© D. Willoughby/Custom Medical Stock Photo.

The relationship between distance and the severity of injury varies depending on the type of weapon involved, such as a rifle, pistol, or shotgun. Air resistance, often referred to as **drag**, slows the projectile, decreasing the depth of penetration and energy of the projectile and thus reducing damage to the tissues. Much like a boat moving through water, the bullet disrupts not only the tissues that are directly in its path but also those in its wake. Therefore, the area that is damaged by medium- and high-velocity projectiles is typically many times larger than the diameter of the projectile itself **Figure 24-17**. This is one reason that exit wounds are often many times larger than entrance wounds. As with motor vehicle crashes, the energy available for a bullet to cause damage is more a function of its speed than its mass (weight). If the mass of the bullet is doubled, the energy that is available to cause injury is doubled. If the velocity of the bullet is doubled, the energy that is available to cause injury is quadrupled. For this reason, it is important for you to try to determine the type of weapon that was used. Although it is not necessary (or always possible) for you to distinguish between medium- and high-velocity injuries, any information regarding the type of weapon that was used should be relayed to medical control. Medium-velocity injuries may be caused by handguns and some rifles, whereas high-velocity injuries may be caused by a military weapon. Police at the scene may be a useful source of information regarding the caliber of weapon. The majority of civilian gunshot wound injuries in the United States are the result of low-velocity weapons.

Table 24-1 summarizes how to recognize developing problems in trauma patients.

Table 24-1 Recognizing Developing Problems in Trauma Patients

Mechanism of Injury	Signs and Symptoms	Index of Suspicion
Blunt or penetrating trauma to the neck	▪ Noisy or labored breathing ▪ Increased respiratory rate ▪ Swelling of the face or neck ▪ Altered gag reflex ▪ Decreasing/low Glasgow Coma Scale (GCS); <9 is severe ▪ Decreasing/low Spo_2 ▪ Rapid, weak pulse ▪ Decreasing/low blood pressure	▪ Significant bleeding or foreign bodies in the upper or lower airway, causing obstruction ▪ Be alert for airway compromise
Significant chest wall blunt trauma from motor vehicle crashes, car-versus-pedestrian, and other crashes; penetrating trauma to the chest wall	▪ Significant chest pain ▪ Shortness of breath ▪ Increased respiratory rate ▪ Asymmetric chest wall movement ▪ Subcutaneous emphysema ▪ Decreasing GCS (<9 is severe) ▪ Decreasing/low Spo_2 ▪ Presence of jugular vein distention ▪ Rapid, weak pulse ▪ Decreasing/low blood pressure ▪ Loss of peripheral pulses during inspiration ▪ Narrowing pulse pressures	▪ Cardiac or pulmonary contusion ▪ Pneumothorax (accumulation of air or gas in the pleural cavity) or hemothorax (accumulation of blood in the pleural cavity) ▪ Broken ribs, causing respiratory compromise
Any significant blunt force trauma from motor vehicle crashes or penetrating injury	▪ Blunt or penetrating trauma to the neck, chest, abdomen, or groin ▪ Blows to the head sustained during motor vehicle crashes, falls, or other incidents, producing loss of consciousness, altered mental status, inability to recall events, combativeness, or changes in speech patterns ▪ Difficulty moving extremities; headache, especially with nausea and vomiting ▪ Decreasing GCS (<9 is severe) ▪ Decreasing/low Spo_2 ▪ Rapid, weak pulse ▪ Decreasing/low blood pressure or increasing blood pressure with slow pulse	▪ Injuries in these regions may tear and cause damage to the large blood vessels located in these body areas, resulting in significant internal and external bleeding ▪ Be alert to the possibility of bruising to the brain and bleeding in and around the brain tissue, which may cause the development of excess pressure inside the skull around the brain
Any significant blunt force trauma, falls from a significant height, or penetrating trauma	▪ Severe back and/or neck pain, history of difficulty moving extremities, loss of sensation or tingling in the extremities ▪ Decreasing GCS (<9 is severe) ▪ Rapid, weak pulse or slow pulse	▪ Injury to the bones of the spinal column or to the spinal cord

Blast Injuries

Although most commonly associated with military conflict, blast injuries are also seen in civilian practice in mines, shipyards, chemical plants, and, increasingly, in association with terrorist activities. As with any explosion there is a risk of contamination of patients from environmental contaminants, toxic chemicals, or dirty bombs. People who are injured in explosions may be injured by any of four different mechanisms Figure 24-18.

- **Primary blast injuries.** These injuries are due entirely to the blast itself; that is, damage to the body is caused by the pressure wave generated by the explosion. When the victim is close to the blast, the blast wave may cause disruption of major blood vessels and rupture of eardrums and major organs, including the lungs. Hollow organs are the most susceptible to the pressure wave. In some cases, pressure wave injuries can amputate limbs.

- **Secondary blast injuries.** Damage to the body results from being struck by flying debris, such as shrapnel from the device or from glass or splinters, which have been set in motion by the explosion. Objects are propelled by the force of the blast wave and strike the victim, causing injury. These objects can travel great distances and be propelled at tremendous speeds, up to nearly 3,000 mph for conventional military explosives.
- **Tertiary blast injuries.** These injuries occur when the patient is hurled by the force of the explosion against a stationary object. A blast wind (sudden change in the surrounding atmosphere) creates a pressure wave. This can cause the patient's body to be hurled or thrown, resulting in further injury. This physical displacement of the body is also referred to as ground shock when the body impacts the ground.
- **Quaternary blast injuries.** This category of miscellaneous injuries includes burns from hot gases or fires started by the blast; respiratory injury from inhaling toxic gases; suffocation; poisoning; medical emergencies incurred as a result of the explosion; crush injuries from the collapse of buildings; contamination of wounds from environmental, chemical, or toxic substances; and mental health emergencies.

Most patients who survive an explosion will have some combination of the four types of injuries mentioned. The discussion here will be confined to primary blast injuries because these injuries are the ones that are most easily overlooked.

Tissues at Risk

Organs that contain air, such as the middle ear, lung, and gastrointestinal tract, are most susceptible to pressure changes. The junction between tissues of different densities and exposed areas such as head and neck tissues are prone to injury as well. The ear is the organ system that is most sensitive to blast injuries. The **tympanic membrane** evolved to detect minor changes in pressure and will rupture at pressures of 5 to 7 pounds per square inch above atmospheric pressure. Thus, the tympanic membranes are a sensitive indicator that you can use to help determine the possible presence of other blast injuries. The patient may report ringing in the ears, pain in the ears, or some loss of hearing, and blood may be visible in the ear canal. Dislocation of structural components of the ear, such as the ossicles conforming the inner ear, may occur. Permanent hearing loss is possible. These findings can be used to assist in triaging patients as they indicate risk of pressure injuries to the lungs.

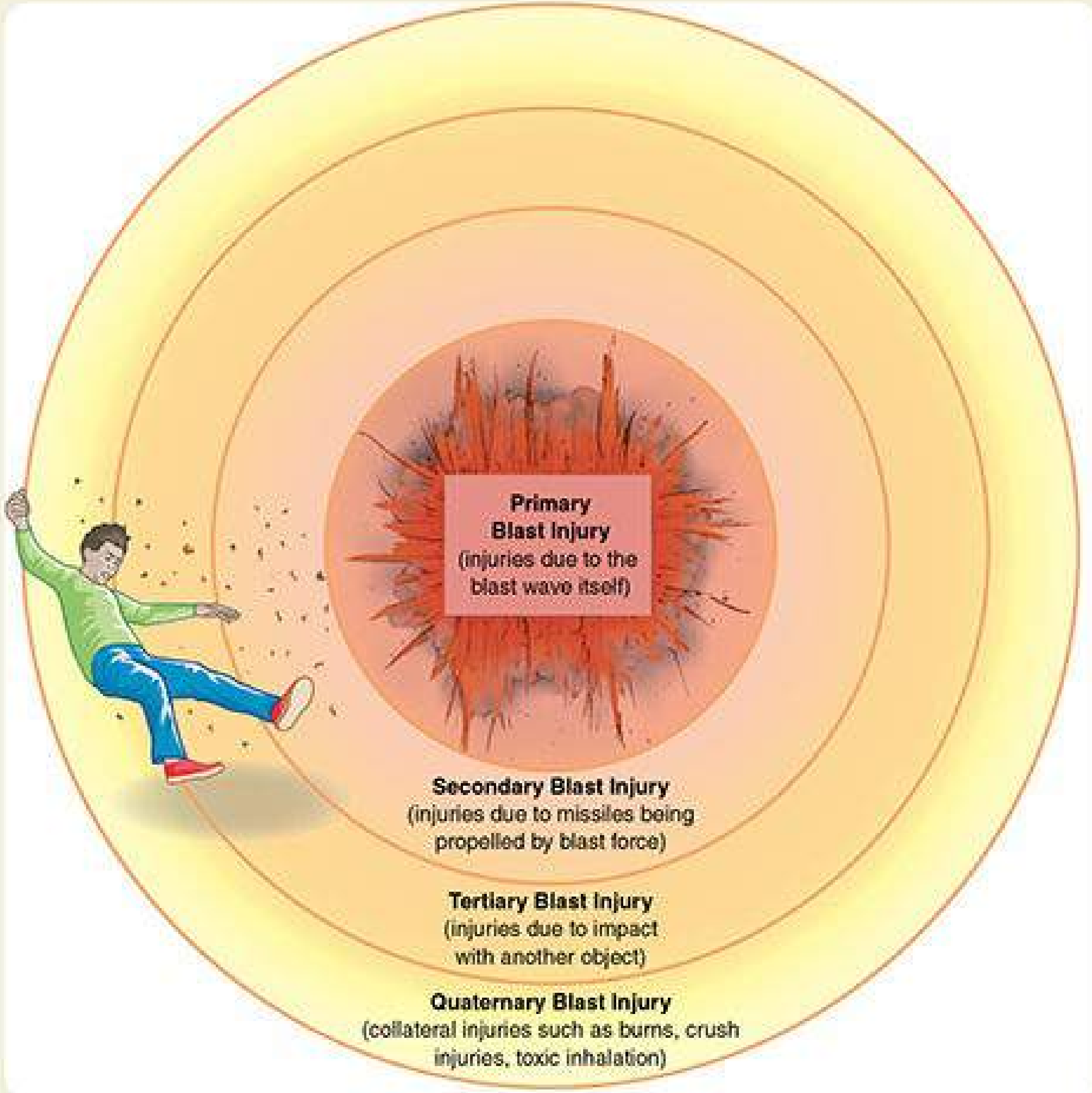


Figure 24-18 The mechanisms of blast injuries.

Pulmonary blast injuries are defined as pulmonary trauma (consisting of contusions and hemorrhages) that results from short-range exposure to the detonation of explosives. When the explosion occurs in an open space, both lungs are usually injured. Primary blast injury is often characterized by a lack of external visible injuries and thus can go unrecognized. The patient may report tightness or pain in the chest and may cough up blood and have tachypnea or other signs of respiratory distress. Subcutaneous emphysema (crackling under the skin) can be detected over the chest through the use of palpation, indicating air in the thorax. Pneumothorax is a common injury and may require emergency decompression (which is covered in Chapter 29, *Chest Injuries*) in the field for your patient to survive. Pulmonary edema may ensue rapidly. If there is any reason to suspect lung injury in a blast victim (even just the presence of a ruptured eardrum), administer oxygen. Avoid giving oxygen under positive pressure, however (that is, by demand valve), because that may simply increase the damage to the lung. Be cautious as well with intravenous fluids, which may be poorly tolerated in patients with this type of lung injury and result in pulmonary edema.

One of the most concerning pulmonary blast injuries is **arterial air embolism**, which occurs on alveolar disruption with subsequent air embolization into the pulmonary vasculature. Even small air bubbles can enter a coronary artery and cause myocardial injury. Air embolisms to the cerebrovascular system can produce disturbances in vision, changes in behavior, changes in state of consciousness, and a variety of other neurologic signs.

Solid organs are relatively protected from shock wave injury but may be injured by secondary missiles or a hurled body. Hollow organs, however, may be injured by the same mechanisms that damage lung tissue. Petechiae, or pinpoint reddish-purple hemorrhages that show up on the skin, to large hematomas may be found. Perforation or rupture of the bowel and colon is a risk. Underwater explosions result in the most severe abdominal injuries.

Neurologic injuries and head trauma are the most common causes of death from blast injuries. Subarachnoid (beneath the arachnoid layer covering the brain) and subdural (beneath the outermost covering of the brain) hematomas are often seen. Permanent or transient neurologic deficits may be secondary to concussion, intracerebral bleeding, or air embolism. Instant but transient unconsciousness, with or without retrograde amnesia, may be initiated not only by head trauma, but also by cardiovascular problems. Bradycardia and hypotension are common after an intense pressure wave from an explosion.

YOU are the Provider — PART 4

The decision is made to transport the patient by air based on his injuries and the news of heavy traffic causing a lengthy delay in transporting him to the Level I trauma center. After full spinal immobilization is employed, the patient is loaded into the ambulance and immediately reassessed.

Recording Time: 10 Minutes	
Level of consciousness	Responds only to pain
Respirations	30 breaths/min; extremely labored
Pulse	130 beats/min; absent radial pulses
Skin	Cool, clammy, and pale
Blood pressure	80/50 mm Hg
Spo_2	89% (supplemental oxygen)

Your partner begins assisting the patient's ventilations with a bag-valve mask (BVM) and high-flow oxygen, and oral suctioning is performed as needed to keep the patient's airway clear of blood. The patient flexes his arms in response to pain, but does not open his eyes or respond verbally when you talk to him. An EMT from one of the engine companies drives the ambulance to the landing zone, which is about a mile away.

6. What trauma scoring systems are commonly used to assess the severity of a trauma patient's condition? How would you apply them to this patient?

Extremity injuries, including traumatic amputations, are common. Patients with traumatic amputation by postblast wind are likely to sustain fatal injuries secondary to the blast. In present day combat, improved body armor has increased the number of survivors of blast injuries from shrapnel wounds to the torso. The number of severe orthopaedic and extremity injuries, however, has increased. In addition, whereas body armor may limit or prevent shrapnel from entering the body, it also "catches" more energy from the blast wave, possibly resulting in the victim being thrown backward, thus increasing the potential for spine and spinal cord injury.

Although blast injuries have usually been the domain of military surgeons, they often occur in industrial settings and are, unfortunately, more common today owing to the increased use of explosives as a tool for urban terrorism and, in the United States, from methamphetamine laboratory explosions. Although civilian blast injuries in an industrial or mining setting used to be mostly characterized by blast injuries and burns, terrorist bombs often contain shrapnel. As an EMT, you and other EMS and trauma services personnel should be fully educated and aware of what to expect in these scenarios.

Multisystem Trauma

Multisystem trauma is a term that describes a person who has been subjected to multiple traumatic injuries involving more than one body system such as head and spinal trauma, chest and abdominal trauma, or chest and multiple extremity trauma. You must recognize patients who fit into this classification and provide rapid treatment and transportation, and alert medical control as to the nature of the patient's injuries so that the trauma center is prepared prior to your arrival. Multisystem trauma patients have a high level of morbidity and mortality; therefore, they require teams of physicians to treat their injuries. These teams may include specialists such as neurosurgeons, thoracic surgeons, and orthopaedic surgeons.

Golden Principles of Prehospital Trauma Care

As with any EMS call, your main priority in managing multisystem trauma is to ensure your safety and the safety of your crew and patient. Next, you must determine the need for additional personnel or equipment, evaluate the MOI, and identify and appropriately manage life threats. Once these steps have been completed, you can focus on patient care. Begin by assessing and managing the airway, including ventilatory support and high-flow oxygen while maintaining cervical spine immobilization. Ensure that basic shock therapy, such as controlling hemorrhages, stopping arterial bleeding, and keeping the patient warm, is completed. If bleeding cannot be controlled rapidly by direct pressure, use a tourniquet. If the patient is bleeding profusely, this must be controlled to ensure sufficient perfusion of organs and tissues.

Once threats to the ABCs are corrected, protect the patient's cervical spine and rapidly proceed with spinal immobilization if indicated. If the patient is entrapped, consider the use of rapid extrication techniques. In most patients with multisystem trauma, definitive care requires surgical intervention; therefore, on-scene time should be limited to 10 minutes or less. This is referred to as the platinum 10 minutes. During transport, obtain a SAMPLE history and complete a secondary assessment. Most care can be provided in transport. However, keep in mind that your patient has sustained multisystem trauma, and the order in which you usually provide treatment and care may need to be adjusted depending on the needs of the patient. For critically injured patients, consider ALS intercept and/or air medical transportation. Regardless of the mode of transport, ensure that the patient is transported to an appropriate facility and that the facility is notified as soon as possible. Specific standards of care in regard to multisystem trauma are addressed in detail in respective chapters.

Words of Wisdom

Rapid transport decisions are needed for patients who have sustained significant trauma. After the first 60 minutes, the body has increasing difficulty in compensating for shock and traumatic injuries. This is referred to as the Golden Hour. Because many injured patients require definitive care in less than an hour, this is also referred to as the Golden Period.

Patient Assessment

Identifying life-threatening illnesses and injuries as soon as possible has proven to improve patient outcomes. As an EMT, you must apply this knowledge as well as the appropriate assessment skills to assess, triage, manage, and transport patients with traumatic injuries to the most appropriate facility. The major components of patient assessment include the following:

- Scene size-up
- Primary assessment
- History taking
- Secondary assessment
- Reassessment

When you are caring for a patient who has experienced a significant MOI and the patient is considered to be in serious or critical condition, you should rapidly perform a physical examination. With a patient who has experienced a nonsignificant MOI, focus on the chief complaint while assessing the patient as a whole. The human body is divided into areas (or systems) based on body function, and its internal organs are subject to unseen injuries when force is applied to the body. For example, the brain may have bruising, the heart and lungs may have bruising or unseen bleeding, and the organs of the abdomen may have life-threatening bleeding. The following sections discuss the assessment of various body systems.

Injuries to the Head

The brain lies well protected within the skull. However, when the head is injured from trauma, disability and unseen injury to the brain may occur. The brain itself may tear or become bruised, causing bleeding. The blood vessels around the brain may also tear and produce bleeding. Bleeding or swelling inside the skull from brain injury is often life threatening; therefore, your assessment must include conducting frequent neurologic examinations. Neurologic assessments coupled with the patient's level of consciousness will often provide details on subtle changes in the patient's condition. Some patients will not have obvious signs or symptoms, such as changes in pupillary size and reactivity, of unseen brain injury until minutes or hours after the injury has occurred.

Injuries to the Neck and Throat

The neck and throat contain many structures that are susceptible to injuries from trauma that could be serious or deadly to your patients. In this region of the human body, the trachea (or windpipe) may become torn or swell after an injury to the neck or deviate after an injury to the lungs. These types of injuries may result in an airway problem that could quickly become a serious life threat because they interfere with the patient's ability to breathe; therefore, your assessment must include frequent physical examination looking for DCAP-BTLS in the neck region. In addition, you should also assess for jugular venous (vein) distention and tracheal deviation (late sign of injury).

The neck also contains large blood vessels that supply the brain with oxygen-rich blood. When a neck injury occurs, swelling may prevent blood flow to the brain and cause injury to the central nervous system, even though the brain may not have been directly affected by the initial force that caused the injury to the neck. If a penetrating injury to the neck results in an open wound, the patient may have significant bleeding, or air may be drawn into the circulatory system. If air enters the veins, this may result in air embolism, which may lead to cardiac arrest if the air enters the heart. Occlusive dressings must be used to keep this from happening. A crushing injury to the upper part of the neck may cause the cartilages of the upper airway and larynx to fracture. This can lead to the leakage of air into the soft tissue of the neck. When air is trapped in subcutaneous tissue (subcutaneous emphysema), it produces a crackling sound or feeling when palpated, called subcutaneous crepitation. Either air in the circulation or an airway cartilage fracture may cause rapid death.

Injuries to the Chest

The chest contains the heart, the lungs, and the large blood vessels of the body. When injury occurs to this area of the body, many life-threatening injuries may occur. For example, blunt trauma to the chest can fracture ribs or the sternum. When ribs are broken and the chest wall does not expand normally during breathing, this interferes with the body's ability to obtain sufficient amounts of oxygen for the cells. Bruising may occur to the heart and cause an irregular heartbeat. Depending on the severity of the trauma, the large vessels of the heart may be torn inside the chest, causing massive unseen bleeding that can quickly kill the trauma patient. In some chest injuries the lungs become bruised, thus interfering with normal oxygen exchange in the body.

Some chest injuries result in air collecting between the lung tissue and the chest wall. As air accumulates in this space, the lung tissue becomes compressed, again interfering with the body's ability to effectively exchange oxygen. This injury is called a *pneumothorax*. If left untreated or unrecognized, the lung tissue becomes squeezed under pressure until the heart is also squeezed and can no longer pump blood. This condition is called a tension pneumothorax and is a life-threatening emergency. In some patients bleeding in this portion of the chest develops. Instead of air collecting in this space, blood collects here and causes interference with breathing. This condition is called a *hemothorax* and it also poses a threat to the patient's life.

A penetration or perforation of the integrity of the chest is called an open chest wound. As air enters the chest cavity, the natural pressure balance within the chest cavity is no longer equal. If left untreated, shock and/or death will result. Regardless of the particular injury, it is imperative that you reassess a trauma patient's chest region every 5 minutes. The assessment should include DCAP-BTLS, lung sounds, and chest rise and fall. Some patients will not have obvious signs or symptoms such as absent breath sounds or respiratory difficulty immediately.

Injuries to the Abdomen

The abdomen is an area of the human body that contains many organs vital to body function. These organs also require a very high amount of blood flow so they can perform the functions necessary for life. The organs of the abdomen and retroperitoneum (the space immediately behind the true abdomen) can be classified into two simple categories: solid and hollow. The solid organs include the liver, spleen, pancreas, and kidneys. The hollow organs include the stomach, large and small intestines, and urinary bladder.

When injuries from trauma occur in this region of the body, serious and life-threatening problems may occur. The solid organs may tear, lacerate, or fracture. This causes serious bleeding into the abdomen that can quickly cause death. Be alert for a trauma patient who reports abdominal pain—it may be a symptom of abdominal bleeding. Also be alert to vital signs that begin to worsen; this can be a sign of serious, unseen bleeding inside the abdominal region of the body.

When the hollow organs of the body have been injured, they may rupture and leak toxic chemicals used for digestion into the abdomen. This not only causes pain, but a life-threatening infection also may eventually develop.

The abdomen also contains large blood vessels that supply the organs of this region and the lower extremities with oxygen-rich blood. Occasionally these vessels rupture or tear and cause serious unseen bleeding that may cause death. Some patients, particularly healthy young adults, are able to compensate longer than others from blood loss; therefore, you should always maintain a high index of suspicion when the MOI suggests injury to the abdominal region. This is best accomplished by reassessing the abdominal region using DCAP-BTLS.

YOU are the Provider — PART 5

The air transport helicopter arrives at the landing zone approximately 5 minutes after your unit. After reassessing the patient, you give your verbal report to the flight paramedic and transfer patient care.

Recording Time: 15 Minutes	
Level of consciousness	Responds only to pain
Respirations	30 breaths/min; extremely labored
Pulse	140 beats/min; absent radial pulses
Skin	Cool, clammy, and pale
Blood pressure	74/50 mm Hg
Spo_2	95% (supplemental oxygen)

After further assessment and treatment, the helicopter personnel load the patient into the aircraft and depart the scene. You later learn that the patient had intrathoracic and intracranial bleeding and multiple rib fractures. He was taken to surgery, and was in critical condition in the surgical intensive care unit.

7. How does the level of trauma care provided by the paramedic differ from that of the EMT?

Management: Transport and Destination

Caring for victims of traumatic injuries requires a solid understanding of the trauma system in the United States. You need a good working knowledge of the resources available to you, including the most optimal methods of rapid transport and trauma centers that can best provide definitive care. Call for ALS and helicopter assistance early, possibly even before you arrive on scene, to avoid delays in treatment and transport.

Scene Time

Because survival of critically injured trauma patients is time dependent, limit on-scene time to the minimum amount necessary to correct life-threatening injuries and package the patient. Optimally, on-scene time for critically injured patients should be less than 10 minutes—the platinum ten. The following criteria will help you identify a critically injured patient:

- Dangerous MOI
- Decreased level of consciousness
- Any threats to airway, breathing, or circulation. Patients who present with these criteria or who are very young or old or have chronic illnesses should also be considered to be high risk, thus requiring rapid treatment and transport.

Type of Transport

As discussed in Chapter 14, *Medical Overview*, modes of transport ultimately come in one of two categories: ground or air. Ground transportation EMS units are generally staffed by EMTs and paramedics. Air transportation EMS units or critical care transport units are often staffed by critical care transport professionals such as critical care nurses and paramedics.

You should be familiar with your local protocols defining indications for use of air medical transport. The Association of Air Medical Services and MedEvac Foundation International identified the following criteria in the 2006 white paper, *Air Medicine: Accessing the Future of Healthcare*, for consideration in deciding the appropriate use of emergency air medical services for trauma patients.

- There is an extended period required to access or extricate a remote (eg, injured hiker, snowmobiler, or boater) or trapped patient (eg, in a crashed car) which depletes the time window to get the patient to the trauma center by ground.
- Distance to the trauma center is greater than 20 to 25 miles.
- The patient needs medical care and stabilization at the ALS level, and there is no ALS-level ground ambulance service available within a reasonable time frame.
- Traffic conditions or hospital availability make it unlikely that the patient will get to a trauma center via ground ambulance within the ideal time frame for best clinical outcome.
- There are multiple patients who will overwhelm resources at the trauma center(s) reachable by ground within the time window.

- EMS systems require bringing a patient to the nearest hospital for initial evaluation and stabilization, rather than bypassing those facilities and going directly to a trauma center. This may add delay to definitive surgical care and necessitate air transport to mitigate the impact of that delay.
- There is a mass-casualty incident.

These recommendations are not to be understood as fully encompassing, but more as a guideline for local decision makers to develop more comprehensive protocols for the use of air medical transport. Always follow your local protocols when determining what type of patient transportation is appropriate.

Destination Selection

You will often be summoned to accident scenes to transport critically ill trauma patients to definitive care. For this reason, it is important for you to be familiar with how the American College of Surgeons' Committee on Trauma (ACS-COT) classifies trauma care. Trauma centers are classified into Levels I through IV, with Level I having the most resources followed by Levels II, III, and IV, respectively Table 24-2.

A Level I facility is a regional resource center and generally serves large cities or heavily populated areas. Level I facilities must be capable of providing every aspect of trauma care from prevention through rehabilitation; therefore, the facility must have adequate personnel and resources. Because of the extensive requirements, most Level I facilities are university-based teaching hospitals.

A Level II facility is typically located in less populated areas. Level II centers are expected to provide initial definitive care, regardless of injury severity. These facilities can be academic institutions or a public/private community facility. Because of its location and resources, a Level II trauma center may not be able to provide the same comprehensive care as a Level I trauma center.

Table 24-2 Key Elements for Trauma Centers

Level	Definition	Key Elements
Level I	A comprehensive regional resource that is a tertiary care facility; capable of providing total care for every aspect of injury—from prevention through rehabilitation	**1.** 24-hour in-house coverage by general surgeons **2.** Availability of care in specialties such as orthopaedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, internal medicine, and critical care **3.** Should also include cardiac, hand, pediatric, and microvascular surgery and hemodialysis **4.** Provides leadership in prevention, public education, and continuing education of trauma team members **5.** Committed to continued improvement through a comprehensive quality assessment program and organized research to help direct new innovations in trauma care
Level II	Able to initiate definitive care for all injured patients	**1.** 24-hour immediate coverage by general surgeons **2.** Availability of orthopaedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, and critical care **3.** Tertiary care needs such as cardiac surgery, hemodialysis, and microvascular surgery may be referred to a Level I trauma center **4.** Committed to trauma prevention and continuing education of trauma team members **5.** Provides continued improvement in trauma care through a comprehensive quality assessment program
Level III	Able to provide prompt assessment, resuscitation, and stabilization of injured patients and emergency operations	**1.** 24-hour immediate coverage by emergency medicine physicians and prompt availability of general surgeons and anesthesiologists **2.** Program dedicated to continued improvement in trauma care through a comprehensive quality assessment program **3.** Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II trauma center **4.** Committed to continuing education of nursing and allied health personnel or the trauma team **5.** Must be involved with prevention and have an active outreach program for its referring communities
Level IV	Able to provide advanced trauma life support (ATLS) before transfer of patients to a higher level trauma center	**1.** Includes basic emergency department facilities to implement ATLS protocols and 24-hour laboratory coverage **2.** Transfer to higher level trauma centers follows the guidelines outlined in formal transfer agreements **3.** Committed to continued improvement of these trauma care activities through a formal quality assessment program **4.** Involved in prevention, outreach, and education within its community

Level III facilities serve communities that do not have access to Level I or II facilities. Level III facilities provide assessment, resuscitation, emergency care, and stabilization. A Level III facility must have transfer agreements with a Level I or II trauma center and must have protocols in place to transfer patients whose needs exceed the resources of the facility.

Level IV facilities are typically found in remote outlying areas where no higher level of care is available. These facilities provide advanced trauma life support prior to transfer to a higher level trauma center. Such a facility may be a clinic urgent care facility, with or without a physician.

Although an inclusive trauma system should leave no facility without a direct link to a Level I or II facility, all facilities are expected to provide the same high quality of initial care regardless of the classification level.

Trauma centers are categorized as either adult trauma centers or pediatric trauma centers, but not necessarily both. Pediatric trauma centers are not nearly as common as adult trauma centers. When transporting a pediatric trauma patient, you must be certain to transport your patient to a pediatric trauma center if there is one in your area; do not make the mistake of transporting a pediatric patient to an adult trauma center when a pediatric trauma center is available.

In 2011, the ACS-COT and the CDC published an updated field triage decision scheme **Figure 24-19**. These criteria are intended to help prehospital care providers recognize injured patients who are likely to benefit from transport to a trauma center compared with transport to an emergency department. It is not intended as a mass-casualty or disaster triage tool; it is only intended for individual patients.

Words of Wisdom

The **trauma score** calculates a number from 1 to 16, with 16 being the best possible score. It takes into account the **Glasgow Coma Scale (GCS) score**, respiratory rate, respiratory expansion, systolic blood pressure, and capillary refill **Table 24-3**. The GCS is an evaluation tool used to determine level of consciousness. It evaluates and assigns point values (scores) for eye opening, verbal response, and motor response; these scores are then totaled and help to effectively predict patient outcomes. Note that the lower the score, the more severe the extent of brain injury. The trauma score relates to the likelihood of patient survival. However, this scoring system does not accurately predict survivability in patients with severe head injuries because motor and verbal deficits make those criteria difficult to assess; in its place, the Revised Trauma Score (RTS), discussed next, is used.

Table 24-3 Glasgow Coma Scale

Test	Response	Score
Eye opening	Spontaneous	4
	Voice	3
	Pain stimulation	2
	None	1
Verbal	Oriented conversation	5
	Confused conversation	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1
Motor	Obeys commands	6
	Localizes pain	5
	Withdraws from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	None	1

Score: 15 indicates no neurologic disabilities.
Score: 13–14 may indicate mild dysfunction.
Score: 9–12 may indicate moderate dysfunction.
Score: 8 or less is indicative of severe dysfunction.

Revised Trauma Score

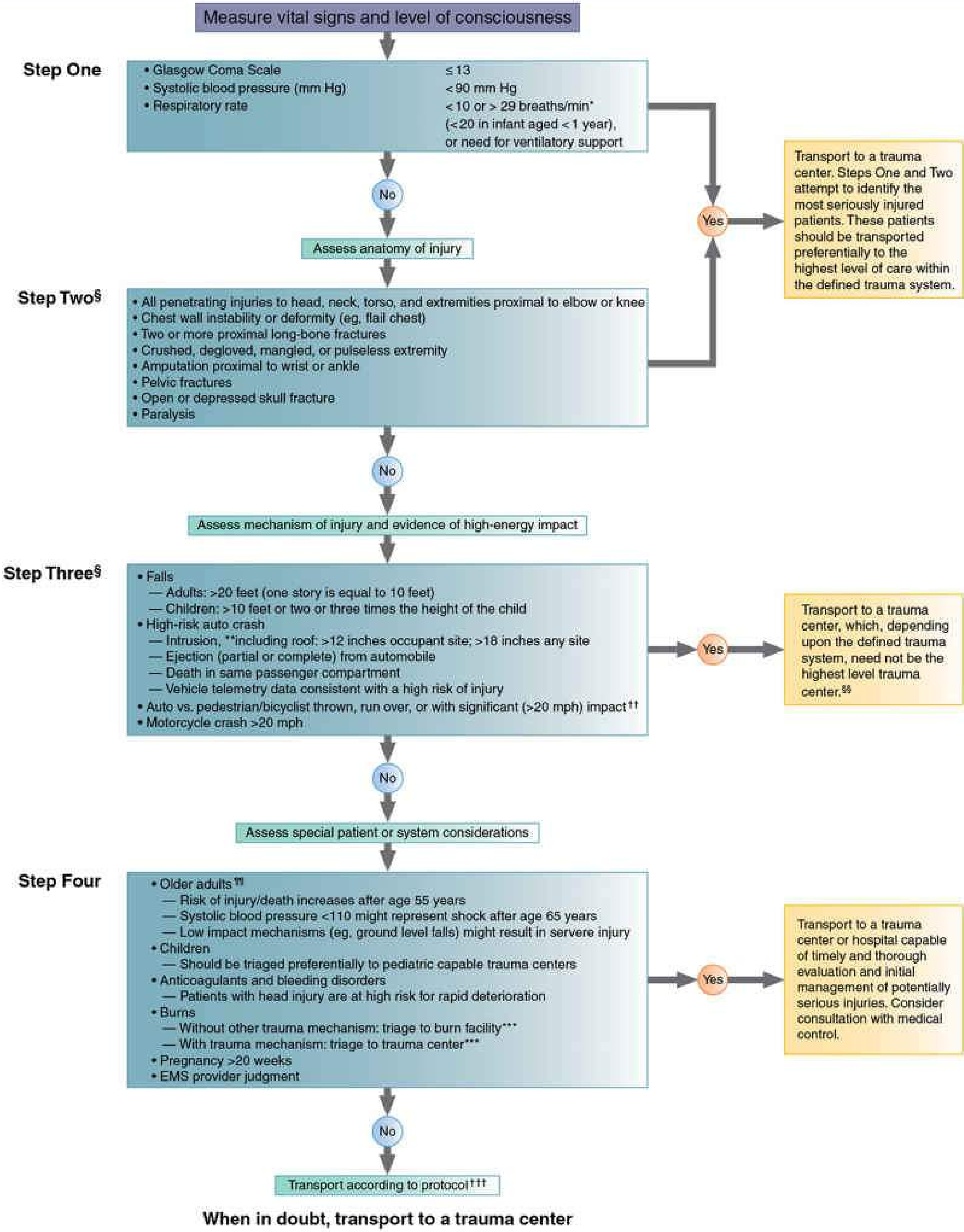
The numeric scoring of trauma patients for determining the severity of their injury is common practice in the health care profession. When the various scoring systems were created, it was thought that the implementation of the scoring system would assist in rapidly identifying the severity of the patient's injuries. There are several different trauma scoring systems. The Revised Trauma Score (RTS) is most commonly used for patients with head trauma because it is weighted to compensate for major head injury without multisystem injury or major physiologic changes.

The RTS is a physiologic scoring system that is also used to assess the severity of a trauma patient's injuries. Objective data used to calculate the RTS include the GCS score, systolic blood pressure (SBP), and respiratory rate (RR). In addition to assessing injury severity, the RTS has also demonstrated reliability in predicting survival in patients with severe injuries. The highest RTS a patient can receive is 12; the lowest is 0. The RTS is calculated as shown in

Table 24-4.

Table 24-4 The Revised Trauma Score

GCS	SBP	RR	Value
13 to 15	>89 mm Hg	10 to 29 breaths/min	4
9 to 12	76 to 89 mm Hg	>29 breaths/min	3
6 to 8	50 to 75 mm Hg	6 to 9 breaths/min	2
4 to 5	1 to 49 mm Hg	1 to 5 breaths/min	1
3	0	0	0



Abbreviation: EMS = emergency medical services.

* The upper limit of respiratory rate in infants is >29 breaths per minute to maintain a higher level of overtriage for infants.

§ Any injury noted in Step Two or mechanism identified in Step Three triggers a "yes" response.

¶ Age <15 years.

** Intrusion refers to interior compartment intrusion, as opposed to deformation, which refers to exterior damage.

†† Includes pedestrians or bicyclists thrown or run over by a motor vehicle or those with estimated impact >20 mph with a motor vehicle.

§§ Local or regional protocols should be used to determine the most appropriate level of trauma center within the defined trauma system; need not be the highest-level trauma center.

¶¶ Age >55 years.

*** Patients with both burns and concomitant trauma for whom the burn injury poses the greatest risk for morbidity and mortality should be transferred to a burn center. If the nonburn trauma presents a greater immediate risk, the patient may be stabilized in a trauma center and then transferred to a burn center.

††† Patients who do not meet any of the triage criteria in Steps One through Four should be transported to the most appropriate medical facility as outlined in local EMS protocols.

Figure 24-19 2011 decision scheme for field triage of injured patients.

Source: Adapted from Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (MMWR), January 13, 2012.

Special Considerations

Because traumatic injuries are as varied as the mechanisms that cause them, it is almost impossible to prepare for every possible situation that you may face during your career. In all situations, you must remain calm, complete an organized assessment, correct life-threatening injuries, and do no harm. You should never hesitate to contact ALS backup or medical control for guidance.

YOU are the Provider — SUMMARY

1. On the basis of the information provided by the dispatch operator, can you predict the potential types of injuries the patient may have? If so, how?

Although you will not ultimately know the type and severity of injuries the patient has until you arrive at the scene, information provided by the dispatch operator can influence your index of suspicion.

En route to this scene, you know that the incident involves a head-on (frontal) crash with a tree, and the patient is still in the vehicle. What you do not know is the speed of the vehicle at the time of impact, whether or not the patient was restrained, or whether or not the air bags deployed. *Just because the patient is still in the vehicle does not indicate that he was restrained*. Until you arrive at the scene and gather more information, you should assume the worst.

The patient has experienced three collisions: collision of the vehicle against another object, collision of himself against the interior of the vehicle, and collision of his internal organs against the solid structures of the body.

Damage to the vehicle (the first collision) provides information about the severity of the collision. The greater the damage is to the vehicle, the greater the energy that was involved and, therefore, the greater the potential to cause injury. If there is significant damage to the vehicle, your index of suspicion for serious injury to the patient should increase, even if injuries are not immediately apparent.

Just like the obvious damage that occurs to the exterior of the vehicle during the first collision, the injuries that result from the second collision are often obvious during primary assessment. Common injuries that occur during the second collision include lower extremity and pelvic fractures (when the knees impact the dashboard), rib fractures, pneumothoraces (when the chest impacts the steering wheel), and head and neck trauma (when the head impacts the windshield).

The type of injury experienced by the unrestrained occupant depends on the path he or she took at the time of impact. There may be injuries to the abdomen, pelvis, and lower extremities if the patient's body took the down-and-under path causing the abdomen to impact the lower part of the steering wheel and the knees to impact the dashboard. Head, neck, or chest trauma may be present if the patient was propelled over the steering wheel. Blunt chest and/or abdominal trauma may result from direct impact with the steering wheel.

The injuries that occur during the third collision may not be as obvious as external injuries, but these injuries are usually the most life threatening. For example, if the chest impacts the steering wheel, the thoracic organs continue their forward motion until they collide with the inside of the chest cavity. As a result of these forces, shearing injuries of the great vessels (eg, aorta, vena cava) or injury to the heart as it impacts with the sternum may occur. If the occupant's head strikes the windshield, the brain continues its forward motion until it strikes the inside of the skull; this results in compression injuries to the anterior part of the brain and stretching or tearing of the posterior part of the brain.

2. Why is it important to determine the speed at which a vehicle was traveling at the time of impact?

A vehicle's speed affects the potential for injury to its occupant(s). According to the equation for kinetic energy ($KE = 1/2mv^2$), the energy available to cause injury doubles when the object's weight doubles, but *quadruples when the object's speed doubles*.

The relationship between a vehicle's speed and its deceleration is best described in these terms: The faster the vehicle is traveling and the quicker it stops, the greater the potential for serious injury to the occupant(s).

3. Where will you most likely find damage to the vehicle's interior based on the patient's signs and symptoms?

The patient's signs and symptoms indicate, at a minimum, injury to his head and chest. He is bleeding from the head, face, and mouth; his level of consciousness is markedly decreased; and his respirations are rapid and labored. Inspection of the interior of the vehicle in this incident will most likely reveal a deformed steering wheel (top, bottom, or both) that occurred when the patient's chest—and maybe abdomen—impacted it. You will also likely find an outward bulge of the windshield with a typical star-burst fracture where the patient's head and face made impact with it. You may also find some of the patient's hair caught in the windshield, and this is a clear indicator of patient impact. Keep in mind that these may not be the only contact points; they are simply the most likely areas based on the patient's injuries.

4. Should the patient be transported to the Level I trauma center or the Level III trauma center? Why?

You are caring for a multisystem trauma patient; that is, he has experienced trauma that affects more than one body system. The obvious trauma to his head and his level of consciousness indicate a traumatic brain injury, the bruising and crepitus to his chest and his labored breathing indicate intrathoracic trauma, and his vital signs indicate a general state of shock. He requires the highest level of trauma care available—a Level I trauma center if possible. There are several reasons you may consider the Level III center, however. If you are unable to achieve an adequate airway to be able to maintain ventilation throughout the time of transport to the Level I center, you should consider going to the Level III center first for stabilization prior to transfer to the Level I center. Similarly, if the patient's condition is otherwise sufficiently grave from the standpoint of his head injury or blood pressure, going to the Level III center first might be warranted. Be familiar with transport times and options to minimize those times (ie, aeromedical transport) in your area.

5. What other transport factors should you consider with this patient?

The patient should be transported to a Level I trauma center; however, the closest one is 30 miles away. Ground transport in heavy traffic will cause a delay in patient care. This situation requires you to make a decision as to how to best transport the patient to a Level I facility in the most expedient manner.

In this scenario, you are faced with two transport options: Try to coordinate a paramedic intercept and transport by ground to the Level I facility, or request air medical transport. Coordinating a paramedic intercept and transporting the patient by ground will get advanced life support (ALS) care to the patient quicker, but it will not get him to the Level I facility any quicker. Conversely, air medical transport via a helicopter will get ALS personnel (ie, paramedic, critical care nurse) to the patient *and* get him to the Level I facility in a shorter period of time. You should also be prepared for the situation where you are faced with the same patient but no access to aeromedical services for some reason such as bad weather. Your priorities remain the same, but the best option for achieving the fastest access to resuscitative care may be less obvious.

6. What trauma scoring systems are commonly used to assess the severity of a trauma patient's condition? How would you apply them to this patient?

The two most commonly used numeric trauma scoring systems are the Glasgow Coma Scale (GCS) and the Revised Trauma Score (RTS).

To assess the patient in this scenario, you must first calculate his GCS. The patient does not open his eyes, even when a painful stimulus is applied; therefore, he receives a 1 for eye opening. For verbal response, he also receives a 1 because he does not respond when you talk to him. For motor response, he receives a 3; he responds to pain by flexing his arms (decorticate posturing). Currently, the patient's GCS score is 5, which indicates a severe brain injury.

To calculate the patient's RTS, you will use his GCS, along with his systolic blood pressure and respiratory rate. He has already been assigned a GCS score of 5; therefore, he is assigned a numeric value of 1. His systolic blood pressure is 80 mm Hg; therefore, he is assigned a numeric value of 3. His respiratory value is 34 breaths/ min; therefore, he is assigned a numeric value of 3. On the basis of these parameters, the patient's RTS is 7.

Note that *a single assessment of a trauma patient's GCS and RTS scores cannot reliably capture his or her clinical progression*. Obtain baseline scores and then frequently (at least every 5 minutes) reassess them. Document all scores you obtained in the field, including the times they were obtained.

7. How does the level of trauma care provided by the paramedic differ from that of the EMT?

The level of trauma care you provide as an EMT versus personnel with a higher level of training, such as AEMTs and paramedics, differs mainly in the emergency treatment interventions that can be performed. For example, paramedics are trained to provide intravenous therapy and to administer certain emergency medications, among others. Although these additional skills can be of great benefit to the patient, they are not definitive care interventions. Paramedics cannot repair a lacerated liver or stop bleeding in the brain; therefore, their focus on trauma care should not be significantly different from yours. Trauma care is based on identifying injuries, stabilizing the patient, and rapid transport to the appropriate medical facility, in this case, a trauma center. In many cases, you will be called on to assist the paramedic in performing advanced level skills. Depending on local protocols, you may even be able to perform additional skills as deemed necessary by the EMS system medical director.

EMS Patient Care Report (PCR)

Date: 9-1-16	**Incident No.:** 012109 N	**Nature of Call:** Motor vehicle crash		**Location:** 2100 Block Hwy 46	
Dispatched: 1520	**En Route:** 1520	**At Scene:** 1528	**Transport:** 1538	**At Landing Zone:** 1540	**In Service:** 1610

Patient Information

Age: 20 **Sex:** M **Weight (in kg [lb]):** estimated at 68 kg (150 lb)	**Allergies:** Unknown **Medications:** Unknown **Past Medical History:** Unknown **Chief Complaint:** Multiple traumatic injuries

Vital Signs

Time: 1533	**BP:** 84/64	**Pulse:** 120	**Respirations:** 22	**Spo_2:** 97%
Time: 1538	**BP:** 80/50	**Pulse:** 130	**Respirations:** 30	**Spo_2:** 89%
Time: 1543	**BP:** 74/50	**Pulse:** 140	**Respirations:** 30	**Spo_2:** 95%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Thermal management, suction, full spinal immobilization

Narrative

Dispatched for a motor vehicle versus tree head-on crash. Rescue assignment and law enforcement were dispatched as well. Arrived at the scene and noted that a small passenger vehicle made frontal impact with a large tree. Damage to the front of the vehicle was significant. The driver, a 20-year-old man, was still in the vehicle; however, he was unrestrained. Driver and passenger side air bags both deployed, and patient was not entrapped. Partner accessed patient through backseat and manually stabilized his head. Primary assessment revealed that the patient was responsive only to pain. He had blood in his oropharynx, a large hematoma and laceration with active bleeding to his forehead, and facial bleeding. His respirations were rapid and labored. Suctioned the patient's oropharynx, controlled the bleeding on his forehead, applied cervical collar, and rapidly extricated him from the vehicle. Due to the MOI and patient's clinical status, requested air transport. Applied oxygen @ 15 L/min via nonrebreathing mask and performed secondary assessment, which revealed diffuse bruising and crepitus to the chest. Breath sounds were diminished over the left side of the chest. Pelvis and upper and lower extremities were unremarkable for gross injury. Pupils were dilated to approximately 6 mm, and sluggish to react. Engine 3 fire fighter reported interior damage to the steering wheel and a starburst fracture to the windshield with evidence of human hair. Applied full spinal immobilization and a blanket for warmth, and loaded patient into the ambulance. Reassessment revealed that his respiratory rate had increased, his breathing effort was more labored, and his oxygen saturation had decreased. Began assisting his ventilations with a BVM and high-flow oxygen. Engine 3 EMT drove ambulance to landing zone (LZ) to meet with air transport helicopter. Continued to reassess patient every 3 to 5 minutes and noted no change in his clinical status. Contacted air medical helicopter via radio and provided patient status update. Continued to assist patient's ventilations and suctioned his oropharynx as needed to maintain airway patency. Vital signs were also reassessed, as noted above. After a 3-minute wait at the LZ, air transport helicopter arrived. Gave verbal report to flight paramedic, and transferred patient care to the flight crew. Helicopter departed the LZ at 1550, and EMS 3 returned to service at 1610.**End of report**

Prep Kit

Ready for Review

- Determine the mechanism of injury (MOI) as quickly as possible; this will assist you in developing an index of suspicion for the seriousness of your patient's unseen injuries.
- Three concepts of energy are typically associated with injury: potential energy, kinetic energy, and work.
- Traumatic injuries can be described as blunt trauma or penetrating trauma.
- Motor vehicle crashes are classified traditionally as frontal (head-on), lateral (T-bone), rear-end, rotational (spins), and rollovers.
- In every crash there are three collisions that occur:
  - The collision of the vehicle against some type of object
  - The collision of the passenger against the interior of the vehicle
  - The collision of the passenger's internal organs against the solid structures of the body
- Maintain a high index of suspicion for serious injury in the patient who has been involved in a motor vehicle crash with significant damage to the vehicle, has fallen from a significant height, or has sustained penetrating trauma to the body.
- Communicate MOI findings in the written patient care report and verbally to hospital staff; this will ensure that appropriate treatment of potential serious injuries continues for the patient at the hospital.
- People who are injured in explosions may have injuries that are classified as primary blast injuries, secondary blast injuries, tertiary blast injuries, and/or miscellaneous blast injuries.
- A patient who has sustained a significant MOI and is considered to be in serious or critical condition should receive a secondary assessment including a rapid examination of the entire body. Any patient who has sustained a non-significant MOI should receive an assessment more focused on the chief complaint while still assessing the patient as a whole.
- Caring for victims of traumatic injuries requires a solid understanding of the trauma system in the United States. This includes transport time, transport destination, and selection of type of transport.
- The criteria for transport to a trauma center vary from system to system. Key variables define the level rating of a trauma center. There are four categories of trauma centers. Your system may include a Level I trauma center, the highest-level trauma center.
- The field triage decision scheme from the American College of Surgeons' Committee on Trauma and the Centers for Disease Control and Prevention outlines criteria to help prehospital care providers recognize injured patients who are likely to benefit from transport to a trauma center.

Vital Vocabulary

arterial air embolism Air bubbles in the arterial blood vessels.

blunt trauma An impact on the body by objects that cause injury without penetrating soft tissues or internal organs and cavities.

cavitation A phenomenon in which speed causes a bullet to generate pressure waves, which cause damage distant from the bullet's path.

coup-contrecoup brain injury A brain injury that occurs when force is applied to the head and energy transmission through brain tissue causes injury on the opposite side of original impact.

deceleration The slowing of an object.

drag Resistance that slows a projectile, such as air.

Glasgow Coma Scale (GCS) score An evaluation tool used to determine level of consciousness, which evaluates and assigns point values (scores) for eye opening, verbal response, and motor response, which are then totaled; effective in helping predict patient outcomes.

index of suspicion Awareness that unseen life-threatening injuries may exist when determining the mechanism of injury.

kinetic energy The energy of a moving object.

mechanism of injury (MOI) The forces, or energy transmission, applied to the body that cause injury.

medical emergencies Emergencies that require EMS attention because of illnesses or conditions not caused by an outside force.

multisystem trauma Trauma that affects more than one body system.

penetrating trauma Injury caused by objects, such as knives and bullets, that pierce the surface of the body and damage internal tissues and organs.

potential energy The product of mass, gravity, and height, which is converted into kinetic energy and results in injury, such as from a fall.

projectile Any object propelled by force, such as a bullet by a weapon.

pulmonary blast injuries Pulmonary trauma resulting from short-range exposure to the detonation of explosives.

Revised Trauma Score (RTS) A scoring system used for patients with head trauma.

trajectory The path a projectile takes once it is propelled.

trauma emergencies Emergencies that are the result of physical forces applied to a patient's body.

trauma score A score calculated from 1 to 16, with 16 being the best possible score. It relates to the likelihood of patient survival with the exception of a severe head injury. It takes into account the Glasgow Coma Scale (GCS) score, respiratory rate, respiratory expansion, systolic blood pressure, and capillary refill.

tympanic membrane The eardrum; a thin, semi-transparent membrane in the middle ear that transmits sound vibrations to the internal ear by means of auditory ossicles.

work The measure of force over distance.

Assessment *in Action*

You are dispatched to a motor vehicle crash on a rural road. On arrival you see a single vehicle in an embankment. The scene appears to be safe. The car has front-end damage and a starred windshield. You find an unrestrained driver sitting in the driver's seat. He opens his eyes when you speak to him; however; he is confused and unable to tell you what happened, but he follows your commands. Examination reveals a laceration on the center of his forehead and a large bruise on his chest. Pulses and motor and sensory function are present in all extremities. His pulse is rapid, and breathing is slightly labored.

1. What is your first concern in this situation?

   A. History taking
   B. Physical examination
   C. Scene size-up
   D. Reassessment

2. What type of chest injury is present?

   A. Blunt
   B. Penetrating
   C. Crushing
   D. Barotrauma

3. What is the Glasgow Coma Scale score for this patient?

   A. 15
   B. 14
   C. 13
   D. 12

4. You would use the Revised Trauma Score scoring system for this patient due to the potential for what type of trauma?

   A. Abdominal
   B. Head

C. Chest
D. Extremity

5. Given the patient's condition and the findings of your assessment, which of the following would be the most correct transport consideration?

   A. Transport the patient to a Level I Trauma Center 1 hour away.
   B. Transport the patient to a Level II Trauma Center that is the same distance as a Level I Trauma Center.
   C. Transport the patient to a Level III Trauma Center.
   D. Call for an ALS unit to respond to the scene or intercept the BLS transport.

6. What is index of suspicion?

   A. Life-threatening injuries are present with a significant mechanism of injury.
   B. The patient has an illness that is not caused by an outside force.
   C. Awareness that due to the mechanism of injury, unseen injuries may be present.
   D. Awareness that the mechanism of injury will rule out any life-threatening injuries.

7. What other injuries might you suspect in this patient?
8. Does this patient meet the criteria for rapid transport? Why or why not?
9. What is a coup-contrecoup injury?
10. What are the three collisions involved in a frontal motor vehicle crash?

CHAPTER
25

Bleeding

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National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Bleeding

Recognition and management of

› Bleeding (pp 883–898)

Pathophysiology, assessment, and management of

› Bleeding (pp 881–898)

Pathophysiology

Applies fundamental knowledge of the pathophysiology of respiration and perfusion to patient assessment and management.

Knowledge Objectives

1. Describe the general structure of the circulatory system and the function of its parts, including the heart, arteries, veins, and capillaries. (pp 879–880)
2. Explain the significance of bleeding caused by blunt force trauma, including the importance of perfusion. (pp 881–882)
3. Discuss hypovolemic shock as a result of bleeding, including the signs of shock. (pp 882–886)
4. Explain the importance of following standard precautions when treating a patient with external bleeding. (p 883)
5. Describe the characteristics of external bleeding, including the identification of the following types of bleeding: arterial, venous, and capillary. (pp 883–884)
6. Explain how to determine the nature of the illness (NOI) for internal bleeding, including identifying possible traumatic and nontraumatic sources. (p 885)
7. Identify the signs and symptoms of internal bleeding. (pp 885–886)

8. Discuss internal bleeding in terms of the different mechanisms of injury (MOI) and their associated internal bleeding sources. (p 885)
9. Explain how to conduct a primary assessment, including identification of life threats beyond bleeding, ensuring a patent airway, and making a transport decision. (pp 886–887)
10. Explain how to assess a patient with external or internal bleeding, including the physical examination, vital signs, and the use of monitoring devices. (p 888)
11. Explain the emergency medical care of the patient with external bleeding. (pp 888–890)
12. Explain the emergency medical care of the patient with internal bleeding. (p 897)

Skills Objectives

1. Demonstrate the emergency medical care of the patient with external bleeding. (pp 890–891, Skill Drill 25-1)
2. Demonstrate the emergency medical care of the patient with external bleeding using a commercial tourniquet. (pp 891–893, Skill Drill 25-2)
3. Demonstrate emergency medical care of the patient with epistaxis, or nosebleed. (pp 895–896, Skill Drill 25-3)
4. Demonstrate the emergency medical care of the patient who shows signs and symptoms of internal bleeding. (pp 897–898, Skill Drill 25-4)

Introduction

After airway management, two of the most important skills you will learn as an EMT are to recognize bleeding and to understand how it affects the body. Bleeding can be external and obvious or internal and hidden. Either type of bleeding is potentially dangerous, first causing weakness and eventually, if left uncontrolled, shock and death. Uncontrolled bleeding is the most common cause of hypoperfusion (shock) following a traumatic injury.

This chapter will help you understand how the cardiovascular system reacts to blood loss. The chapter begins with a brief review of the anatomy and function of the cardiovascular system. It then describes the signs, symptoms, and emergency medical care of both external and internal bleeding. The chapter concludes with a discussion about the relationship between bleeding and hypovolemic shock.

Anatomy and Physiology of the Cardiovascular System

Recall from Chapter 6, *The Human Body*, that the cardiovascular system circulates blood to the body's cells and tissues, delivering oxygen and nutrients and carrying away metabolic waste products **Figure 25-1**.

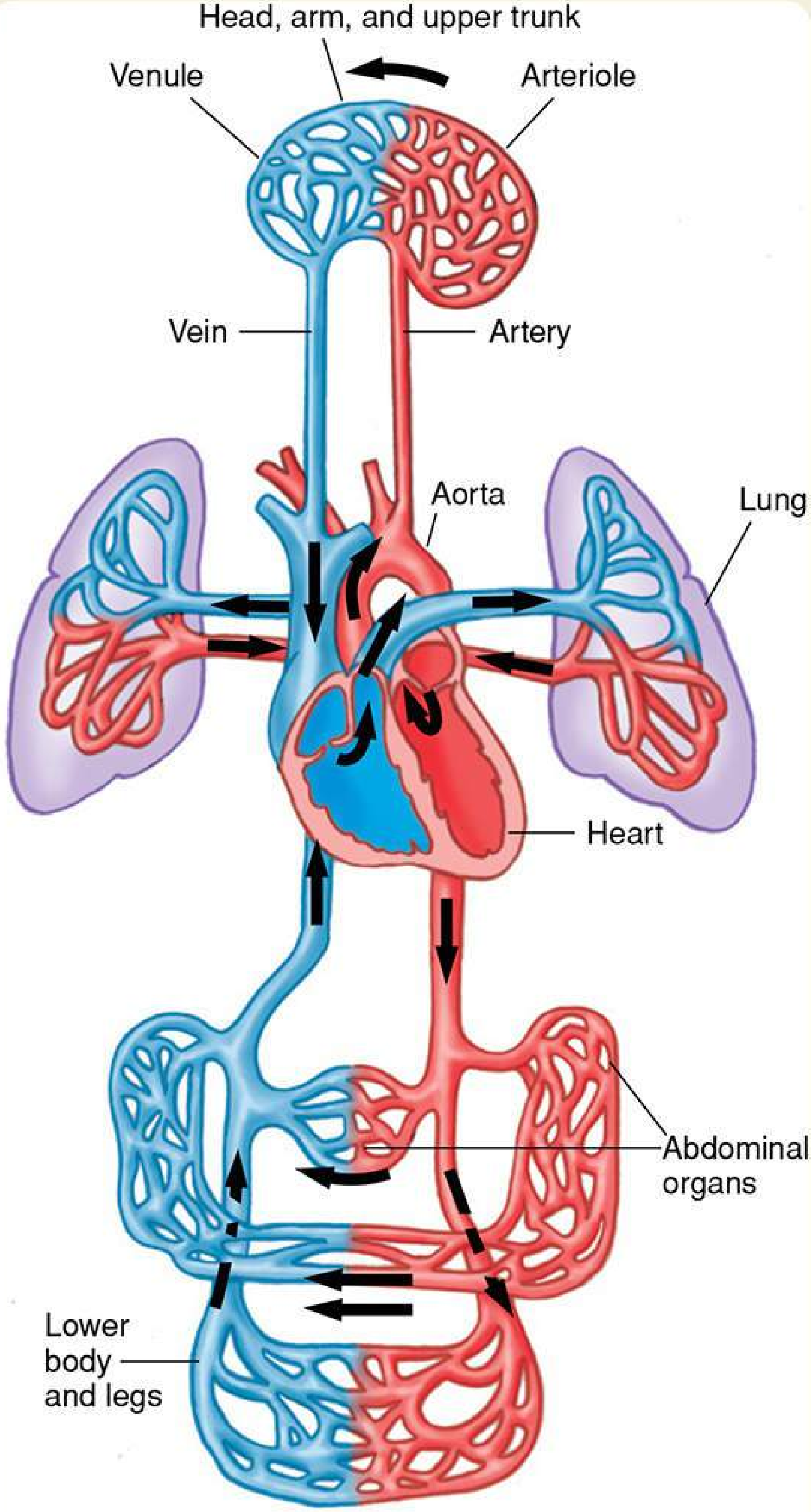


Figure 25-1 The cardiovascular system includes the heart, arteries, veins, and interconnecting capillaries.

The cardiovascular system is the main system responsible for supplying and maintaining adequate blood flow. It consists of three parts:

- The pump (the heart)
- A container (the blood vessels that reach the cells of the body)
- The fluid (blood and body fluids)

YOU are the Provider **PART 1**

At 1620 hours, you are dispatched to a woodworking shop at 517 East Graham Street for a 32-year-old man with severe bleeding from the arm. The exact mechanism of injury (MOI) is unknown. You and your partner proceed to the scene with a response time of approximately 6 minutes.

1. What are the functions of arteries? What major arteries are located in the upper extremity?
2. Why is arterial bleeding more severe than venous bleeding?

The Heart

All organs depend on the heart to provide a rich blood supply. For this reason, the heart muscle has several unique features. First, because the heart cannot tolerate a disruption of its blood flow for more than a few minutes, the heart muscle needs a rich and well-distributed blood supply. Second, the heart works as two paired pumps **Figure 25-2**. Each side of the heart has an upper chamber (atrium) and a lower chamber (ventricle), both of which pump blood. Blood leaves each chamber of a normal heart through a one-way valve, which keeps the blood moving in the proper direction by preventing backflow.

Blood Vessels and Blood

As blood flows out of the heart, it passes into the **aorta**, the largest **artery** in the body. The arteries become smaller the farther they are from the heart. The smaller blood vessels that connect the arteries and capillaries are **arterioles**. **Capillaries** are small tubes, with the diameter of a single red blood cell, that pass among all the cells in the body, linking the arterioles and the **venules**. Blood leaving the distal side of the capillaries flows into the venules. These small, thin-walled vessels empty into the **veins**, and the veins then empty into the inferior and superior venae cavae. This is the process that returns blood in the venous portion of the circulatory system to the heart. Oxygen and nutrients easily pass from the capillaries into the cells, and waste and carbon dioxide diffuse from the cells into the capillaries **Figure 25-3**. This transportation system allows the body to rid itself of waste products.

Blood contains red cells, white cells, platelets, and plasma **Figure 25-4**. Red blood cells transport oxygen to the cells and transport carbon dioxide (a waste product of cellular metabolism) away from the cells to the lungs, where it is removed from the body during exhalation. Platelets are the key to formation of blood clots. Blood clots are an important response from the body to control blood loss. In the body, blood clot formation depends on several factors: blood stasis, changes in the blood vessel wall (such as a wound), and the blood's ability to clot (affected by disease processes or medications). When tissues are injured, platelets begin to collect at the site of injury; this causes red blood cells to become sticky and clump together. As the red blood cells begin to clump, a protein in plasma reinforces the developing clot by converting to a threadlike mesh that forms a clot. Medical conditions that interfere with the normal clotting process will be discussed later in this chapter.

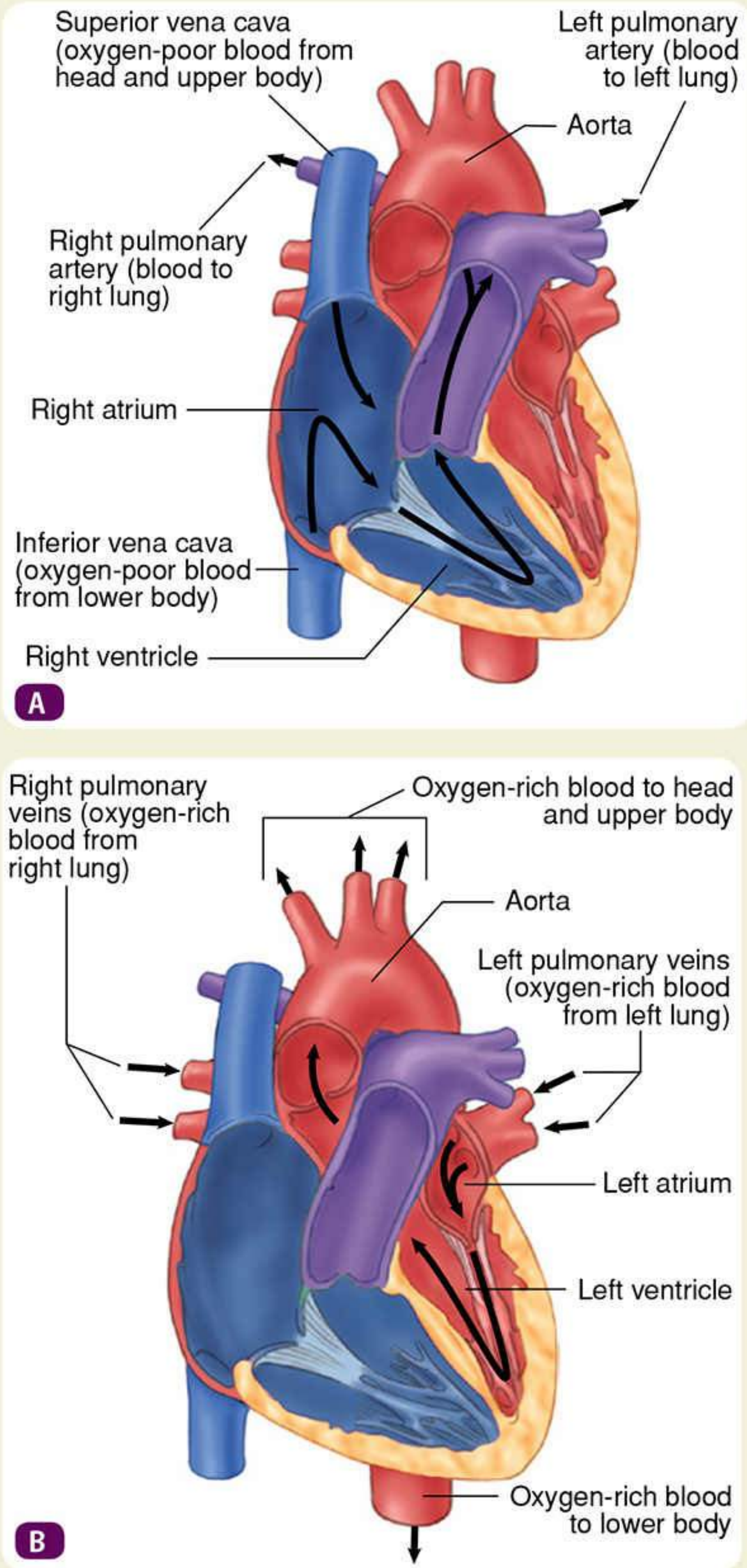


Figure 25-2 **A.** The right side of the heart circulates blood from the body to the lungs. **B.** The left side of the heart circulates oxygen-rich blood from the lungs to the rest of the body. It is the more muscular of the two pumps because it must pump blood into the aorta and arteries in order to reach all cells of the body.

The autonomic nervous system monitors the body's needs and adjusts the blood flow by constricting or dilating blood vessels as required. During an emergency, the autonomic nervous system automatically redirects blood away from other organs to the heart, brain, lungs, and kidneys. Thus, the cardiovascular system adapts to changing conditions in the body to maintain homeostasis and perfusion. As discussed in Chapter 12, *Shock*, if blood volume is significantly diminished and the system fails to provide sufficient circulation for every body part to perform its function, then **hypoperfusion**, or **shock**, results.

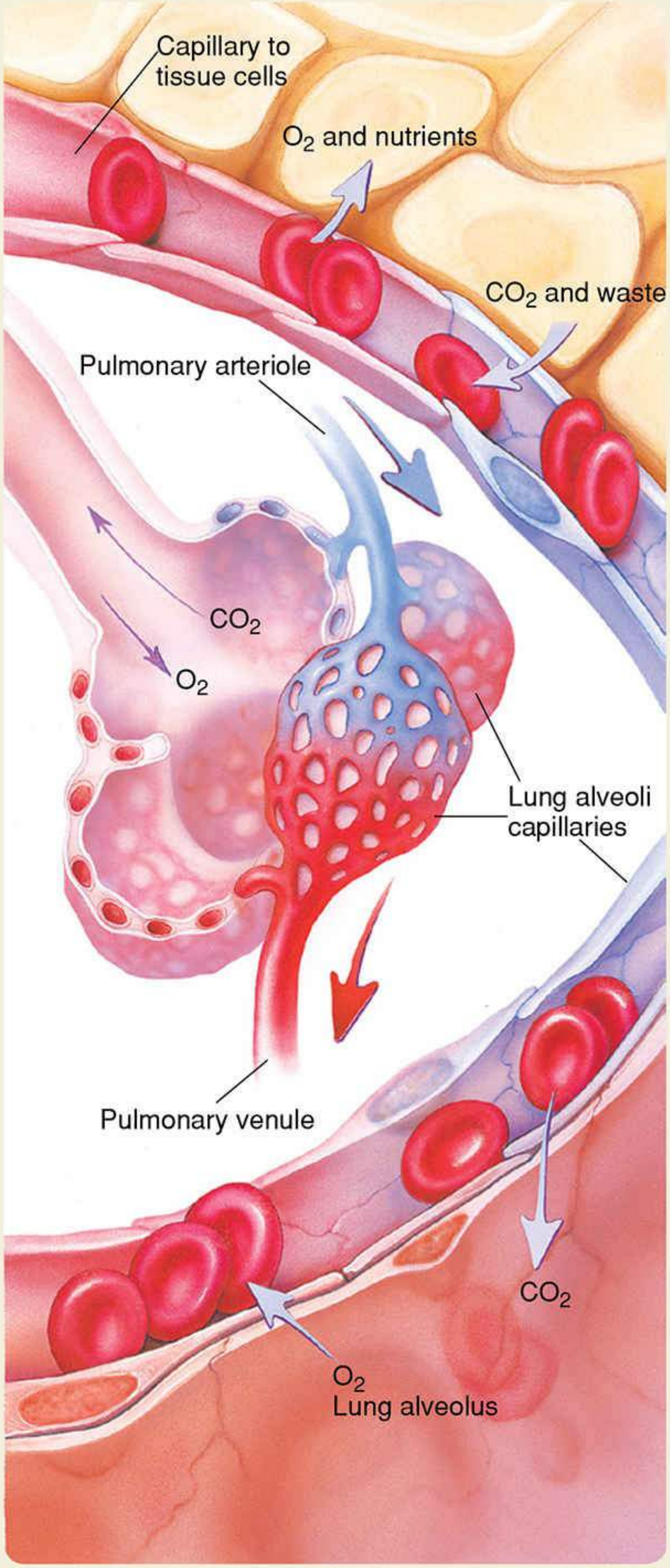


Figure 25-3 Oxygen and nutrients pass easily from the capillaries into the cells, and waste and carbon dioxide diffuse from the cells into the capillaries (top). Oxygen and carbon dioxide pass freely between the lungs and capillaries (bottom).

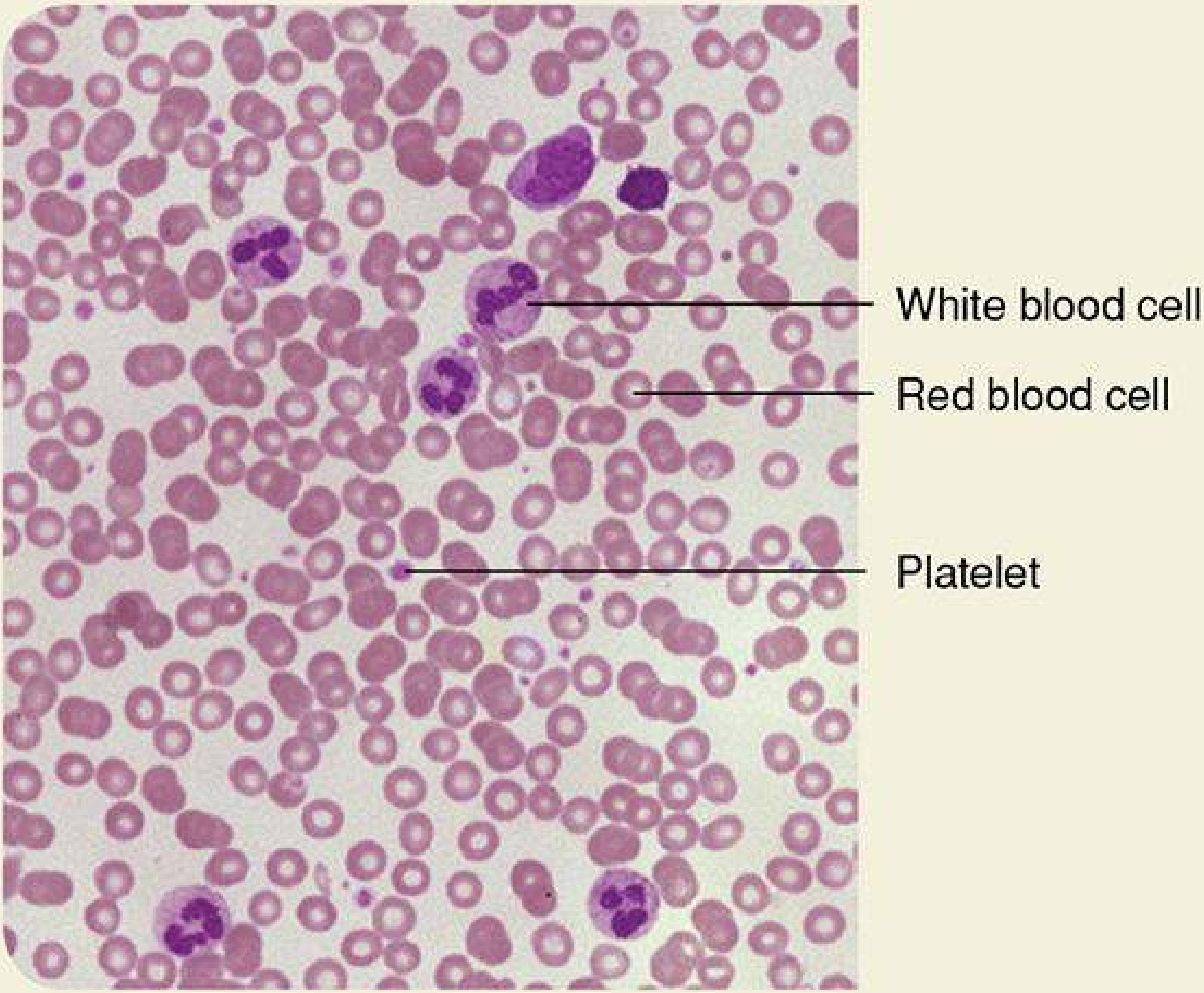


Figure 25-4 The microscopic appearance of the three major elements in blood: red blood cells, white blood cells, and platelets.

Pathophysiology and Perfusion

Perfusion is the circulation of blood within an organ or tissue in adequate amounts to meet the cells' current needs for oxygen, nutrients, and waste removal. Blood enters an organ or tissue first through the arteries, then the arterioles, and finally the capillary beds **Figure 25-5**. As it passes through the capillaries, the blood delivers nutrients and oxygen to the surrounding cells and picks up the wastes they have generated.

Blood must pass through the cardiovascular system fast enough to maintain adequate circulation throughout the body and to avoid clotting, yet slow enough to allow each cell time to exchange oxygen and nutrients for carbon dioxide and other waste products. Although some tissues never rest and require a constant blood supply, most require a large volume of circulating blood only intermittently, with less required when at rest. For example, skeletal muscles require a minimal blood supply during sleep, as opposed to a large blood supply during exercise. Another example is the gastrointestinal tract, which requires a high flow of blood after a meal. After digestion is completed, however, the gastrointestinal tract functions well with only a small fraction of that blood flow.

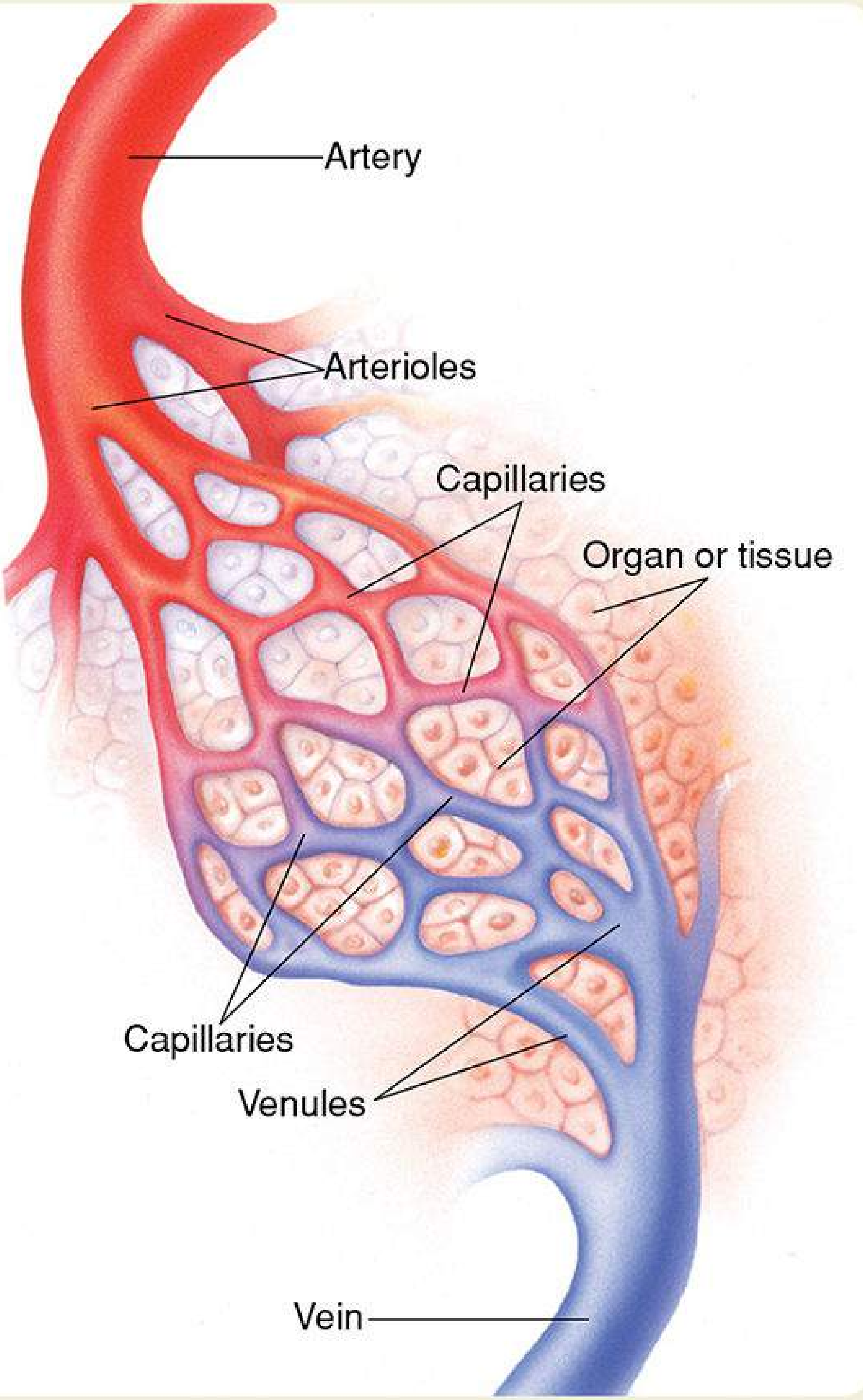


Figure 25-5 Perfusion occurs when blood circulates through tissues or an organ to provide the necessary oxygen and nutrients and remove waste products.

All organs and organ systems of the human body depend on adequate perfusion to function properly. Some organs require a rich supply of blood and do not tolerate interruption of blood supply for even a few minutes without sustaining damage. If perfusion to these organs is interrupted, then dysfunction and failure of that organ system will occur. The death of an organ system can quickly lead to the death of the patient. Emergency medical care is designed to support adequate perfusion of these critical organs and organ systems, listed in Table 25-1, until the patient arrives at the hospital.

The heart requires constant perfusion to function optimally; without it, cells in the brain and spinal cord start to die after 4 to 6 minutes. (Remember that cells of the central nervous system do not have the capacity to regenerate.) Without adequate perfusion, the lungs can survive only 15 to 20 minutes and kidneys can be damaged after 45 minutes. Skeletal muscle demonstrates evidence of injury after 2 to 3 hours of inadequate perfusion, while the gastrointestinal tract can tolerate slightly longer periods. These times are based on a normal core body temperature (98.6°F [37.0°C]). An organ or tissue that is kept at a considerably lower temperature may be better able to resist damage from hypoperfusion.

Table 25-1 Critical Organs and Corresponding Organ Systems

Organ	Organ System
Heart	Cardiovascular system
Brain	Central nervous system
Lungs	Respiratory system
Kidneys	Renal system

External Bleeding

Hemorrhage means bleeding. External bleeding is visible hemorrhage. Examples include nosebleeds and bleeding from open wounds. As an EMT, you must understand how to control external bleeding.

The Significance of External Bleeding

With serious external bleeding, it is often difficult to determine the amount of blood loss because blood will look different on different surfaces, such as when it is absorbed in clothing, when it has been diluted in water, or when the environment is dark. It is important to estimate the amount of external blood loss; however, treatment should be based on the patient's presentation and MOI.

The typical adult male body contains approximately 70 mL of blood per kilogram of body weight, whereas the adult female body contains approximately 65 mL of blood per kilogram of body weight. Therefore, a typical adult man weighing 175 pounds (79 kg) has a total blood volume of about 10 to 12 pints (6 L). The body cannot tolerate an acute blood loss of greater than 20% of this total blood volume, or more than 2 pints (about 1 liter) in the average adult. With significant blood loss, adverse changes in vital signs will occur, including increased heart and respiratory rates and decreased blood pressure. Because infants and children have less blood volume compared with adults, these effects are seen with smaller amounts of blood loss. For example, a 1-year-old has a typical total blood volume of about 27 oz (800 mL); the child will show significant symptoms of blood loss after only 3 to 6 oz (100 to 200 mL) of blood loss, or less than half the volume of liquid in a 12-oz (350-mL) can of soda.

How well a patient's body can compensate for blood loss is related to how rapidly the blood loss occurs. A healthy adult can comfortably donate 1 unit, or roughly 1 pint (500 mL) of blood within 15 to 20 minutes and adapt well to this decrease in blood volume. If this volume of blood loss occurs during a much shorter period, however, symptoms of **hypovolemic shock**, a condition in which low blood volume results in inadequate perfusion and even death, might develop. The age and preexisting health of the patient should also be considered.

In any situation, severe blood loss presents an immediate life threat. Your priority is to quickly control major external bleeding, even before you address airway and breathing concerns.

Safety Tips

Remember that a bleeding patient may expose you to potentially infectious body fluids; therefore, always follow standard precautions when treating patients with external bleeding. Wear gloves and eye protection in all situations, and wear a gown and mask if there is a risk of blood splatter **Figure 25-6**. Always keep spare gloves with you. Avoid direct contact with body fluids if possible. Take special care if you have an open sore, cut, scratch, or ulcer. Also remember that frequent, thorough handwashing between patients and after every call is a simple yet important protective measure. When you care for multiple patients, remember to wash your hands frequently and don clean gloves between patients to avoid cross-contamination of body fluids and blood. If soap and water are unavailable, use a waterless hand sanitizer, and wash with soap and water as soon as possible.

Figure 25-6 Your safety is paramount. Always wear proper protective equipment when caring for a patient who is bleeding.

Characteristics of External Bleeding

Injuries and some illnesses can disrupt blood vessels and cause external bleeding. You should consider bleeding to be severe if:

- The patient has a poor general appearance and has no response to external stimuli.
- Assessment reveals signs and symptoms of shock (hypoperfusion).
- You note a significant amount of blood loss.
- The blood loss is rapid and ongoing.
- You cannot control the bleeding.
- It is associated with a significant MOI.

Typically, arterial bleeding from an open artery is bright red (because it is oxygen rich) and spurts in time with the pulse. The pressure that causes the blood to spurt also makes this type of bleeding difficult to control. As the amount of blood circulating in the body drops, so does the patient's blood pressure and, eventually, the arterial spurting.

Venous bleeding from an open vein is darker than arterial blood (because it is oxygen poor) and can flow slowly or rapidly, depending on the size of the vein. Because it is under less pressure, most venous blood does not spurt and is easier to manage; however, it can be profuse and life threatening. Capillary bleeding from damaged capillary vessels is dark red and oozes from a wound steadily but slowly. Venous and capillary blood is more likely to clot spontaneously than arterial blood **Figure 25-7**.

On its own, bleeding tends to stop rather quickly, within about 10 minutes, in response to internal mechanisms and exposure to air. When a person's skin is broken, blood flows rapidly from the open blood vessel. Soon afterward, the cut ends of the blood vessel begin to narrow (**vasoconstriction**), reducing the amount of bleeding. Then a clot forms, plugging the hole and sealing the injured portions of the blood vessel. This process is called **coagulation**. With a severe injury, the damage to the blood vessel may be so great that a clot cannot completely block the hole. Bleeding will never stop if an effective clot does not form, unless the injured blood vessel is completely cut off from the main blood supply by direct pressure or a tourniquet.

Figure 25-7 **A.** Bleeding from capillary vessels is dark red and oozes from the wound slowly but steadily. **B.** Venous bleeding is darker than arterial bleeding and flows steadily. **C.** Arterial bleeding is characteristically bright red and spurts in time with the pulse.

A: Sasha Radosavljevic/iStock; B: © E.M. Singletary, MD. Used with permission; C: © Brian Slichta/AP Photo.

Despite the efficiency of the circulatory system, it may fail in certain situations. Movement, disease process, certain medications (such as blood thinners), removal of bandages, the external environment, or body temperature commonly affect the blood's clotting factors. Occasionally, blood loss is very rapid. In these cases, the patient might die before clotting occurs.

A small portion of the population lacks one or more of the blood's clotting factors, a condition called **hemophilia**. There are several forms of hemophilia, most of which are hereditary and some of which are severe. Sometimes bleeding occurs spontaneously in patients with hemophilia. Because the patient's blood does not clot effectively, all injuries, no matter how trivial, are potentially serious. Transport a patient with hemophilia immediately.

Words of Wisdom

If a bandage has already been applied to control bleeding before your arrival on the scene, obtain a description of the wound and the amount of bleeding from the patient or bystanders. If blood has seeped through the dressing, do not remove it; most likely the clotting process has already begun and removing the dressing will disturb the clot. Instead, apply a clean dressing on top of the first one to reinforce it. You can also observe the old dressing to estimate the amount of blood loss.

Internal Bleeding

Internal bleeding is any bleeding that occurs in a cavity or space inside the body. Internal bleeding can be very serious, especially because it is not easy to detect immediately. Injury or damage to internal organs commonly results in extensive internal bleeding, which can cause hypovolemic shock before you realize the extent of blood loss. A person with a bleeding stomach ulcer may sustain a large amount of blood loss very quickly. Similarly, a person who has a lacerated liver or a ruptured spleen may sustain a considerable amount of blood loss within the abdomen, yet the patient may have no outward signs of bleeding.

Broken bones, especially broken ribs, also may cause serious internal blood loss. Sometimes this bleeding extends into the chest cavity and the soft tissues of the chest wall. A broken femur can easily result in the loss of 2 pints (about 1 liter) or more of blood into the soft tissues of the thigh. Often the only signs of such bleeding are local swelling and bruising (called a **contusion**, or **ecchymosis**) caused by the accumulation of blood around the ends of the broken bone. Severe pelvic fractures may result in life-threatening hemorrhage.

Always be alert to the possibility of internal bleeding. Assess the patient for related signs and symptoms, particularly if the MOI is significant. If you suspect that a patient is bleeding internally, treat for shock and promptly transport him or her to the hospital.

Mechanism of Injury for Internal Bleeding

A high-energy MOI should increase your index of suspicion for the possibility of serious, unseen injuries such as internal bleeding in the abdominal cavity. Internal bleeding is possible whenever the MOI suggests that severe forces affected the body. These forces include blunt and penetrating trauma. Internal bleeding commonly occurs as a result of falls, blast injuries, and motor vehicle crashes. Remember that internal bleeding can result from penetrating trauma as well.

As you assess a patient, look for signs of injury using the DCAP-BTLS mnemonic (Deformities, Contusions, Abrasions, Punctures, Burns, Tenderness, Lacerations, and Swelling) as well as any other signs of injury. Always suspect internal bleeding in a patient who has sustained a penetrating injury or blunt trauma.

Nature of Illness for Internal Bleeding

Internal bleeding is not always caused by trauma. Many illnesses can cause internal bleeding. Some of the more common causes of nontraumatic internal bleeding include bleeding ulcers, bleeding from the colon, ruptured ectopic pregnancy, and aneurysms.

Abdominal tenderness, guarding, rigidity, pain, and distention are frequent in these situations but are not always present. In older patients, dizziness, faintness, or weakness may be the first sign of non-traumatic internal bleeding. Ulcers or other gastrointestinal problems may cause vomiting of blood or bloody diarrhea.

It is not as important for you to know the specific organ involved as it is to recognize the patient is in shock. When combined with prompt transport decisions and limited time spent at the scene, the rapid recognition of a patient in shock should result in the rapid administration of potentially life-saving treatments.

Signs and Symptoms of Internal Bleeding

The most common symptom of internal bleeding is pain. Significant internal bleeding will generally cause swelling in the area of bleeding, but swelling is often undetected until massive blood loss has occurred. Internal bleeding is most common in head, extremity, and pelvic injuries and is often associated with significant abdominal trauma. Intra-abdominal bleeding will often cause pain and distention. Bleeding into the chest cavity or lung may cause dyspnea, tachycardia, **hemoptysis** (the coughing up of bright red blood), and hypotension. A **hematoma**, a mass of blood that has collected in the soft tissues beneath the skin, indicates bleeding into soft tissues and may be the result of a minor or a severe injury. Bruising or ecchymosis may not be present initially, and the only sign of severe pelvic or abdominal trauma may be redness, skin abrasions, or pain.

Bleeding from any body opening, however slight, is serious. It usually indicates internal bleeding that is not easy to see or control. Bright red bleeding from the mouth or rectum or blood in the urine (**hematuria**) may suggest serious internal injury or disease. Nonmenstrual vaginal bleeding is always significant.

Other signs and symptoms of internal bleeding in trauma and medical patients include the following:

- **Hematemesis**. The vomiting of blood. The vomitus may be bright red or dark red. If the blood has been partially digested, the vomitus may look like coffee grounds.
- **Melena**. Black, foul-smelling, tarry stool that contains digested blood.
- **Pain, tenderness, bruising, guarding, or swelling.** These signs and symptoms may mean that a closed fracture is bleeding.
- **Broken ribs, bruises over the lower part of the chest, or a rigid, distended abdomen.** These signs and symptoms may indicate a lacerated spleen or liver. Patients with an injury to one of these organs may have referred pain in the right shoulder (indicating the liver is injured) or left shoulder (indicating the spleen is injured). Suspect internal abdominal bleeding in a patient with referred pain.

The first sign of hypovolemic shock is a change in mental status, such as anxiety, restlessness, or combativeness. In nontrauma patients, weakness, faintness, or dizziness on standing is another early sign. Changes in skin color or pallor (pale skin) are often seen in both trauma and medical patients. Later signs of hypovolemic shock suggesting internal bleeding include the following:

- Tachycardia
- Weakness, fainting, or dizziness at rest
- Thirst
- Nausea and vomiting
- Cold, moist (clammy) skin
- Shallow, rapid breathing
- Dull eyes
- Slightly dilated pupils that are slow to respond to light
- Capillary refill time longer than 2 seconds in infants and children
- Weak, rapid (thready) pulse
- Decreasing blood pressure
- Altered level of consciousness

Patients with these signs and symptoms, particularly in the setting of significant MOI, require prompt transport, preferably to a trauma center. See Chapter 12, *Shock*, for a review of hypovolemic shock.

Patient Assessment for External and Internal Bleeding

Scene Size-up

As you approach the patient, be alert to potential hazards to yourself and the crew, bystanders, and the patient. At vehicle crashes, ensure there are no fluids leaking from the vehicle or energized power lines in the area where you will be working. In incidents involving violence, such as assaults or patients with gunshot wounds, make sure that police have advised the scene is safe. You may need to stage several blocks away until law enforcement personnel have secured the area.

Follow standard precautions. Place several spare pairs of gloves in your pocket for easy access in case your gloves tear or there are multiple patients with bleeding. If you enter a residence, be alert for anxious bystanders, family members, and even pets, as they may become hostile. Determine the number of patients needing care. Consider early on what you additional resources you may need, and verify as you begin your assessment.

Determine the nature of the illness (NOI) by observing signs (such as bloody emesis) or the MOI (such as an upturned step stool). Consider the need for spinal immobilization and/or additional resources, such as an advanced life support unit. Be sure to also consider environmental factors in your decision making. For example, caring for a sick or injured victim of a motor vehicle crash on a clear, sunny day is different from treating the same victim during a snowstorm. Extremely hot or cold weather can worsen a patient's overall condition.

Special Populations

In older patients, dizziness, syncope, or weakness may be the first sign of nontraumatic internal hemorrhage.

Primary Assessment

When you treat a patient with significant blood loss from a visible wound or with suspected internal bleeding, do not be distracted from identifying and managing life threats, which is the focus of your primary assessment. As you approach a trauma patient, note important indicators that may signal the seriousness of the patient's condition. For example, a patient with external bleeding may have bloodstains on his or her clothing. Be aware of obvious signs of injury and distress, such as facial grimace. Determine the patient's gender and age.

Perform a rapid exam of the patient, look for life threats, and treat them as you find them. If the patient has obvious, life-threatening external bleeding, remember to address it *first* (even before airway and breathing) by controlling it quickly; then assess the ABCs and provide treatment. If direct pressure is ineffective in controlling massive hemorrhage from an arm or leg, the patient may require a tourniquet before the airway is opened. Next, assess skin color: cool, moist skin that is pale or gray suggests a perfusion problem. Determine the patient's level of consciousness using the AVPU scale (Awake and Alert, Responsive to Verbal Stimuli, Responsive to Pain, Unresponsive). Does the patient have a patent (open) airway? If the patient is able to speak, then this indicates the airway is patent. What is the mental status of the patient? These indicators will help you assess how sick the patient is, which will help you develop an index of suspicion for serious illness or injuries related to internal bleeding.

Consider the need for spinal immobilization. At the same time, ensure a patent airway, look for adequate breathing, and check for breath sounds. If necessary, provide the patient with high-flow oxygen or assist ventilation with a bag-valve mask (BVM) or nonrebreathing mask, depending on the patient's level of consciousness and rate and quality of breathing. If the patient is unconscious, the airway may be obstructed. Insert an oropharyngeal (oral) airway to secure the airway.

Words of Wisdom

Non–life-threatening bleeding, such as from an abrasion, can be bandaged later in the assessment as necessary. However, significant and ongoing bleeding, whether internal or external, is an immediate life threat.

Quickly assess pulse rate and quality; determine the condition, color, and temperature of the skin; and check the capillary refill time to help establish the potential for internal bleeding and shock. Treat the patient for shock, if needed, by applying oxygen, improving circulation, and maintaining a normal body temperature.

The results of your initial general impression and your assessment of the ABCs will help you decide whether to manage the patient on scene or transport immediately and manage the patient en route to the hospital. If the patient has signs and symptoms of internal bleeding or airway or breathing problems, provide rapid transport to the most appropriate facility. The condition of patients with significant bleeding will quickly become unstable. Signs such as tachycardia, tachypnea, low blood pressure, weak pulse, and clammy skin are signs of impending circulatory collapse and indicate the need for rapid transport.

History Taking

After the primary assessment is complete, investigate the chief complaint and be alert for signs or symptoms of other injuries due to the MOI and/or NOI. Remember, internal bleeding can be found in both medical and trauma patients. For example, ectopic pregnancy, gastrointestinal bleeding, bleeding from a dialysis shunt, and severe nosebleed are medical causes of potential internal bleeding. If signs and symptoms of internal bleeding are not obvious, look more carefully during the patient assessment process. In a responsive trauma patient with an isolated injury and a limited MOI, consider a detailed physical examination of the specific area before you assess vital signs and obtain a history.

When you encounter a patient who is bleeding, avoid focusing solely on the bleeding. With significant trauma, assess the entire patient, looking for the source of the problem, any preexisting illnesses, and other issues.

If the patient is responsive, obtain a SAMPLE history (Signs and symptoms, Allergies, Medications, Pertinent past medical history, Last oral intake, Events leading up to the illness or injury). It is important to ask the patient if he or she takes blood-thinning medications because bleeding is generally more profuse and difficult to control in patients who take blood thinners. Blood thinners are often prescribed for patients with a history of stroke, pulmonary embolism, or heart attack. Common blood thinners include aspirin, warfarin (Coumadin), rivaroxaban (Xarelto), dabigatran (Pradaxa), apixaban (Eliquis), and clopidogrel (Plavix).

YOU are the Provider — PART 2

You arrive at the scene and find the patient standing outside in front of the shop. He has a towel wrapped around his left wrist; it is soaked in blood and you can see a large amount of blood on the ground. He is conscious and alert but anxious. He tells you he cut his wrist on a table saw when his arm slipped and ran into the blade.

Recording Time: 0 Minutes	
Appearance	Anxious
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions or foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Bleeding from the left wrist; skin is cool, pale, and dry; pulse is rapid and strong

3. Is the patient effectively controlling the bleeding from his injury?
4. What should be your initial treatment priority?

If the patient is unresponsive, obtain medical history information from medical alert tags or ask family members or bystanders if they have any information. Look for signs and symptoms of hypoperfusion and determine how much blood loss has occurred.

Secondary Assessment

Unless you discover a life-threatening condition during the primary assessment, next conduct a secondary assessment, which is a detailed, comprehensive examination of the patient to uncover injuries or illness that may have been missed during the primary assessment. Record vital signs, complete an assessment of pain, and attach appropriate monitoring devices to quantify oxygenation and circulatory status. In some instances, such as a critically injured patient or a short transport time, there may not be time to conduct a secondary assessment.

Assess all areas for DCAP-BTLS to identify underlying or secondary injuries. For isolated injuries such as pain in the ankle, assess that area only (detailed physical examination). When examining the head, be alert for uncontrolled bleeding from large scalp lacerations. In the abdomen, feel all four quadrants for tenderness or rigidity. In the extremities, record pulse, motor, and sensory function.

Obtain baseline vital signs; this allows you to more easily identify any changes that may occur during treatment. In an adult patient, a systolic blood pressure of less than 100 mm Hg with a weak, rapid pulse and cool, moist skin that is pale or gray are signs of hypoperfusion that require immediate attention.

In geriatric patients and patients who take certain blood pressure medications, the pulse rate may not increase with early shock; therefore, try to determine the patient's baseline blood pressure and quickly obtain a medical history and list of medications to help you better assess the patient's condition.

Reassessment

Because the signs and symptoms of internal bleeding are often slow to develop, it is important to reassess the patient frequently. Children especially will compensate well for blood loss and then "crash" quickly. The reassessment is your best opportunity to determine whether your patient's condition is improving or getting worse and to determine the effectiveness of any interventions and treatments. Reassess an unstable patient every 5 minutes and a stable patient every 15 minutes.

Whenever you suspect significant bleeding, either external or internal, provide high-flow oxygen. If significant bleeding is visible, control external bleeding as shown in Skill Drill 25-1. Using multiple methods to control external bleeding usually works best. If the patient has signs of hypoperfusion, provide aggressive treatment for shock and rapid transport to the appropriate hospital. If internal bleeding is suspected, apply high-flow oxygen via a nonrebreathing mask and provide rapid transport to the hospital. See Skill Drill 25-4 for additional steps.

Do not delay transport of a patient to complete an assessment, particularly when significant bleeding is present, even if the bleeding is controlled. The assessment can be started during transport.

In patients with severe external bleeding, it is important to recognize, estimate, and report the amount of blood loss that has occurred and how rapidly or over what period of time it occurred. For example, you may report that approximately 2 pints (about 1 liter) of blood loss occurred or that the bleeding soaked through three trauma dressings. Report this information to hospital personnel during transport to allow the hospital to evaluate needed resources, such as the availability of surgical suites, surgeons, and other specialty providers. Your transfer report at the hospital should update hospital personnel on how your patient has responded to your care. Be sure your paperwork reflects all of the patient's injuries and the care you have provided.

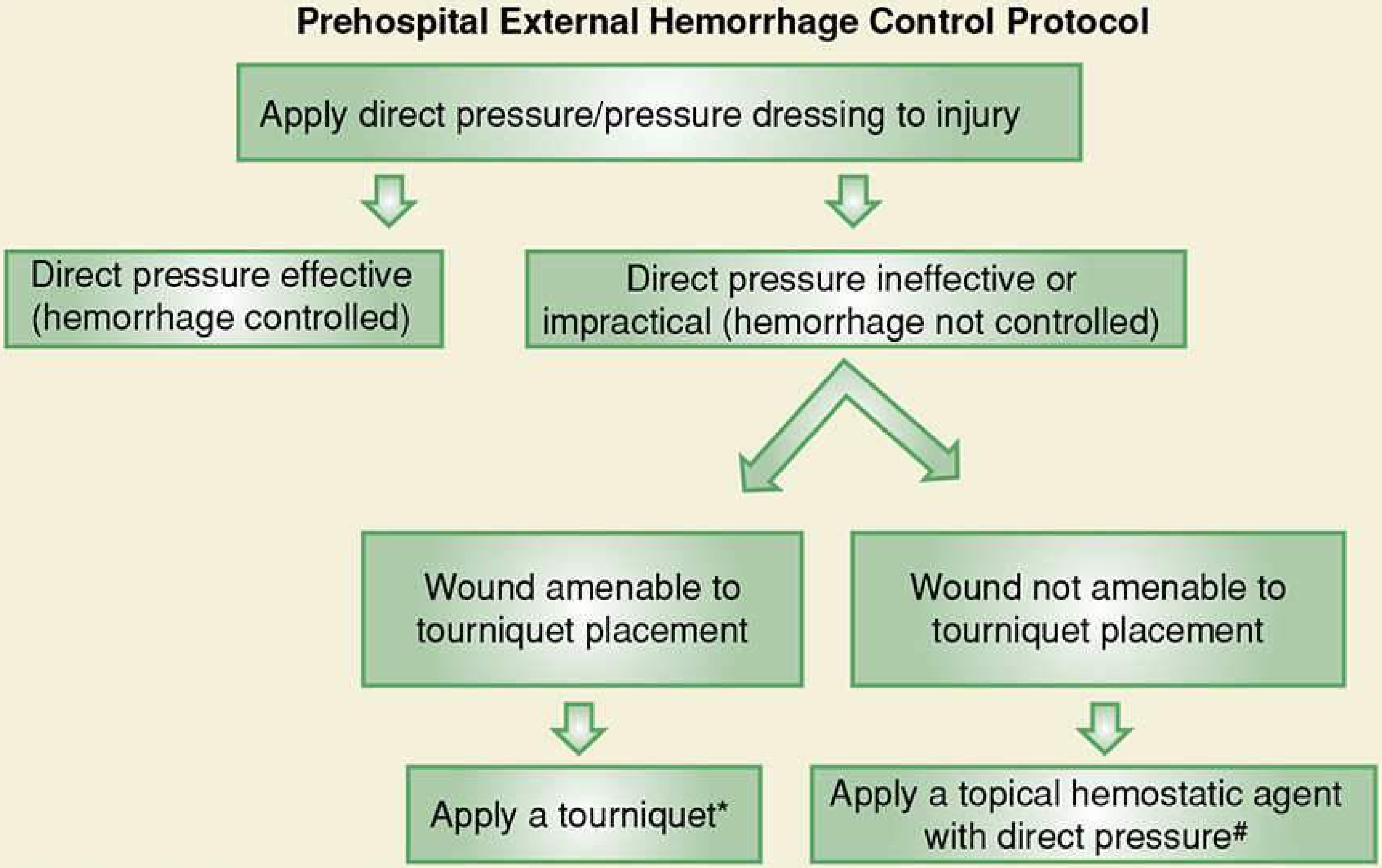
Emergency Medical Care for External Bleeding

Before you care for a patient with obvious external bleeding, remember to follow standard precautions. This includes gloves and eye protection at a minimum and may include a mask and gown. As with all patient care, make sure the patient has an open airway and is breathing adequately. Provide high-flow oxygen, then concentrate on controlling the bleeding. If obvious, life-threatening bleeding is present, control it as quickly as possible.

Several methods are available to control external bleeding. The most commonly used include:

- Direct, even pressure
- Pressure dressings and/or splints
- Tourniquets

To control bleeding, follow the steps shown in **Figure 25-8**. Begin with direct pressure, and move to the next steps if direct pressure does not control the bleeding.



*Use of tourniquet for extremity hemorrhage is strongly recommended if sustained direct pressure is ineffective or impractical; Use a commercially-produced, windlass, pneumatic, or ratcheting device, which has been demonstrated to occlude arterial flow and avoid narrow, elastic, or bungee-type devices; Utilize improvised tourniquets only if no commercial device is available; Do not release a properly-applied tourniquet until the patient reaches definitive care.

#Apply a topical hemostatic agent, in combination with direct pressure, for wounds in anatomic areas where tourniquets can not be applied and sustained direct pressure alone is ineffective or impractical; Only apply topical hemostatic agents in a gauze format that supports wound packing; Only utilize topical hemostatic agents which have been determined to be effective and safe in a standardized laboratory injury model.

Figure 25-8 Steps of bleeding control.

Most cases of external bleeding can be controlled simply by applying direct, local pressure to the bleeding site. This method is by far the most effective way to control external bleeding. (Previously, elevation of the extremity was also recommended, but there is no evidence it helps control bleeding and it may aggravate other injuries.) Pressure stops the flow of blood and permits normal coagulation to occur. You may apply pressure with your gloved fingertip or hand over the top of a sterile dressing if one is immediately available. If there is an object protruding from the wound, never remove it unless it is in the cheek and blocking the patient's airway. Apply bulky dressings to stabilize the impaled object in place, and apply pressure as best you can for at least 5 minutes without interruption.

In most cases, direct pressure will stop the bleeding. Once you have applied a dressing to control bleeding, create a pressure dressing to maintain the pressure by firmly wrapping a sterile, self-adhering roller bandage around the entire wound. Use 4-inch × 4-inch (101-mm × 101-mm) sterile gauze pads for small wounds and sterile universal dressings for larger wounds.

Cover the entire dressing with the bandage above and below the wound, and stretch the bandage tight enough to control bleeding. If you were able to palpate a distal pulse before applying the dressing, then you should still be able to palpate a distal pulse on the injured extremity after applying the pressure dressing. If bleeding continues, then the dressing is insufficient. If the bleeding oozes slowly through the dressing, then reinforce it by applying more dressings on top of it. Do not remove a dressing until a physician has evaluated the patient.

YOU are the Provider — PART 3

You immediately apply direct pressure to patient's wrist with a dry, sterile dressing and apply a splint. You then apply a pressure dressing. This effectively controls the patient's bleeding. While you further assess the patient, your partner applies high-flow oxygen, obtains the patient's vital signs, and inquires about his medical history. The patient denies having any medical problems and states he does not take any medications.

Recording Time: 5 Minutes	
Respirations	24 breaths/min; regular and adequate
Pulse	120 beats/min; strong and regular
Skin	Cool, pale, and dry
Blood pressure	104/60 mm Hg
Spo_2	94% (on oxygen)

5. What are the components of the cardiovascular system?
6. What factors determine the severity of external bleeding?

Bleeding will almost always stop when the pressure of the dressing exceeds arterial pressure. This will assist in controlling bleeding and helping blood to clot.

If direct pressure fails to immediately stop hemorrhage, then apply additional manual pressure through the dressing and apply a tourniquet above the level of the bleeding. If this is not possible because the bleeding is too proximal, then apply direct pressure and hold it until you arrive at the hospital.

Skill Drill 25-1 illustrates the basic techniques to control external bleeding:

1. Follow standard precautions.
2. Maintain the airway with cervical spine immobilization if the MOI suggests the possibility of spinal injury.
3. Apply direct pressure over the wound with a dry, sterile dressing Step 1.
4. Apply a pressure dressing Step 2.
5. If direct pressure and a pressure dressing are not immediately effective, apply a tourniquet to an extremity above the level of the bleeding Step 3.
6. Tighten the tourniquet until pulses are no longer palpable distal to the tourniquet Step 4. Position the patient supine unless there is a reason not to; for example, underlying respiratory issues.

Skill Drill 25-1 Controlling External Bleeding

Step 1

Take standard precautions. Apply direct pressure over the wound with a dry, sterile dressing.

Step 2

Apply a pressure dressing.

Step 3

If direct pressure with a pressure dressing does not control bleeding, apply a tourniquet above the level of the bleeding.

Step 4

Tighten the tourniquet until distal pulses are no longer palpable. Properly position the patient. Apply high-flow oxygen as necessary. Keep the patient warm. Transport promptly.

7. Apply high-flow oxygen, as necessary, once hemorrhage is controlled. Keep the patient warm. Transport promptly.

Words of Wisdom

Much of the bleeding associated with broken bones occurs because the sharp ends of the bones cut muscles and other tissues. As long as a fracture remains unstable, the bone ends will move and continue to injure partially clotted blood vessels. Therefore, immobilizing a fracture and decreasing movement will help control bleeding. Often, a simple splint will quickly control bleeding associated with a fracture **Figure 25-9**. If the patient is unstable, however, do not waste time splinting a fracture.

Figure 25-9 Use of a simple splint will often quickly control bleeding associated with a fracture. If a fracture is not immobilized, then the bone ends are free to move and may continue to injure partially clotted blood vessels.

▶ Hemostatic Agents

A **hemostatic agent** is any chemical compound that slows or stops bleeding by assisting with clot formation. Hemostatic agents are primarily utilized in military medicine to stop profuse bleeding. They come in two forms—a granular powder, which can be inserted into small wounds to create a tight seal (such as a gunshot wound), and gauze impregnated with a clay substance, which speeds blood clot formation. Gauze can also be packed into larger wounds to control hemorrhage.

Hemostatic agents can be used together with direct pressure when direct pressure alone is ineffective, such as with massive chest injuries, or when tourniquet placement is impossible **Figure 25-10**. These agents have the potential to improve prehospital bleeding control, especially when transport time to definitive care is prolonged. However, the use of hemostatic agents in EMS remains largely experimental. Because of the lack of scientific evidence demonstrating an effect on survival in civilian settings, most local protocols do not allow for their use. Be aware of and follow your local protocols.

Figure 25-10 When a wound is located on a part of the body where tourniquet placement is impossible, a hemostatic agent may be applied to increase clotting. Follow your local protocols.

Courtesy of Medtrade Products Ltd., UK.

Tourniquets

If direct pressure does not control extremity bleeding, then use a **tourniquet**. The tourniquet is especially useful if a patient has substantial bleeding from an extremity injury. Several different types of commercial tourniquets are on the market, including the mechanical advantage tourniquet (MAT), the combat application tourniquet (CAT), the ratcheting medical tourniquet (RMT), and the special weapons and tactics tourniquet (SWAT-T) **Figure 25-11**.

Follow the manufacturer's instructions for the specific type of tourniquet used by your service. Follow the steps in Skill Drill 25-2 to apply a commercial tourniquet.

1. Follow standard precautions.
2. Apply direct pressure over the bleeding site.
3. Place the tourniquet around the extremity high and tight, proximal to the bleeding site (in the axillary region for upper extremity injuries and at the groin for lower extremity injuries) Step 1.
4. Click the buckle into place and pull the strap tight.

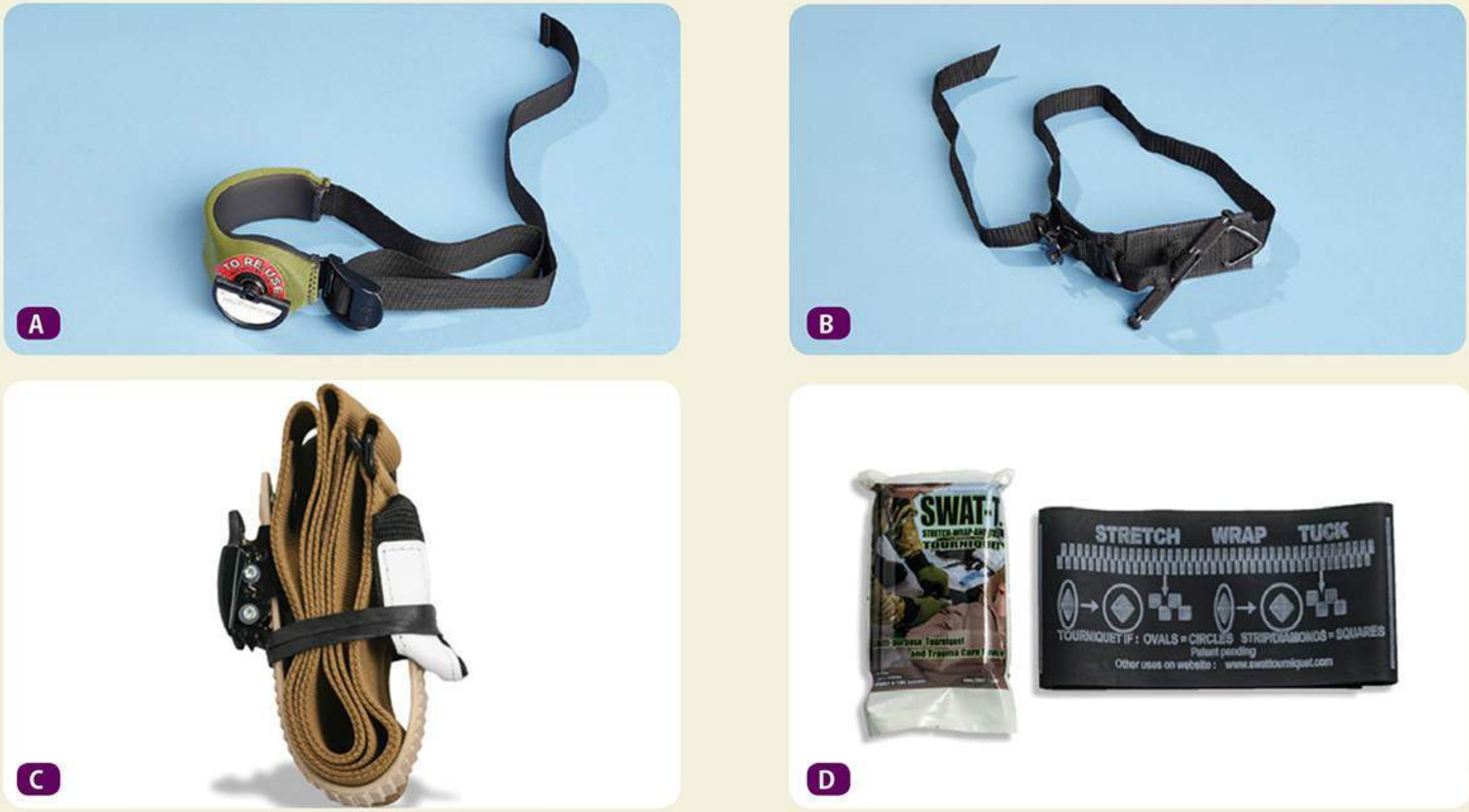


Figure 25-11 Different examples of commercial tourniquets. **A.** Mechanical advantage tourniquet (MAT). **B.** Combat application tourniquet (CAT). **C.** Ratcheting medical tourniquet (RMT). **D.** Special weapons and tactics tourniquet (SWAT-T).

A, B: © Jones & Bartlett Learning; C, D: Photo by Diane Zahorodny. Courtesy of Chinook Medical Gear.

Skill Drill 25-2 Applying a MAT Commercial Tourniquet

Step 1

Apply pressure over the bleeding site and place the tourniquet proximal to the injury (in the axillary region for upper extremity injuries and at the groin for lower extremity injuries).

Step 2

Click the buckle into place, pull the strap tight, and turn the tightening dial clockwise until pulses are no longer palpable distal to the tourniquet or until bleeding has been controlled.

Words of Wisdom

If the patient has an open fracture of an extremity, bleeding can be substantial. Consider a tourniquet early if bleeding is not easily controlled with direct pressure or if pressure results in excessive pain. The method used to control severe external bleeding may be governed by local protocol, but regardless of the method, it must be quick and effective. Remember, uncontrolled bleeding may result in shock and death. Patients can bleed to death from extremity injuries. It is imperative that you use effective techniques to stop bleeding when you encounter it. Twist the stick or rod to tighten the tourniquet until the bleeding stops.

5. Turn the tightening dial clockwise until pulses are no longer palpable distal to the tourniquet or until bleeding has been controlled Step 2.
6. Do not release a tourniquet once applied, unless instructed to do so by medical control.

If a commercial tourniquet is unavailable, then follow these steps to apply a tourniquet using a triangular bandage and a stick or rod:

1. Fold a triangular bandage until it is 4 inches (101 mm) wide and six to eight layers thick.
2. Wrap the bandage around the extremity twice. Place the bandage high and tight, proximal to the injury (in the axillary region for upper extremity injuries and at the groin for lower extremity injuries).
3. Tie one knot in the bandage. Then place a stick or rod on top of the knot, and tie the ends of the bandage over the stick in a square knot.
4. Use the stick or rod as a handle, and twist it to tighten the tourniquet until the bleeding has stopped; then stop twisting Figure 25-12.
5. Secure the stick in place, and make the wrapping neat and smooth.
6. Write “TK” (for “tourniquet”) and the exact time (hour and minute) that you applied the tourniquet on a piece of adhesive tape. Securely fasten the tape to the patient’s forehead or write the time directly on the forehead with a marker. Notify hospital personnel on your arrival that your patient has a tourniquet in place. Record this same information on the ambulance run report form.

7. As a last resort, you can use a blood pressure cuff as a tourniquet. Position the cuff proximal to the bleeding point and inflate it just enough to stop the bleeding. Leave the cuff inflated. Monitor the gauge continuously to make sure that the pressure is not gradually dropping, which could allow the bleeding to restart. You may have to clamp the tube leading from the cuff to the inflating bulb with a hemostat to prevent loss of pressure. Consider wrapping the cuff with tape to prevent the Velcro from loosening under continuous high pressure.

Figure 25-12 Twist the stick or rod to tighten the tourniquet until the bleeding stops.

Whenever you apply a tourniquet, make sure you observe the following precautions:

- Do not apply a tourniquet directly over any joint. Always place the tourniquet proximal to the injury (in the axillary region for upper extremity injuries and at the groin for lower extremity injuries).
- Make sure the tourniquet is tightened securely.
- Never use wire, rope, a belt, or any other narrow material that could cut into the skin.
- If it is possible to do so without causing a delay, consider placing padding under the tourniquet as you apply it. This step may protect the skin and help with arterial compression.

- Never cover a tourniquet with a bandage. Leave it in full view.
- Do not loosen the tourniquet after you have applied it, unless directed by medical control. Hospital personnel will loosen it once they are prepared to manage the bleeding.

Mark the exact time the tourniquet was applied and be sure to communicate the time of application, the site of application, and the rationale for application clearly and specifically to hospital personnel upon arrival.

Splints

Air splints (commonly known as soft splints or pressure splints) can control internal or external bleeding associated with severe extremity injuries, such as fractures **Figure 25-13**. They also immobilize the fracture itself. An air splint acts like a pressure dressing applied to an entire extremity rather than to a small, local area. Use only approved, clean, or disposable valve stems when orally inflating air splints.

Rigid splints will help immobilize fractures as well as reduce pain and further damage to soft tissues. Once you have applied a splint, be sure to monitor pulse and motor and sensory function in the distal extremity.

Figure 25-13 Air splints can also be used to control bleeding because they act as a pressure bandage for the entire extremity. They are not as effective as tourniquets, however, and should never be used when a tourniquet is otherwise indicated.

Words of Wisdom

Research indicates that a **pelvic binder** **Figure 25-14** is an effective method to reduce the width of pelvic ring injuries. This helps to control internal bleeding, specifically bleeding associated with a life-threatening **open-book pelvic fracture**. It is important to provide the correct amount of force when applying a compression device. A pelvic sling is designed to prevent over- and under-compression. Use of a pelvic compression device may or may not be allowed in your service, so always follow local protocols. A pelvic compression device or binder.

Figure 25-14 A pelvic compression device or binder.

SAM Medical Products®.

YOU are the Provider — PART 4

The patient is placed onto the stretcher and loaded into the ambulance. He remains conscious and alert but is still anxious. You place him in a supine position and cover him with a blanket. Shortly before departing the scene, you reassess him and obtain another set of vital signs.

Recording Time: 10 Minutes	
Level of consciousness	Conscious and alert; anxious
Respirations	24 breaths/min; regular and adequate
Pulse	116 beats/min; strong and regular
Skin	Cool, pale, and dry
Blood pressure	112/70 mm Hg
Spo_2	98% (on oxygen)

7. How might a patient's outcome be affected if bleeding is internal rather than external?
8. What are the signs and symptoms of internal bleeding?

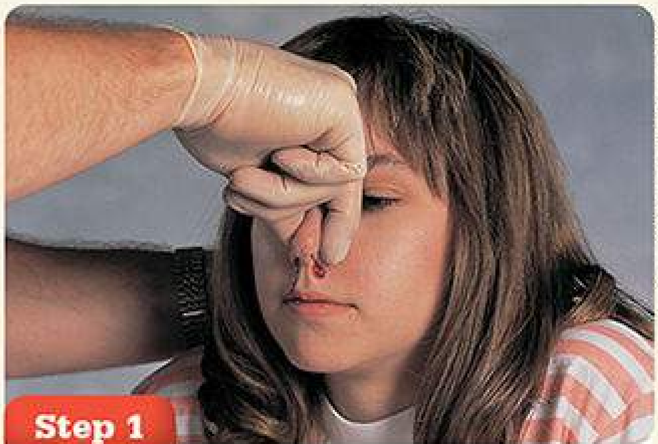
Bleeding From the Nose, Ears, and Mouth

Bleeding around the face always presents a risk for airway obstruction or aspiration. Maintain a clear airway by positioning the patient appropriately and using suction when indicated. Several conditions can result in bleeding from the nose, ears, and/or mouth, including the following:

- Skull fracture
- Facial injuries, including those caused by a direct blow to the nose
- Sinusitis, infections, nose drop use and abuse, dried or cracked nasal mucosa, intranasal use of street drugs (snorting), or other abnormalities
- High blood pressure
- Coagulation disorders
- Digital trauma (nose picking)

Epistaxis, or nosebleed, is a common emergency. Occasionally, it can cause blood loss great enough to send a patient into shock. Keep in mind that the blood that is visible may be only a small part of the total blood loss. Much of the blood may pass down the throat into the stomach as the patient swallows. A person who swallows a large amount of blood may become nauseated and start vomiting the blood, which is sometimes confused with internal bleeding. Most nontraumatic nosebleeds occur from sites in the septum (the tissue dividing the nostrils). You can usually handle this type of bleeding effectively by pinching the nostrils together. **Skill Drill 25-3** illustrates the basic techniques to control epistaxis.

Skill Drill 25-3 Controlling Epistaxis



Step 1

Position the patient sitting, leaning forward. Apply direct pressure, pinching the fleshy part of the nostrils together.

Step 2

Alternative method: Apply pressure with a rolled gauze bandage between the upper lip and gum. Calm the patient.

Step 3

Apply ice over the nose. Maintain pressure until bleeding is controlled. Initiate prompt transport while you or the patient applies pressure. Assess and treat for shock, including oxygen, as needed.

1. Follow standard precautions.
2. Help the patient to sit, leaning forward, with the head tilted forward. This position stops the blood from trickling down the throat or being aspirated into the lungs.
3. Apply direct pressure for at least 15 minutes by pinching the fleshy part of the nostrils together. This is the preferred method. This technique may also be performed by the patient Step 1.
4. Another option is to place a rolled 4-inch × 4-inch (101-mm × 101-mm) gauze bandage between the upper lip and the gum. Have the patient apply pressure by stretching the upper lip tightly against the rolled bandage and pushing it up into and against the nose. If the patient is unable to do this effectively, use your gloved fingers to press the gauze against the gum Step 2.
5. Keep the patient calm and quiet, especially if he or she has high blood pressure or is anxious. Anxiety tends to increase blood pressure, which could worsen the nosebleed.
6. Apply ice over the nose.

7. Maintain the pressure until the bleeding is completely controlled, usually no more than 15 minutes if this is the patient's only problem. Most often, failure to stop a nosebleed is the result of releasing the pressure too soon **Step 3**.
8. Provide prompt transport. You can initiate transport while having the patient maintain direct pressure or while maintaining pressure yourself.
9. Assess the patient for signs and symptoms of shock and treat appropriately.

Bleeding from the nose or ears following a head injury may indicate a skull fracture. In these cases, do not attempt to stop the blood flow. This bleeding may be difficult to control. Applying excessive pressure to the injury may force the blood leaking through the ear or nose to collect within the head. This could increase the pressure on the brain and possibly cause permanent damage. If you suspect a skull fracture, loosely cover the bleeding site with a sterile gauze pad to collect the blood and help keep contaminants away from the site. Apply light compression by wrapping the dressing loosely around the head **Figure 25-15**. If blood or drainage contains cerebrospinal fluid, you will see a characteristic staining of the dressing much like a target or halo shape **Figure 25-16**.

Figure 25-15 Bleeding from the ear after a head injury may indicate a skull fracture. Loosely cover the bleeding site with a sterile gauze pad and apply light compression by wrapping the dressing loosely around the head.

Figure 25-16 When cerebrospinal fluid is present in blood or drainage, a stain in the shape of a target or halo will appear.

Courtesy of Rhonda Hunt.

Emergency Medical Care for Internal Bleeding

Controlling internal bleeding or bleeding from major organs usually requires surgery or other procedures that must be done in the hospital. It is important for you to remain calm and reassure the patient. Keeping the patient as still and quiet as possible assists the body's clotting process. Provide high-flow oxygen and cover the patient with a blanket to maintain body temperature. You can usually control internal bleeding into the extremities in the field simply by splinting the extremity, usually most effectively with an air splint. Never use a tourniquet to control the bleeding from closed, internal, soft-tissue injuries. Follow the steps in **Skill Drill 25-4** to care for patients with possible internal bleeding.

1. Follow standard precautions.
2. Maintain the airway with cervical spine immobilization if the MOI suggests the possibility of spinal injury.
3. Administer high-flow oxygen and provide artificial ventilation as necessary Step 1.
4. Control all obvious external bleeding.
5. Treat suspected internal bleeding in an extremity by applying a splint Step 2.
6. Depending on local protocols, use a pelvic compression device or splint to control suspected internal bleeding from the pelvic area Step 3.
7. Monitor and record the vital signs at least every 5 minutes.
8. Keep the patient warm Step 4.
9. Give the patient nothing by mouth, not even small sips of water.
10. Provide prompt transport for all patients with signs and symptoms of hypoperfusion. Report any changes in the patient's condition to emergency department personnel.

YOU are the Provider PART 5

You continue to monitor the patient en route to the hospital and reassess his condition as appropriate. After reassessing the patient and his vital signs, you call your radio report into the receiving facility.

Recording Time: 17 Minutes	
Level of consciousness	Conscious and alert; restless
Respirations	20 breaths/min; regular and adequate
Pulse	110 beats/min; strong and regular
Skin	Cool, pale, and dry
Blood pressure	114/68 mm Hg
Spo_2	97% (on oxygen)

The patient is delivered to the hospital and you give your report to the attending physician. An intravenous line is started, and the patient is given normal saline to improve his perfusion status. He is taken to the operating room for repair of severed tendons, nerves, and an artery as a result of the injury.

9. How does the body typically respond to blood loss?

Skill Drill 25-4 Controlling Internal Bleeding

Step 1

Follow standard precautions. Maintain the airway and be alert for cervical spine injury. Administer oxygen and provide ventilation as necessary.

Step 2

Control obvious external bleeding and treat suspected internal bleeding using a splint. Apply a tourniquet for severe bleeding that cannot be controlled with direct pressure.

Step 3

Depending on local protocols, use a pelvic compression device or splint to control suspected internal bleeding in the pelvic region.

Step 4

Monitor vital signs and keep the patient warm.

YOU are the Provider — SUMMARY

1. What are the functions of arteries? What major arteries are located in the upper extremity?

Arteries are high-pressure blood vessels that distribute oxygenated blood throughout the body. The major arteries located in the upper extremity include the brachial artery, located on the inner (medial) aspect of the arm, just proximal to the elbow; the radial artery, located on the thumb-side (lateral) aspect of the wrist, proximal to the hand; and the ulnar artery, located on the opposite side of the forearm from the radial artery. The radial and ulnar arteries are the two terminal branches of the brachial artery.

2. Why is arterial bleeding more severe than venous bleeding?

Blood flow through the arteries is driven by contraction of the powerful left ventricle. Pressure in the arteries is much higher than pressure in the veins, so blood loss from an artery is generally more rapid and severe. Arterial bleeding is also more difficult to control than venous bleeding.

3. Is the patient effectively controlling the bleeding from his injury?

As evidenced by the blood-soaked towel and large amount of blood on the ground, it is clear that the patient is *not* effectively controlling the bleeding from his injury. Furthermore, you do not know how much blood loss he has sustained because he is standing outside—not in the area where the injury occurred. The fact that he is anxious and has cool, pale skin suggests significant external blood loss.

4. What should be your initial treatment priority?

You must take immediate action to control the patient's bleeding. His airway is patent, as evidenced by the fact that he is conscious, alert, and talking.

In most cases, direct pressure will control both venous and arterial bleeding. If direct pressure is ineffective in immediately controlling severe external bleeding, apply a tourniquet and transport. Only after the tourniquet is applied should you administer oxygen and consider splinting the arm.

5. What are the components of the cardiovascular system?

The cardiovascular system—the system responsible for supplying and maintaining adequate blood flow to the body's tissues and cells—consists of three components: the pump (the heart), the container (the blood vessels), and the fluid (blood and body fluids). These components of the cardiovascular system are interdependent—that is, they rely on each other to perform a common function.

6. What factors determine the severity of external bleeding?

The single most influential factor is the type and size of the blood vessel that is injured. A lacerated brachial artery, for example, will bleed more severely than a small vein in the leg. The patient's blood pressure and heart rate can also affect the severity of external bleeding. The greater the pressure on the arterial wall and the faster the heart rate, the more rapid the bleeding tends to be. The patient's medical history also should be considered. Bleeding in patients who take blood-thinning medications or in those with a bleeding disorder tends to be more difficult to control and may result in more blood loss because it takes longer for the blood to clot.

7. How might a patient's outcome be affected if bleeding is internal rather than external?

Internal bleeding is hidden and cannot be controlled in the prehospital setting. Many patients with internal bleeding do not have signs or symptoms of shock until a significant amount of blood loss has occurred. Overall, patients with internal bleeding have a higher mortality rate than those with external bleeding. Most of these deaths are the result of intrathoracic or intra-abdominal bleeding, in which surgical intervention is delayed. Internal bleeding can also be caused by multiple long bone fractures and pelvic fractures.

8. What are the signs and symptoms of internal bleeding?

Since internal bleeding is not visible, you must rely on your assessment skills and careful evaluation of the mechanism of injury. Signs and symptoms of internal bleeding are essentially those of shock: restlessness or anxiety; cool, pale, clammy skin; tachycardia; rapid, shallow breathing; and thirst. A late sign is hypotension. External indicators of internal bleeding in both medical and trauma patients include hematemesis (vomiting blood), melena (dark, tarry stools), and hemoptysis (coughing up blood). Other indicators of internal bleeding, which are more common in trauma patients, include redness or bruising, swelling, or tenderness over the injured area. Always be alert to the possibility of internal bleeding, particularly if the MOI is significant. Remember that if a trauma patient is in shock but does not have any obvious external signs of injury, suspect internal bleeding!

9. How does the body typically respond to blood loss?

If the typical adult sustains more than approximately 2 pints (about 1 L) of blood loss, significant changes in vital signs will occur, including increased heart and respiratory rates (compensatory phase) and, as a later sign, decreased blood pressure (indicating decompensation).

A loss of circulating blood volume is sensed by receptors in the body that send messages to the nervous system. In response, the sympathetic nervous system releases epinephrine and norepinephrine. Norepinephrine constricts the peripheral blood vessels (vasoconstriction), thus shunting blood from areas of lesser need (eg, skin and muscles) to areas of greater need (eg, heart, brain, kidneys, liver). If blood loss continues, however, the body's compensatory mechanisms will eventually fail, the patient's blood pressure will fall, and he or she will die.

EMS Patient Care Report (PCR)

Date: 6-30-16	**Incident No.:** 220109	**Nature of Call:** Laceration		**Location:** 517 E. Graham St.	
Dispatched: 1620	**En Route:** 1621	**At Scene:** 1627	**Transport:** 1642	**At Hospital:** 1655	**In Service:** 1704

Patient Information

Age: 32 **Sex:** M **Weight (in kg [lb]):** 82 kg (180 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** None **Chief Complaint:** Laceration to left wrist

Vital Signs

Time: 1637	**BP:** 104/60	**Pulse:** 120	**Respirations:** 24	**Spo_2:** 94%
Time: 1642	**BP:** 112/70	**Pulse:** 116	**Respirations:** 24	**Spo_2:** 98%
Time: 1649	**BP:** 114/68	**Pulse:** 110	**Respirations:** 20	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Shock treatment

Narrative

Dispatched for a patient with severe bleeding from the arm. Arrived on scene to find the patient, a 32-year-old male, standing in front of his place of employment, a woodworking shop. He was conscious and alert, but notably anxious. His airway was patent and his breathing, although increased, was producing adequate tidal volume. Patient had blood-soaked towel wrapped around his left wrist and a significant amount of blood was on the ground where he was standing. Patient stated that his hand slipped while he was working with a table saw and his left wrist ran across the blade. Immediately applied direct pressure to patient's wrist with sterile dressing and applied a splint. This intervention successfully controlled the bleeding; a pressure dressing was then applied to maintain bleeding control. Applied oxygen at 15 L/min via nonrebreathing mask and obtained vital signs, as noted above. Further assessment revealed that patient's skin was cool, pale, and dry. Patient denied significant past medical history and further denied taking any medications. Placed patient onto stretcher, covered him with a blanket, and placed him into the ambulance. Reassessed patient's vital signs and began transport to the hospital. Continued to monitor patient's condition en route; he remained conscious and alert, although anxious, and his vital signs remained stable. Reassessed bandaged wound and noted that the bleeding remained controlled. Called report to receiving facility and informed them of our arrival. Delivered patient to hospital without incident. Verbal report given to charge nurse. **End of report**

Prep Kit

Ready for Review

- Perfusion is the circulation of blood in adequate amounts to meet the cells' current needs for oxygen, nutrients, and waste removal.
- The cardiovascular systems contains three main parts: a working pump (heart), a container (blood vessels), and fluid (oxygen-carrying blood).
- Hypoperfusion, or shock, occurs when one or more of these three components is not working properly and the cardiovascular system fails to provide adequate perfusion.
- Always ask the patient if he or she takes blood-thinning medications (aspirin, warfarin) because bleeding is generally more profuse and difficult to control in these patients.
- Both internal and external bleeding can cause shock. You must know how to recognize and control both.
- The methods to control bleeding, in order, are:
  - Direct, local pressure
  - Pressure dressing
  - Tourniquet
  - Splinting device
- Bleeding from the nose, ears, and/or mouth may result from a skull fracture. Other causes include high blood pressure and sinus infection. Evaluate the MOI and consider the more serious problem of skull fracture.
- Bleeding around the face always presents a risk for airway obstruction or aspiration. Maintain a clear airway by positioning the patient appropriately and using suction when indicated.
- If bleeding is present at the nose and a skull fracture is suspected, place a gauze pad loosely under the nose.
- If bleeding from the nose is present and a skull fracture is not suspected, pinch both nostrils together for 15 minutes. If the patient is awake and has a patent airway, place a gauze pad inside the upper lip against the gum.
- Promptly transport any patient you suspect of having internal bleeding or significant external bleeding.
- If the MOI is significant, be alert to signs and symptoms of internal bleeding in the chest or abdomen, such as serious bruising or complaints of difficulty breathing or abdominal pain.
- Signs of serious internal bleeding include the following:
  - Vomiting blood (hematemesis)
  - Black, tarry stools (melena)
  - Coughing up blood (hemoptysis)
  - Distended abdomen
  - Broken ribs
- The signs and symptoms of internal bleeding are often slow to develop; therefore, reassess an unstable patient every 5 minutes and a stable patient every 15 minutes.

Vital Vocabulary

aorta The main artery that receives blood from the left ventricle and delivers it to all the other arteries that carry blood to the tissues of the body.

arterioles The smallest branches of arteries leading to the vast network of capillaries.

artery A blood vessel, consisting of three layers of tissue and smooth muscle, that carries blood away from the heart.

capillaries The small blood vessels that connect arterioles and venules; various substances pass through capillary walls, into and out of the interstitial fluid, and then on to the cells.

coagulation The formation of clots to plug openings in injured blood vessels and stop blood flow.

contusion A bruise from an injury that causes bleeding beneath the skin without breaking the skin; also see *ecchymosis*.

ecchymosis A buildup of blood beneath the skin that produces a characteristic blue or black discoloration as the result of an injury; also see *contusion*.

epistaxis A nosebleed.

hematemesis Vomited blood.

hematoma A mass of blood that has collected within damaged tissue beneath the skin or in a body cavity.

hematuria Blood in the urine.

hemophilia A hereditary condition in which the patient lacks one or more of the blood's normal clotting factors.

hemoptysis The coughing up of blood.

hemorrhage Bleeding.

hemostatic agent A chemical compound that slows or stops bleeding by assisting with clot formation.

hypoperfusion A condition in which the circulatory system fails to provide sufficient circulation to maintain normal cellular functions; also called shock.

hypovolemic shock A condition in which low blood volume, due to massive internal or external bleeding or extensive loss of body water, results in inadequate perfusion.

melena Black, foul-smelling, tarry stool containing digested blood.

open-book pelvic fracture A life-threatening fracture of the pelvis caused by a force that displaces one or both sides of the pelvis laterally and posteriorly.

pelvic binder A device to splint the bony pelvis to reduce hemorrhage from bone ends, venous disruption, and pain.

perfusion The circulation of blood within an organ or tissue in adequate amounts to meet the current needs of the cells.

shock A condition in which the circulatory system fails to provide sufficient circulation to maintain normal cellular functions; also called hypoperfusion.

tourniquet The bleeding control method used when a wound continues to bleed despite the use of direct pressure; useful if a patient is bleeding severely from a partial or complete amputation.

vasoconstriction The narrowing of a blood vessel, such as with hypoperfusion or cold extremities.

veins The blood vessels that carry blood from the tissues to the heart.

venules Very small, thin-walled blood vessels.

Assessment *in Action*

Your unit is dispatched to a roadside construction site for a blast-related injury. Fire department personnel arrive before you and radio to tell you that the scene is safe. On your arrival, you are informed that your patient is a 46-year-old man who had been blasting rock and had set the fuse too short. As he was leaving the area to seek cover from the explosion, he was blown forward onto a gravel area. He tells you that he remembers everything and he did not have a loss of consciousness. He also indicates that the entire front of his body hurts and he can't hear well. He denies having any past medical history or allergies and does not take any medications.

On examination, you find minor bleeding from his ears and some cuts and bruises to his arms. As you remove his clothing, you find that his chest and abdomen are bruised. He reports increasing pain and experiences severe trouble breathing. As you begin your transport, you notice that he is now has hematemesis, cool and clammy skin, tachycardia, and hypotension.

1. Which is the first important factor to consider in this scenario?

   A. Scene safety
   B. Mechanism of injury
   C. Level of consciousness
   D. Apparent injuries

2. After considering this, which factor should you consider next?

   A. Scene safety
   B. Mechanism of injury
   C. Level of consciousness
   D. Apparent injuries

3. The minor bleeding from his ears is most likely an indication of:

   A. a skull fracture.
   B. internal hemorrhaging.

C. cardiac distress.
D. an ocular cavity.

4. You determine that your patient is experiencing internal bleeding. What should you do first?

   A. Apply pressure dressings.
   B. Immobilize the injury.
   C. Administer oxygen.
   D. Apply cold packs.

5. Which condition is likely when signs of hypotension, tachycardia, and cool, clammy skin are found?

   A. Internal bleeding
   B. Shock
   C. Central nervous system depression
   D. Intracranial bleeding

6. Effective primary treatment of this patient should consist of:

   A. tourniquet use.
   B. direct pressure.
   C. rapid transport.
   D. placing the patient in the recovery position.

7. Which is the best position to immobilize and transport this patient?

   A. Supine
   B. Left lateral recumbent
   C. Fowler
   D. Prone

8. Is your patient's pain likely to be a result of internal or external injuries? Explain your answer.
9. What aspect of the MOI should make you suspect this patient has a serious injury?
10. What is the significance of hypotension in this patient?

CHAPTER

26

Soft-Tissue Injuries

National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Soft-Tissue Trauma

Recognition and management of

› Wounds (pp 907–912, 914–923)

› Burns

- Electrical (pp 923–931, 935–937)
- Chemical (pp 923–931, 934–935)
- Thermal (pp 923–933)

› Chemicals in the eye and on the skin (pp 923–931, 934–935)

Pathophysiology, assessment, and management

› Wounds

- Avulsions (pp 907, 909–910, 912–919)
- Bite wounds (pp 907, 912–919, 922–923)
- Lacerations (pp 907, 909–910, 912–919)
- Puncture wounds (pp 907, 909–919, 937)
- Incisions (pp 907, 909, 912–919)

› Burns

- Electrical (pp 907, 923–931, 935–937)
- Chemical (pp 907, 923–931, 934–935)
- Thermal (pp 907, 923–933)
- Radiation (pp 907, 923–931, 937–938)

› Crush syndrome (pp 907–909, 912–919)

Knowledge Objectives

1. Describe the anatomy of the skin; include the layers of the skin. (pp 905–906)
2. Know the major functions of the skin. (p 906)
3. Name the three types of soft-tissue injuries. (p 907)
4. Describe the types of closed soft-tissue injuries. (pp 907–909)
5. Describe the types of open soft-tissue injuries. (pp 909–912)
6. Explain patient assessment of closed and open injuries. (pp 912–918)
7. Explain patient assessment of closed and open injuries in relation to airway management. (pp 914–915)
8. Explain the emergency medical care for closed and open injuries. (pp 918–919)
9. Explain the emergency medical care for an open wound to the abdomen. (pp 919–920)
10. Explain the emergency medical care for an impaled object. (pp 920–921)
11. Explain the emergency medical care for neck injuries. (pp 921–922)
12. Describe the steps of the emergency treatment of small animal bites, human bites, and rabies. (pp 922–923)
13. Explain how the seriousness of a burn is related to its depth and extent. (pp 924–925)
14. Define superficial, partial-thickness, and full-thickness burns; include the characteristics of each burn. (pp 925–926)
15. Explain the primary assessment of a burn patient. (pp 928–929)
16. Explain the emergency medical care for burn injuries. (p 931)
17. Describe the emergency management of chemical, electrical, thermal, inhalation, and radiation burns. (pp 931–938)
18. Know the functions of sterile dressings and bandages. (pp 938–939)

Skills Objectives

1. Demonstrate the emergency medical care of an open chest wound. (pp 911, 914–915, 918)
2. Demonstrate the emergency medical care of closed soft-tissue injuries. (p 918)
3. Demonstrate how to control bleeding from an open soft-tissue injury. (pp 918–919)
4. Demonstrate the emergency medical care of an open abdominal wound. (pp 919–920)
5. Demonstrate how to stabilize an impaled object. (pp 920–921, Skill Drill 26-1)
6. Demonstrate how to care for a burn. (pp 931–932, Skill Drill 26-2)
7. Demonstrate the emergency medical care of a chemical, electrical, thermal, inhalation, or radiation burn. (pp 931–938)

Introduction

As an EMT, you will be regularly called to care for victims with soft-tissue injuries. These injuries can be as simple as a cut or scrape or as serious as a life-threatening internal injury. It is important to not allow yourself to become distracted by dramatic wounds and make the critical mistake of neglecting more life-threatening conditions such as airway obstructions. It is your responsibility as an EMT to assess and treat each of these injuries within the current standard of care guidelines.

The soft tissues of the body can be injured through a variety of mechanisms. A blunt injury occurs when the energy exchange between the patient and an object is more than the tissues can tolerate, as discussed in Chapter 24, *Trauma Overview*. While a blunt injury does not penetrate the skin, a penetrating injury occurs when an object, such as a bullet or knife, breaks through the skin and enters the body. Barotrauma, commonly seen in blast injury victims, refers to injuries that result from sudden or extreme changes in air pressure. Burns may also result in soft-tissue injuries.

Soft-tissue trauma is a common form of injury. Open wounds accounted for approximately 4.1 million emergency department (ED) visits in 2011. In fact, wound care is one of the most frequently performed procedures in EDs across the United States. Most of these injuries require basic interventions such as wound irrigation, dressing, bandaging, and limited suturing.

Death resulting from soft-tissue injury is often related to hemorrhage or infection. Uncontrolled hemorrhage can quickly lead to shock and death. When the skin barrier is breached, invading pathogens—bacteria, fungi, and viruses—can cause local or systemic infection. Infection can be life or limb threatening, especially in children, older adults, and people with diabetes or other conditions that may compromise the immune system.

Soft-tissue injuries and their associated complications can often be prevented by using simple protective actions. For example, wearing gloves when working with abrasive materials helps prevent skin injuries. To reduce injuries in the workplace, safety measures have been implemented that include the use of safety devices to prevent interaction between machine parts and body parts. Using plastic scissors, plastic knives, and plastic drinking cups at home will reduce the risk of cuts and other skin injuries among children. Effective strategies that have reduced injury and death from burns include using smoke alarms, controlling the temperature of hot water heaters, and enforcing building codes that regulate electrical and construction practices.

This chapter discusses the various types of soft-tissue injuries and the appropriate assessment and treatment of this classification of injuries.

Anatomy and Physiology of the Skin

The skin is our first line of defense against external forces and infection. It is also the largest organ in the body. Although it is relatively tough, skin is still quite susceptible to injury. Injuries to soft tissues range from simple bruises and abrasions to serious lacerations and amputations. Soft-tissue injury may result in exposure of deep structures such as blood vessels, nerves, and bones. In all instances, you must control bleeding, prevent further contamination to decrease the risk of infection, and protect the wound from further damage. Therefore, you must know how to apply dressings and bandages to various parts of the body.

YOU are the Provider — PART 1

You and your partner are standing by at the scene of a house fire when firefighters bring over a 45-year-old man who was rescued from the burning structure. The patient is wrapped in a blanket. He is conscious and alert, he is in severe pain, and his face is covered with soot.

1. What should be your most immediate priority?

2. What is a thermal burn? What are the causes of thermal burns?

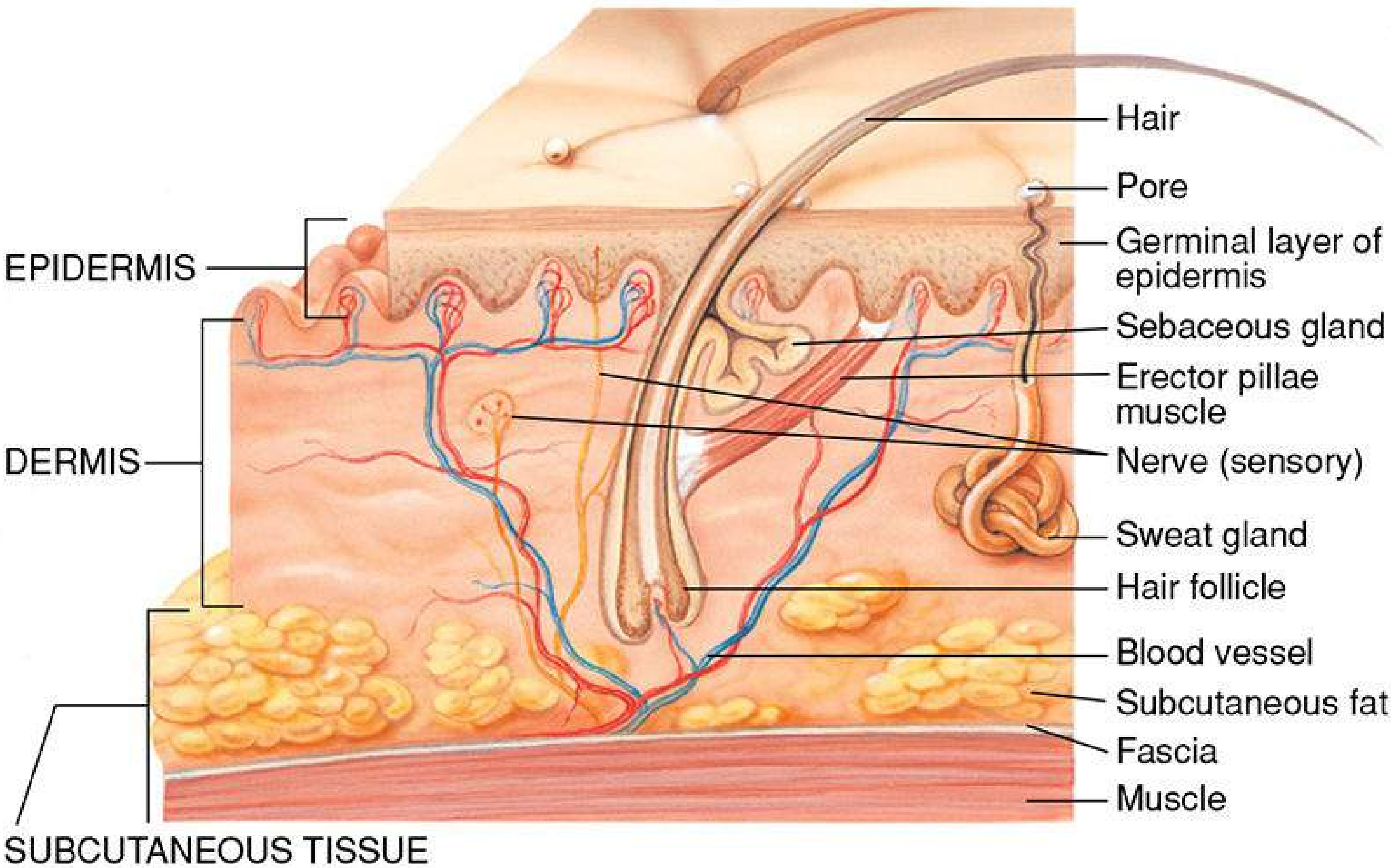


Figure 26-1 The skin comprises a tough external layer called the epidermis and a vascular inner layer called the dermis.

Skin varies in thickness, depending on a person's age and the area the skin covers. The skin of the very young and the very old is thinner than the skin of a young adult. The skin covering the scalp, the back, and the soles of the feet is quite thick, while the skin of the eyelids, lips, and ears is very thin. Thin skin is more easily damaged than thick skin.

Anatomy

The skin has two principal layers: the epidermis and the dermis **Figure 26-1**. The **epidermis** is the tough, external layer that forms a watertight covering for the body. The epidermis contains several layers. The cells on the surface layer of the epidermis are constantly worn away. They are replaced by cells that are pushed to the surface when new cells form in the germinal layer at the base of the epidermis. Deeper cells in the germinal layer contain pigment granules. Along with blood vessels in the dermis, these granules produce skin color.

The **dermis** is the inner layer of the skin. It lies below the germinal cells of the epidermis. The dermis contains the structures that give the skin its characteristic appearance: hair follicles, sweat glands, and sebaceous glands. The sweat glands' primary function is to cool the body. They discharge sweat onto the surface of the skin through small pores, or ducts, that pass through the epidermis. Sebaceous glands produce sebum, the oily material that waterproofs the skin and keeps it supple. Sebum travels to the skin's surface along the shaft of adjacent hair follicles. *Hair follicles* are small organs that produce hair. There is one follicle for each hair, each connected with a sebaceous gland and a tiny muscle. This muscle pulls the hair erect whenever a person is cold or frightened.

Blood vessels in the dermis provide the skin with nutrients and oxygen. Small branches reach up to the germinal cells, but blood vessels do not penetrate farther into the epidermis. There are also specialized nerve endings within the dermis.

The skin covers all external surfaces of the body. The various openings in the body, including the mouth, nose, anus, and vagina, are not covered by skin. Instead, these openings are lined with **mucous membranes**. Similar to skin, these membranes provide a protective barrier against bacterial invasion, but mucous membranes differ from skin in that they secrete a watery substance that lubricates the openings. Therefore, mucous membranes are moist, whereas skin is generally dry.

Physiology

The skin serves many functions. It protects the body by keeping pathogens out and fluids in, and it helps regulate body temperature. The nerves in the skin report to the brain on the environment and on many sensations. It is this nerve pathway connection that allows the body to adapt to environments through responses in the skin and surrounding tissues.

The skin is the body's major organ for regulating temperature. In a cold environment, the blood vessels in the skin constrict, diverting blood away from the skin and decreasing the amount of heat that radiates from the body's surface. In hot environments, the vessels in the skin dilate. The skin becomes flushed or red, and heat radiates from the body's surface. In addition, sweat glands secrete sweat to help cool the body. As the sweat evaporates from the skin's surface, the body temperature drops, and the person begins to cool down.

Any break in the skin allows bacteria to enter and increases the possibilities of infection, fluid loss, and loss of temperature control. Any one of these conditions can cause serious illness and even death. Soft tissues are often injured because they are exposed to the environment. There are three types of soft-tissue injuries:

- **Closed injuries**, in which soft-tissue damage occurs beneath the skin or mucous membrane but the surface of the skin or mucous membrane remains intact.
- **Open injuries**, in which there is a break in the surface of the skin or the mucous membrane, exposing deeper tissues to potential contamination.
- **Burns**, in which the soft-tissue damage occurs as a result of thermal heat, frictional heat, toxic chemicals, electricity, or nuclear radiation.

Pathophysiology of Closed and Open Injuries

Wounds heal in a natural process that involves several overlapping stages, all directed toward the larger goal of maintaining homeostasis or balance. Ultimately, the goal is for the body to return to a functional state, although the injured area may not always be restored to its preinjury state.

Among the primary concerns in wound healing is the cessation of bleeding. Loss of blood, internal or external, hinders the provision of vital nutrients and oxygen to the affected area. It also impairs the tissue's ability to eliminate wastes. The end result is abnormal or absent function, which interferes with homeostasis. To stop the flow of blood, the vessels, platelets, and clotting cascade must work in unison.

During inflammation (the next stage of wound healing), additional cells move into the damaged area to begin repair. White blood cells migrate to the area to combat pathogens that have invaded exposed tissue. Foreign products and bacteria are also removed from the body. Similarly, lymphocytes (a type of white blood cell) destroy bacteria and other pathogens. Mast cells release histamine as part of the body's response in the early stages of inflammation. Histamine dilates blood vessels, increasing blood flow to the injured area and resulting in a reddened, warm area immediately around the site. Histamine makes capillaries more permeable, and swelling may occur as fluid seeps out of these "leaky" capillaries. Inflammation ultimately leads to the removal of foreign material, damaged cellular parts, and invading microorganisms from the wound site.

In the outer layer of skin, cells are stacked in layers. To replace the area damaged in a soft-tissue injury, a new layer of cells must be moved into this region. This is the next stage of wound healing. Cells quickly multiply and redevelop across the edges of the wound. Except in cases of clean incisions, the appearance of the restructured area seldom returns to the preinjury state. For example, large wounds or injuries that result in significant disruption of the skin will often not complete this process. People with lightly pigmented skin may see a pink line of scar tissue signaling the presence of collagen, a structural protein that has reinforced the damaged tissue. Despite the changed appearance, the function of the area may be restored to near normal.

During the next stage of wound healing, new blood vessels form as the body attempts to bring oxygen and nutrients to the injured tissue. New capillaries bud from intact capillaries that lie adjacent to the damaged skin. These vessels provide a channel for oxygen and nutrients and serve as a pathway for waste removal. Because they are new and delicate, bleeding might result from a very minor injury. It may take weeks to months for the new capillaries to be as stable as preexisting vessels.

Collagen is a tough, fibrous protein found in scar tissue, hair, bones, and connective tissue. In the last stage of wound healing, collagen provides stability to the damaged tissue and joins wound borders, thereby closing the open tissue. Unfortunately, collagen cannot restore damaged tissue to its original strength.

Words of Wisdom

Wound healing does not always follow the pattern described. Infection or an abnormal scar may develop, excessive bleeding may occur, or healing may be slow.

Closed Injuries

Closed soft-tissue injuries are characterized by a history of blunt trauma, pain at the site of injury, swelling beneath the skin, and discoloration. Such injuries can vary from mild to quite severe.

A **contusion**, or bruise, is an injury that causes bleeding beneath the skin but does not break the skin. Contusions result from blunt forces striking the body. The epidermis remains intact, but cells within the dermis are damaged, and small blood vessels are usually torn. The depth of the injury varies, depending on the amount of energy absorbed. As fluid and blood leak into the damaged area, the patient may have swelling and pain. The buildup of blood produces a characteristic blue or black discoloration called **ecchymosis** **Figure 26-2**.

A **hematoma** is blood that has collected within damaged tissue or in a body cavity **Figure 26-3**. A hematoma occurs whenever a large blood vessel is damaged and bleeds rapidly. It is usually associated with extensive tissue damage. A hematoma can result from a soft-tissue injury, a fracture, or any injury to a large blood vessel. In severe cases, the hematoma may contain more than a liter of blood.

A **crushing injury** occurs when significant force is applied to the body **Figure 26-4**. The extent of the damage depends on how much force is applied and how long it is applied. In addition to causing direct soft-tissue damage, continued compression of the soft tissues cuts off circulation, producing further tissue destruction. For example, if a patient's legs are trapped under a collapsed pile of rocks, damage to the leg tissues will continue until the rocks are removed.

When an area of the body is trapped for longer than 4 hours and arterial blood flow is compromised, **crush syndrome** can develop. When a patient's tissues are crushed beyond repair, muscle cells die and release harmful substances into the surrounding tissues. The oppressing force prevents blood from returning to the injured body part, so these harmful substances are released into the body's circulation *after* the limb is freed and blood flow is returned. For this reason, when possible, advance life support (ALS) providers should administer IV fluid *before* the crushing object is lifted off the body. Freeing the limb or other body part from entrapment not only results in the release of the by-products of metabolism and harmful products of tissue destruction, but it also creates the potential for cardiac arrest and renal failure. Consider requesting ALS assistance for situations of prolonged entrapment prior to extrication.

Figure 26-2 Contusions, more commonly known as bruises, occur as a result of a blunt force striking the body. The characteristic blue or black discoloration (ecchymosis) signifies bleeding underneath the skin.

Compartment syndrome develops when edema and swelling result in increased pressure within a closed soft-tissue compartment. Because tissues are limited in the amount they can stretch or expand, pressure increases within the compartment, which in turn interferes with circulation. Compartment syndrome commonly develops in the extremities and may occur in conjunction with open or closed injuries or when swelling occurs under restrictive immobilization devices such as a cast. As pressure develops, delivery of nutrients and oxygen is impaired and by-products of normal metabolism accumulate. This causes pain, especially on passive movement. Signs of impaired circulation may also be present. The longer this situation persists, the greater the chance for tissue death. Continually reassess skin color, temperature, and pulses distal to the injury site during transport if crush injury is suspected.

Figure 26-3

A hematoma develops whenever a large blood vessel is damaged and bleeds rapidly.

Courtesy of Rhonda Hunt.

Figure 26-4 The damage associated with a crush or compression injury varies depending on the direct damage to the soft tissues and how long the tissue was cut off from circulation.

Severe closed injuries can also damage internal organs. The greater the amount of energy absorbed from the blunt force, the greater the risk of injury to deeper structures. Therefore, you must assess all patients with closed injuries for more serious hidden injuries. Remain alert for signs of shock or internal bleeding, and begin treatment of these conditions if necessary.

Open Injuries

Open injuries differ from closed injuries in that the protective layer of skin is damaged. This can produce extensive bleeding.

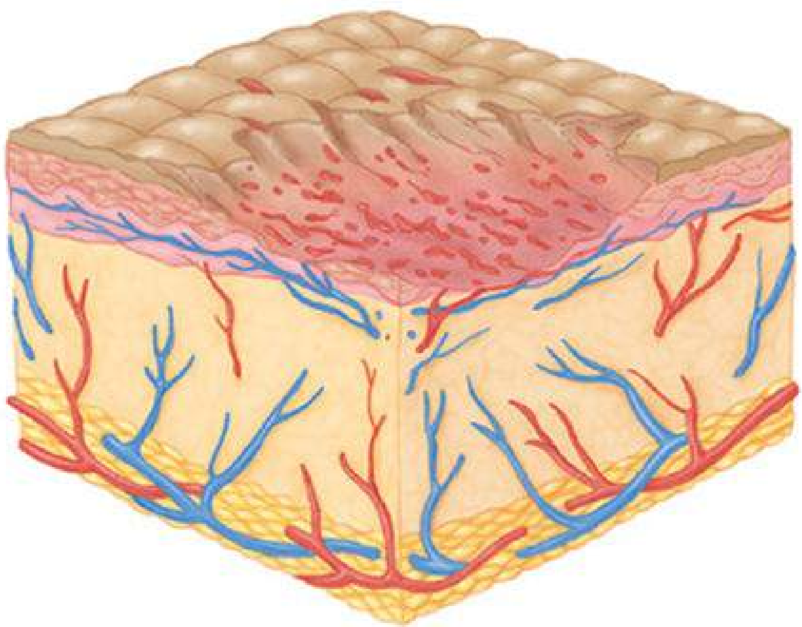
More important, a break in the protective skin layer or mucous membrane means the wound is contaminated and may become infected. **Contamination** is the presence of infectious organisms (pathogens) or foreign bodies, such as dirt, gravel, or metal, in the wound. You must address excessive bleeding and contamination in your treatment of open soft-tissue wounds. There are four types of open soft-tissue wounds that you must be prepared to manage:

- Abrasions
- Lacerations
- Avulsions
- Penetrating wounds

An **abrasion** is a wound of the superficial layer of the skin, caused by friction when a body part rubs or scrapes across a rough or hard surface. An abrasion usually does not penetrate completely through the dermis, but blood may ooze from the injured capillaries in the dermis. Also known as road rash, road burn, strawberry, and rug burn, abrasions can be extremely painful because the nerve endings are located in this area **Figure 26-5**.

A **laceration** is a jagged cut in the skin caused by a sharp object or a blunt force that tears the tissue, whereas an **incision** is a sharp, smooth cut. The depth of the injury can vary, extending through the skin and subcutaneous tissue, even into the underlying muscles and adjacent nerves and blood vessels **Figure 26-6**. Lacerations and incisions may appear linear (regular) or stellate (irregular) and may occur along with other types of soft-tissue injury. Lacerations or incisions that involve arteries or large veins may result in severe bleeding.

A



B

Figure 26-5 Abrasions usually do not penetrate completely through the dermis, but blood may ooze from the capillaries. These wounds are typically superficial and result from rubbing or scraping across a hard, rough surface.

An **avulsion** is an injury that separates various layers of soft tissue (usually between the subcutaneous layer and **fascia**) so they become either completely detached or hang as a flap **Figure 26-7**. Often there is significant bleeding. If the avulsed tissue is hanging from a small piece of skin, the circulation through the flap may be at risk. If you can, replace the flat avulsed flap in its original position as long as it is not visibly contaminated with dirt and/or other foreign materials. If an avulsion is complete, you should wrap the separated tissue in sterile gauze and take it with you to the ED. This type of avulsion often poses serious infection concerns. Never remove an avulsion skin flap, regardless of its size.

Figure 26-6 Lacerations vary in depth and can extend through the skin and subcutaneous tissue to the underlying muscles, nerves, and blood vessels. These wounds can be smooth or jagged depending on the object that caused the injury.

An **amputation** is an injury in which part of the body is completely severed. Chapter 31, *Orthopaedic Injuries*, covers this topic in detail. We usually think of amputations as involving the upper and lower extremities. But other body parts, such as the scalp, ear, nose, penis, or lips, may also be totally avulsed, or amputated. You can easily control the bleeding from some amputations, such as the fingers, with direct pressure and pressure dressings. If an amputation involves a large area of muscle mass, such as a thigh, there may be massive bleeding. In this situation, you should stop the bleeding, which often requires a tourniquet, and treat the patient for hypovolemic shock. See Chapter 25, *Bleeding*.

A **penetrating wound** (or puncture wound) is an injury resulting from a piercing object, such as a knife, ice pick, splinter, or bullet. Such objects leave relatively small entrance wounds, so there may be little external bleeding **Figure 26-8**. However, these objects can damage structures deep within the body and cause unseen bleeding. If the wound is to the chest or abdomen, the injury can cause rapid, fatal bleeding. Assessing the amount of damage a puncture wound has created is very difficult and is reserved for the physician at the hospital.

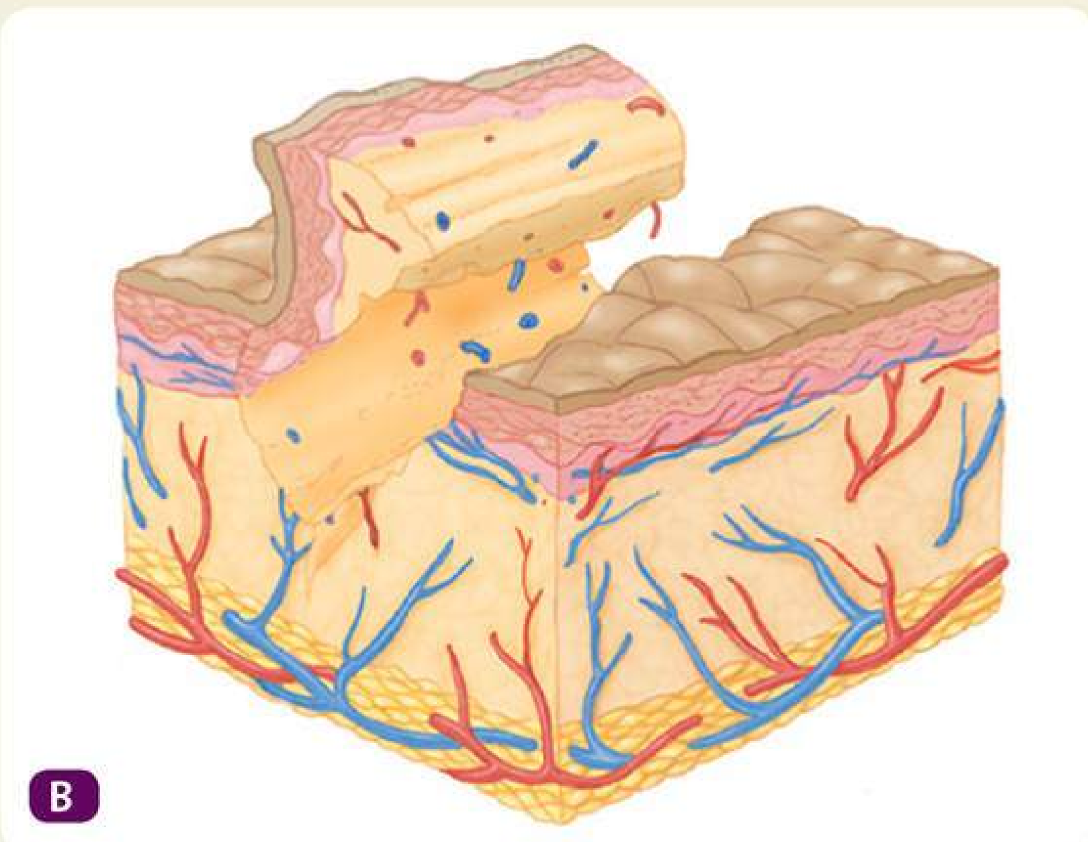


Figure 26-7 Avulsions are injuries characterized by complete separation of tissue or tissue hanging as a flap. Significant bleeding is common.

Objects that penetrate the skin but remain in place are referred to as **impaled objects**. The concerns with this type of injury include the amount of damage to structures deep inside the body and the presence of foreign materials deep inside the tissue. The damage to underlying structures is difficult to determine and manage, and the presence of foreign materials inside the tissue results in a significantly higher risk of infection. An impaled object also requires specific treatments and care, described later in this chapter.

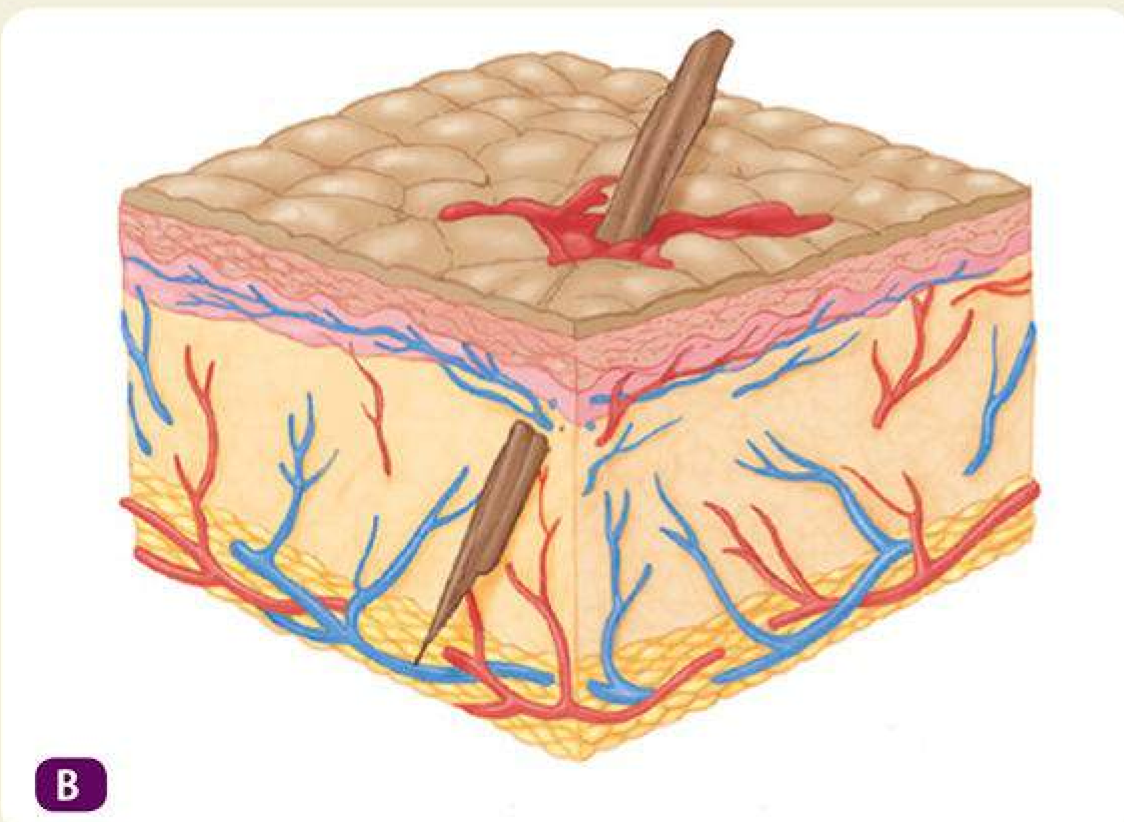


Figure 26-8 Penetrating wounds and impaled objects may cause very little external bleeding but can damage structures deep within the body.

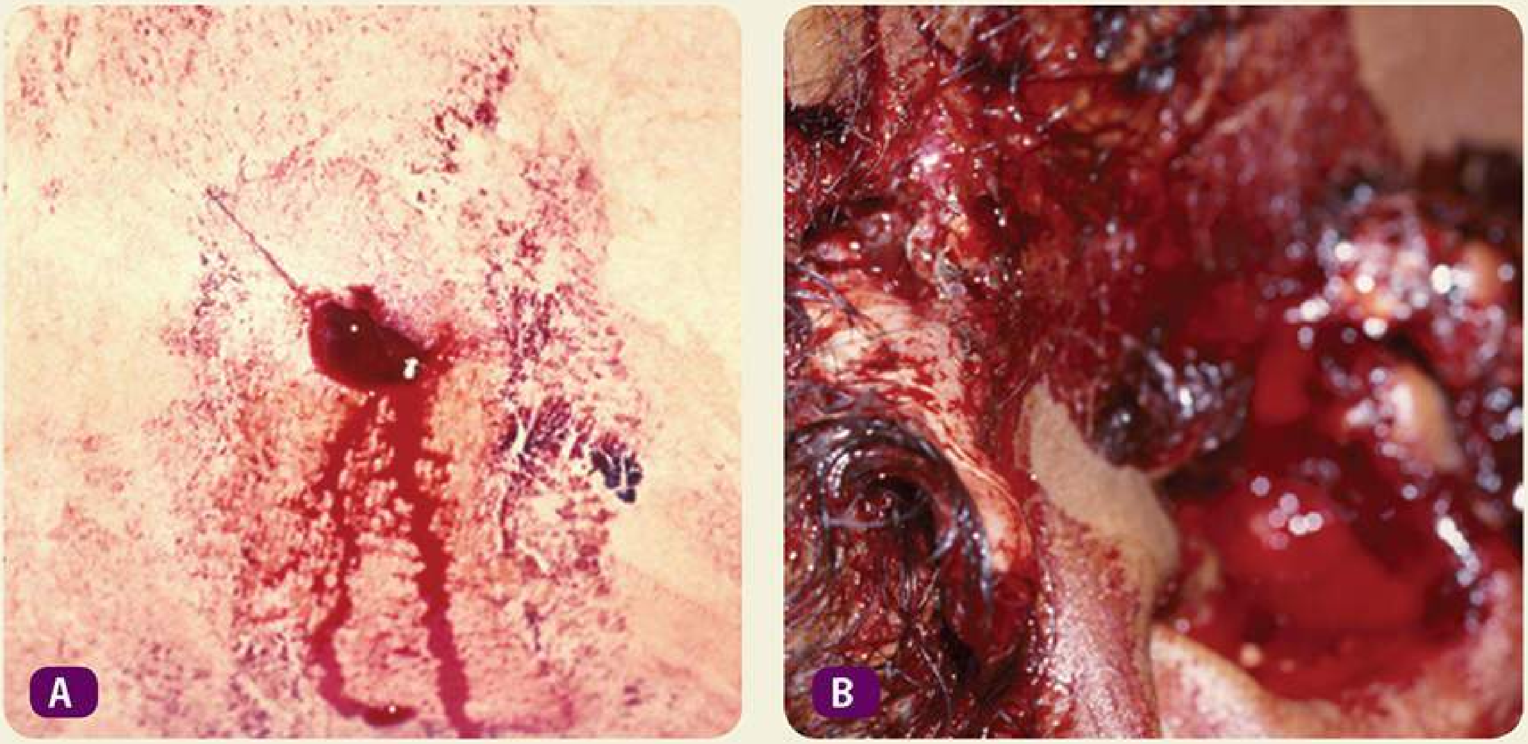


Figure 26-9 **A.** An entrance wound from a gunshot may have burns around the edges. **B.** An exit wound is often larger than an entrance wound and is associated with greater damage to soft tissues locally.

A: © Chuck Stewart, MD; B: © D. Willoughby/Custom Medical Stock Photography.

Words of Wisdom

Treat all penetrating wounds of the neck, chest, back, and upper abdomen with an occlusive dressing to prevent the possible movement of air into the vascular space, thoracic cavity, and/or abdominal cavity.

Words of Wisdom

Do not spend time trying to distinguish between an entrance and an exit wound. Find the wounds and treat them, but be aware of the number of wounds overall and the relative location of each.

Stabbings and shootings often result in multiple penetrating injuries. You must assess these patients carefully to identify all wounds. Since a penetrating object can pass completely through the body, always count the number of penetrating injuries (or holes), especially with gunshot wounds. Knowing the difference between entrance wounds and exit wounds may be difficult in a prehospital setting, especially with the different types of ammunition available. While entrance wounds are often smaller than exit wounds **Figure 26-9**, it is better to simply count the number of penetrating injuries, and leave the distinction between entrance and exit to the physician who is working in a more controlled environment. Gunshot wounds have some unique characteristics that require special care. The amount of energy transmitted by a gunshot injury is directly related to the speed of the bullet. When possible, determine the type of gun used in the shooting, but do not let this delay patient transport. Sometimes, the patient or bystanders can tell you how many rounds were fired, but given the stress of the environment their information may be unreliable; however, it may help hospital personnel to better care for the patient.

Shotgun wounds create multiple paths of missiles (shot) and create a larger surface area and volume of tissue damage.

Many cases involving shootings go to court at some point, and you may be called to testify. Therefore, you must carefully document the circumstances surrounding any gunshot injury, the patient's condition, and the treatment you give.

As with closed wounds caused by crushing, open wounds caused by crushing may involve damaged internal organs or broken bones, as well as extensive soft-tissue damage **Figure 26-10**. Whereas external bleeding may be minimal, internal bleeding may be severe, or even life threatening. The crushing force damages soft tissues as well as vessels and nerves. This frequently results in a painful, swollen, deformed area.

Blast injuries, as discussed in Chapter 24, *Trauma Overview*, may also result in multiple penetrating injuries. The mechanism of injury (MOI) from a blast is generally due to three factors:

- **Primary blast injury:** Injuries to the body caused by the blast wave itself; damage to the body is caused by the sudden pressure changes generated by the explosion.
- **Secondary blast injury:** Injuries caused to the body from being struck by flying debris, propelled by the force of the blast. These small objects may cause multiple penetrating wounds.
- **Tertiary blast injury:** Injuries to the body from being thrown or hurled by the force of the explosion into an object or onto the ground.

It is very important to conduct a complete primary and secondary assessment to determine what types of injuries are sustained from a blast injury and treat appropriately.

Figure 26-10 A crushing open wound is characterized by extensive tissue damage and deformity that is often accompanied by swelling and extreme pain.

Courtesy of Andrew N. Pollak, MD, FAAOS.

Patient Assessment of Closed and Open Injuries

Assessing closed injuries is much more difficult than assessing open injuries. Therefore, anytime you observe bruising, swelling, or deformity, or the patient reports pain, the possibility of a closed injury should be considered.

Assessing an open injury is generally easier than assessing a closed injury because you can see the injury. Open wounds are defined as injuries in which there is a break in the surface of the skin or the mucous membrane, exposing deeper tissues to potential contamination. You must use caution to avoid letting a patient's non–life-threatening gruesome injury distract you from recognizing another injury that is considered life threatening.

Words of Wisdom

Extremities that are painful, swollen, or deformed should be splinted. When you splint these types of injuries, remember to assess the patient's pulses and motor, and sensory functions before and after applying the splint. You should also evaluate the mechanism of injury (MOI). Because diffuse or generalized soft-tissue injuries can be life threatening, all patients with a significant MOI should be considered to have internal bleeding and shock until proven otherwise by the ED staff.

Scene Size-up

As you arrive on scene, observe the scene for hazards and threats to the safety of the crew, bystanders, and the patient. Assess the impact of hazards on patient care and address the hazards. As always, ensure the scene is safe and consider the need for additional resources.

Ensure that you and your crew have taken the necessary standard precautions before you approach the scene—a minimum of gloves and eye protection. Eye exposures may occur from splashes and droplets at a busy scene. Eye protection is required when managing open injuries to avoid potential splashing. Place several pairs of gloves in your pocket for easy access in case your gloves tear or there are multiple patients with bleeding.

Open soft-tissue injuries can be very messy but should not take priority over more serious life-threatening injuries. Controlling bleeding and bloody contaminants can be difficult because of the nature of the wounds. Be very careful where you put your hands or place your equipment and how you package the patient for transport. Because of the color of blood and how well it soaks through clothing, you can often identify patients with an open injury as you approach the scene. However, blood can be hidden under thick, dark clothing, such as denim and leather, or in the environment, such as sand, grass, or carpeting. Do not spend time trying to estimate blood loss; focus on controlling the bleeding.

Words of Wisdom

With blunt and penetrating injuries, the MOI may provide insight into the potential damage underneath the skin that may not be immediately evident during your physical assessment.

As you observe the scene, look for indicators of the MOI. This helps you develop an early index of suspicion for underlying injuries in a patient who has sustained a significant MOI. Remember, the MOI alone does not necessarily describe the true extent of injuries but it helps you understand the potential for injury. When you put together information from dispatch and your observations of the scene, consider how the MOI produced the injuries expected. Remember, medical emergencies may result in trauma, so there may be conditions to consider beyond the traumatic injuries. Your interactions with the patient and your assessment will ultimately provide you with additional information about the extent of the actual injuries. For example, in a vehicle crash, a patient who has sustained abrasions and lacerations to the face from an impact with the steering wheel or windshield may have experienced enough force to injure the cervical spine as well. In this case and in many trauma situations, spinal immobilization should be maintained throughout your care of the patient. The MOI may also provide information about potential safety threats. For example, gunshot wounds may indicate the presence of an angry and violent offender in the area or a dangerous scene. Make sure you use all available information to evaluate scene safety and consider whether additional resources may be necessary.

Primary Assessment

The primary assessment for a patient with a closed or open injury should focus on identifying and managing life-threatening concerns and identifying transport priority.

Your general impression will help you develop an index of suspicion for serious injuries and determine how urgently your patient needs care. As you approach the patient, important indicators will alert you to the seriousness of the patient's condition, such as:

YOU are the Provider — PART 2

The patient is ambulatory, so you immediately move him to the ambulance that is parked a short distance away and complete your primary assessment. Your partner obtains additional information from the firefighters who rescued him.

Recording Time: 2 Minutes	
Appearance	Shivering; in obvious pain
Level of consciousness	Conscious and alert

Airway	Open; clear of secretions or foreign bodies
Breathing	14 breaths/min; adequate depth; unlabored
Circulation	Increased pulse rate; strong at the radial site; no obvious bleeding

You apply high-flow oxygen via a nonrebreathing mask and then carefully remove clothing that is not adhered to his skin so you can assess the severity of his burns.

3. What additional information should you obtain from the firefighters who rescued the patient?
4. How are thermal burns classified? What are the characteristics of each type of burn?

- Is the patient awake and interacting with his or her surroundings, or lying still and not making sounds?
- Is he or she appropriately or inappropriately responding to you?
- Is the patient's breathing pattern rapid or slow, deep or shallow?
- What is the color and condition of the patient's skin?
- Does the patient have any apparent life threats?

The answers to these questions contribute to your general impression and help to determine your treatment priorities and the urgency of care needed. A good question to ask yourself is, "How sick is my patient based on what I know right now?"

Closed soft-tissue injuries may appear to be minor; however, they may indicate serious internal injuries. For example, a patient with a hematoma on the head and a decreased level of consciousness may have a serious brain injury. Open injuries may be obvious and significant, likely indicating a serious condition. However, other injuries may not be as obvious but may still indicate a serious condition.

Words of Wisdom

It is easy to become distracted when a patient has significant soft-tissue injuries, there is a large amount of blood, or the patient is frightened or screaming. However, this is when you need to focus on the problems at hand and follow the protocols you have learned.

Check for responsiveness. If the patient is alert, ask about the chief complaint to help direct you to any apparent life threats. If the patient is not alert, determine if he or she responds to verbal or painful stimuli or if he or she is unresponsive. An unresponsive patient may indicate a life-threatening condition. Administer high-flow oxygen via a nonrebreathing mask to patients whose level of consciousness is less than alert and oriented, treat for potential shock, and provide immediate transport to the ED.

If significant trauma has likely affected multiple body systems, start with a rapid exam of the patient to be sure you have found all of the problems and injuries. A rapid 60- to 90-second exam may identify factors that assist you in determining whether a patient requires rapid transport. Begin with the head and neck while manually holding the head in place. When you are done, apply a cervical collar if it is indicated.

When performing the rapid exam, look for life threats and treat them as you find them. Significant bleeding is an immediate life threat and must be controlled quickly using appropriate methods. A patient with massive hemorrhage may require a tourniquet (or direct pressure dressings if tourniquets are not available) *before* the airway is opened. If the patient has obvious life-threatening external bleeding, control the bleeding first (even *before* airway and breathing), then assess and treat the ABCs, and provide treatment for shock.

Words of Wisdom

As you consider the MOI and form suspicions about where bleeding is occurring, expose that part of the body. Blood flowing freely from veins in a large gash can be as much of a threat as blood spurting from an artery.

Providing high-flow oxygen may help reduce the effects of shock and assist in perfusion of damaged tissues, particularly in crush injuries. If the patient has signs of hypoperfusion, treat aggressively for shock: place the patient supine, prevent heat loss with a blanket, and provide rapid transport to the hospital. Request ALS as necessary to assist with more aggressive shock management.

Ensure the patient has a clear and patent airway. If the airway is not patent, take the necessary steps to make it clear and patent. Protect the patient from further spinal injury as you manage the airway by preventing the head and torso from moving. If the patient is unresponsive or has a significantly altered level of consciousness, consider inserting an oropharyngeal airway or nasopharyngeal airway and suction the airway as needed.

You must quickly assess the patient for adequate breathing. Inspect and palpate the chest wall for DCAP-BTLS. If a soft-tissue injury is discovered on the chest or abdomen, auscultate for clear and symmetric breath sounds, and look at the structure of the chest wall to ensure equal expansion and rise and fall of the chest. Then provide high-flow oxygen, or provide assisted ventilations using a bag-valve mask (BVM) as needed, depending on the level of consciousness and if your patient is breathing inadequately.

Open soft-tissue injuries of the face and neck have a potential to interfere with the effectiveness of the airway and breathing. Evaluate the patient's voice and ability to speak to identify throat injuries. If an open injury is found on the chest, evaluate for air movement through the wound in the form of bubbling or sucking sounds, which indicate a deep penetrating injury. Assess the patient's back for injuries that might need treatment as well. Quickly place an occlusive dressing over the wound. Provide high-flow oxygen or assisted ventilations with a BVM as needed, depending on the patient's level of consciousness and on the adequacy of the patient's breathing. Monitor the patient for signs of increasing respiratory distress that may require you to relieve pressure built up under the dressing (caused by a pneumothorax).

Quickly assess the patient's pulse rate, rhythm, and quality; determine the skin condition, color, and temperature; and check the capillary refill time. These assessments will help you determine the presence of circulatory problems or shock. Closed soft-tissue injuries may not always have visible signs of bleeding because most of the bleeding is occurring inside the body. Your assessment of the pulse and skin will indicate how aggressively you need to treat your patient for shock.

Determine whether your patient needs immediate transport or stabilization on scene. If the patient you are treating has an airway or breathing problem or signs and symptoms of shock or internal bleeding, you must consider rapid transport to the hospital for treatment or request ALS support. Also, if you identify conditions that have the potential to become unstable, such as a distended abdomen or femur fractures, the patient requires rapid and immediate transport.

You should also consider whether transport to the closest hospital is appropriate or whether the patient would be better served by transport to a trauma center that might be farther away. In some situations it may be appropriate to request aeromedical transport to expedite transfer to a trauma or specialty center. Each consideration requires that you clearly and completely understand your local resources and protocols.

Most patients do not require immediate load-and-go transportation, but there are certain conditions for which treatment is limited in the field, and, therefore, immediate transport is the better choice. The following list will help guide you in determining the types of patients that need immediate transportation:

- Poor initial general impression
- Altered level of consciousness
- Dyspnea
- Abnormal vital signs
- Shock
- Severe pain

Do not delay transport of a seriously injured trauma patient to complete nonlifesaving treatments in the field, such as splinting extremity fractures or treating minor bleeding such as abrasions; instead, complete these types of treatments en route to the hospital during the secondary assessment.

YOU are the Provider — PART 3

The patient tells you he sustained the burns when he was trying to escape from the burning house. Both of the exits were blocked by fire and debris, so he ran into the bedroom. However, he was unable to exit through the window because of burglar bars he had installed; this was when the firefighters found him. He denies losing consciousness. Your partner assesses his vital signs as you perform a secondary assessment.

Recording Time: 6 Minutes	
Respirations	14 breaths/min; adequate depth; unlabored
Pulse	108 beats/min; strong and regular
Skin	Red, warm, and dry; burns to the torso and arms
Blood pressure	166/86 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)

Your secondary assessment reveals partial-thickness burns to his anterior chest and abdomen, and partial- and full-thickness burns to both of his arms, including his hands. His face is covered with soot, and his facial hair and the hair just above his hairline are singed. You do not see any obvious skin burns to his facial area, and the remainder of your assessment does not reveal any other injuries. The patient denies having difficulty breathing or any other symptoms other than pain.

5. What percentage of the patient's body surface area has been burned?
6. What factors should you consider to determine the severity of a burn?

Patients who have visible significant bleeding or signs of significant internal bleeding may quickly become unstable. Stay alert for signs of hypoperfusion (tachycardia; tachypnea; weak pulse; cool, moist skin) and reassess your priority and transport decision if they develop.

History Taking

After you manage life threats during the primary assessment, investigate the chief complaint or history of present illness. Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives such as no pain or loss of sensation.

Make every attempt to obtain a SAMPLE history from your patient. Using OPQRST may provide some background on isolated extremity injuries. When you use SAMPLE, OPQRST, and DCAP-BTLS together, your assessment will be well-rounded and provide significant insight into the patient's condition. You have the opportunity to interview the patient well before the ED physician's examination. Any information you receive will be very valuable if the patient loses consciousness.

If the patient is not responsive, attempt to obtain the history from other sources, such as friends, family members, or even bystanders who might have witnessed the event. Medical identification jewelry and cards in wallets may also provide information about the patient's medical history or alert you to the presence of implanted medical devices. While these items may not seem significant, they can provide information about the patient's underlying medical conditions. This information, in conjunction with the physical assessment, may help provide an overview of the patient's overall status.

Typical signs of an open injury include bleeding, a break in the skin, shock, hemorrhage, and disfigurement or loss of a body part. Typically, symptoms include pain and/or burning at the injury site. Chronic medical conditions such as anemia (low quantity of hemoglobin in the blood) and hemophilia (a disorder in which blood has a diminished ability to clot) as well as a host of other medical conditions can complicate open soft-tissue injuries. Medications, such as aspirin or others that impair the blood's ability to clot and are frequently taken by older patients, may make it more difficult to control bleeding.

Secondary Assessment

After you evaluate ABCs and identify and treat immediate life threats, a more detailed assessment should follow. The secondary assessment is a more systematic full-body scan or focused examination of the patient that is used to reveal injuries or medical conditions that may have been missed during the primary assessment. In some instances, such as with a critically injured patient or a short transport time, you may not have time to conduct a full secondary assessment. Typically, the secondary assessment, which includes assessing interventions and repeating vital signs, occurs en route to the ED.

Listen to breath sounds with a stethoscope. Breath sounds should be clear and equal bilaterally, anteriorly, and posteriorly. Determine the patient's respiratory rate and note the pattern and quality of the respiratory effort. Assess for asymmetric chest wall movement.

Assess the neurologic system to gather baseline data on your patient. This examination should include the level of consciousness, pupil size and reactivity, and motor and sensory response.

Assess the musculoskeletal system by performing a detailed exam of the entire body. Look for DCAPBTLS. Assess the chest, abdomen, and extremities for hidden bleeding and injuries. Log roll the patient, and assess the posterior torso for injuries. Once the back has been assessed, the patient can be log rolled back down onto a backboard, followed by complete spinal immobilization if indicated. Log rolling and securing the patient to a backboard or other full-body immobilization device should take into consideration injuries found during the primary assessment as well as local protocols.

Assess all anatomic regions, looking for the following signs/symptoms:

- Check the neck for jugular vein distention and tracheal deviation. Be alert for patients with a stoma or tracheostomy.
- Check the pelvis for stability.
- Check the abdomen; feel all four quadrants for tenderness rigidity, and inspect for bruising. If the abdomen is tender, expect internal bleeding.
- Check the extremities, and record pulse, motor, and sensory function.

Patients who have hidden internal injuries under a closed soft-tissue injury may have internal bleeding and may rapidly become unstable. It is important to reassess the vital signs to identify how quickly the patient's condition is changing; a single vital sign will not always provide the necessary information to evaluate the patient's condition. Make sure you obtain a series of vital signs to ensure subtle changes are evident as soon as possible. Signs such as tachycardia, tachypnea, low blood pressure, weak pulse, and cool, moist, and pale skin indicate hypoperfusion and imply the need for rapid transport and treatment at the hospital. Remember that soft-tissue injuries, even without a significant MOI, can cause shock. The reassessment of your patient's vital signs will give you a good understanding of how well or how poorly your patient is tolerating the injury and whether your interventions have been effective.

Reassessment

Reassessment of a patient is just as important as your original assessment and should be regularly conducted during transport to ensure your patient's condition is not declining. Repeat the primary assessment completely, but pay extra attention to areas of concern that you identified during your initial assessment and assess the effectiveness of prior treatments. Reassess vital signs and the chief complaint. Are the airway, breathing, and circulation still adequate? Recheck patient interventions. Are the treatments you provided for problems with the ABCs still effective? Reassessing a patient with an open soft-tissue injury is extremely important, especially if you did not put the bandage on the patient's injury. Frequently, other emergency care personnel may have dressed and bandaged the wound before your arrival. You may need to place additional dressings over the original dressing or bandages. If so, frequently reassess the effectiveness of the bandaging. If blood continues to soak through bandages, use additional methods to control bleeding as discussed later in the chapter. How is the patient's condition improving with the interventions? Identify and treat changes in the patient's condition.

Closed soft-tissues injuries can be life threatening if not appropriately treated. Assess and manage all threats to the patient's airway, breathing, and circulation. Supplemental oxygen is commonly given to all patients with traumatic injuries impacting airway or ventilation or those with a potential for shock via a nonrebreathing mask.

Although most open soft-tissues injuries are not serious, they tend to be graphic and can be distracting to the patient. If not appropriately treated, they can lead to substantial blood loss and even shock. By appropriately treating open soft-tissue injuries, you can decrease the risk of common complications such as bleeding, shock, pain, and infection. Expose all wounds, control bleeding, and be prepared to treat the patient for shock. Consider flushing small wound surfaces *without* significant bleeding with sterile saline prior to applying a dressing. If any material is "stuck" in the wound, do not remove it as this may worsen bleeding and shock.

Extremities that are painful, swollen, or deformed should be splinted. Take great care when splinting these types of injuries. If done correctly, splinting can actually assist with pain management and bleeding control, but if done poorly may cause greater harm. When splinting these types of injuries, remember to assess the patient's pulse, motor, and sensory functions distal to the injury zone both before and after applying the splint.

YOU are the Provider — PART 4

After caring for the patient's burns, you cover him with a blanket and begin transport to the hospital. You contact medical control as soon as you leave the scene, and you are advised to provide transport to the emergency department because the closest burn center is 75 miles away. You reassess the patient, including his vital signs.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert, but anxious
Respirations	22 breaths/min; becoming labored; voice is becoming hoarse
Pulse	120 beats/min; strong and regular
Skin	Red, warm, and dry
Blood pressure	158/84 mm Hg
Spo_2	95% (on oxygen)

7. What is the proper treatment for the patient's burns?
8. How has the patient's condition changed? What should you do now?

Words of Wisdom

Estimating blood loss is very difficult and even the most skilled providers are often not able to accurately estimate blood loss, especially when blood has been absorbed into fabrics or porous surfaces. Note that blood has soaked through a towel, an article of clothing, or the number of bandages used to control the patient's bleeding as these are valuable descriptors for the ED staff.

Your communication and documentation must include a description of the MOI and the position in which you found the patient when you arrived on scene. This will provide key information to the hospital staff that may impact the patient care plan provided at the hospital. You should attempt to report blood loss using terms that you are comfortable with and that will be easily understood by other personnel. For example, you may say "the bleeding soaked through the patient's jeans prior to our arrival" or "the bleeding has soaked through three trauma dressings during our time with the patient." Include the location and description of any soft-tissue injuries or other wounds you have located and treated. Describe the size and depth of the injury. Provide an accurate account of how you treated these injuries. Your ability to clearly and accurately communicate and document enables the physicians and nurses at the hospital to continue to deliver quality care.

Emergency Medical Care for Closed Injuries

Small contusions generally do not require special emergency medical care, but you should note their presence when trying to determine the true extent of the patient's injuries. More extensive closed injuries may involve significant swelling and bleeding beneath the skin, which could lead to hypovolemic shock. Depending on the time the injury occurred and the response time, the injuries might not have had time to cause swelling or bruising. Closely watch any area of injury throughout the time you are caring for the patient, no matter how minor it may look upon initial assessment.

Treat a closed soft-tissue injury by applying the mnemonic RICES:

- **Rest.** Keep the patient as quiet and comfortable as possible.
- **Ice.** Use ice or cold packs to slow bleeding by causing blood vessels to constrict and also to reduce pain.
- **Compression.** Apply pressure over the injury site to slow bleeding by compressing the blood vessels.
- **Elevation.** Raise the injured part just above the level of the patient's heart to decrease swelling.
- **Splinting.** Immobilize a soft-tissue injury or an injured extremity to decrease bleeding and reduce pain.

In addition to using these measures to control bleeding and swelling, you should also be alert for signs of developing shock. Look for anxiety or agitation and changes in mental status as these can be early signs of developing shock. An increased heart rate, increased respiratory rate, diaphoresis, cool or clammy skin, and eventual decreases in blood pressure may not develop until late in your care of the patient. Any or all of these signs may indicate internal bleeding resulting from injuries to internal organs. If the patient exhibits signs and symptoms of shock, treat accordingly and aggressively.

Emergency Medical Care for Open Injuries

Before you begin caring for a patient with an open wound, be sure to protect yourself by following standard precautions. If life-threatening bleeding is observed, assign a team member to apply direct pressure over the wound to control the bleeding. Then assess the severity of the wound. If the wound is in the chest, upper abdomen, or upper back, cover it with an occlusive dressing.

Words of Wisdom

While most wounds are simple and can be managed with direct pressure, do not spend time trying to use pressure, elevation, and pressure dressings on a wound that is hemorrhaging profusely. Apply a tourniquet early when there is massive hemorrhage to rapidly stop bleeding, avoid further blood loss, and allow you to quickly focus on providing other treatments for shock.

Your treatment priorities are the primary assessment and to begin lifesaving interventions. This includes controlling the bleeding, which can be extensive and severe. Several methods are available to control open injuries or external bleeding. Start with the most commonly used; these include the following:

- Direct, even pressure and elevation
- Pressure dressings and/or splints
- Tourniquets

It will often be useful to combine these methods. Different types of tourniquets are shown in **Figure 26-11**.

All open wounds are assumed to be contaminated and present a risk of infection. By applying a sterile dressing, you are reducing the risk of further contamination. This keeps foreign material, such as hair, clothing, and dirt, out of the wound and decreases the risk of infection. In general, you should not remove material from an open wound, no matter how dirty the wound is. Rubbing, brushing, or washing an open wound can cause additional bleeding, but small wound surfaces without significant bleeding can be flushed with sterile saline prior to applying a dressing. Chemical burns and contamination should be flushed to remove remaining chemicals. In most circumstances, hospital personnel, rather than EMTs, will clean open wounds. To prevent a wound from drying, you may apply sterile dressings moistened with sterile saline solution and then cover the moist dressing with a dry, sterile dressing.

In some cases, you can better control bleeding from open soft-tissue wounds by splinting the extremity, even if there is no fracture. Splinting can help you keep the patient calm and quiet, as it typically reduces pain. Splinting also keeps sterile dressings in place, minimizes damage to an already injured extremity, and makes it easier to move the patient.

Words of Wisdom

Hypovolemic shock is a risk for any patient who has had significant bleeding or bleeding that cannot be controlled. Be alert for this potential and treat aggressively to reduce the risk.

Figure 26-11 If bleeding continues or recurs, apply a tourniquet above the site of bleeding in an extremity–preferably the groin for leg wounds and the axilla for arm wounds. **A.** A CAT tourniquet. **B.** An EMT tourniquet. **C.** A SOF-T tourniquet.

A, C: Courtesy of Peter T. Pons, MD, FACEP; B: Courtesy of Delfi Medical Innovations, Inc.

Abdominal Wounds

An open wound in the abdominal cavity may expose internal organs. In some cases, the organs may even protrude through the wound, an injury called an **evisceration** **Figure 26-12**. Do not touch or move the exposed organs. Instead, cover the wound with sterile gauze moistened with sterile saline solution and secure with an occlusive dressing **Figure 26-13**. Because the open abdomen radiates body heat very effectively and quickly, and because exposed organs lose fluid rapidly, you must keep the organs moist and warm. If you do not have gauze compresses, you may use moist sterile dressings, covered and secured in place with a bandage and tape. Do not use any material that is adherent or loses its substance when wet, such as toilet paper, facial tissue, paper towels, or absorbent cotton. If the patient's legs and knees are uninjured, and spinal injury is *not suspected*, flex them to relieve pressure on the abdomen. Most patients with abdominal wounds require immediate transport to a trauma center, depending on the local protocol.

Figure 26-12 An abdominal evisceration is an open wound to the abdomen in which organs protrude through the wound.

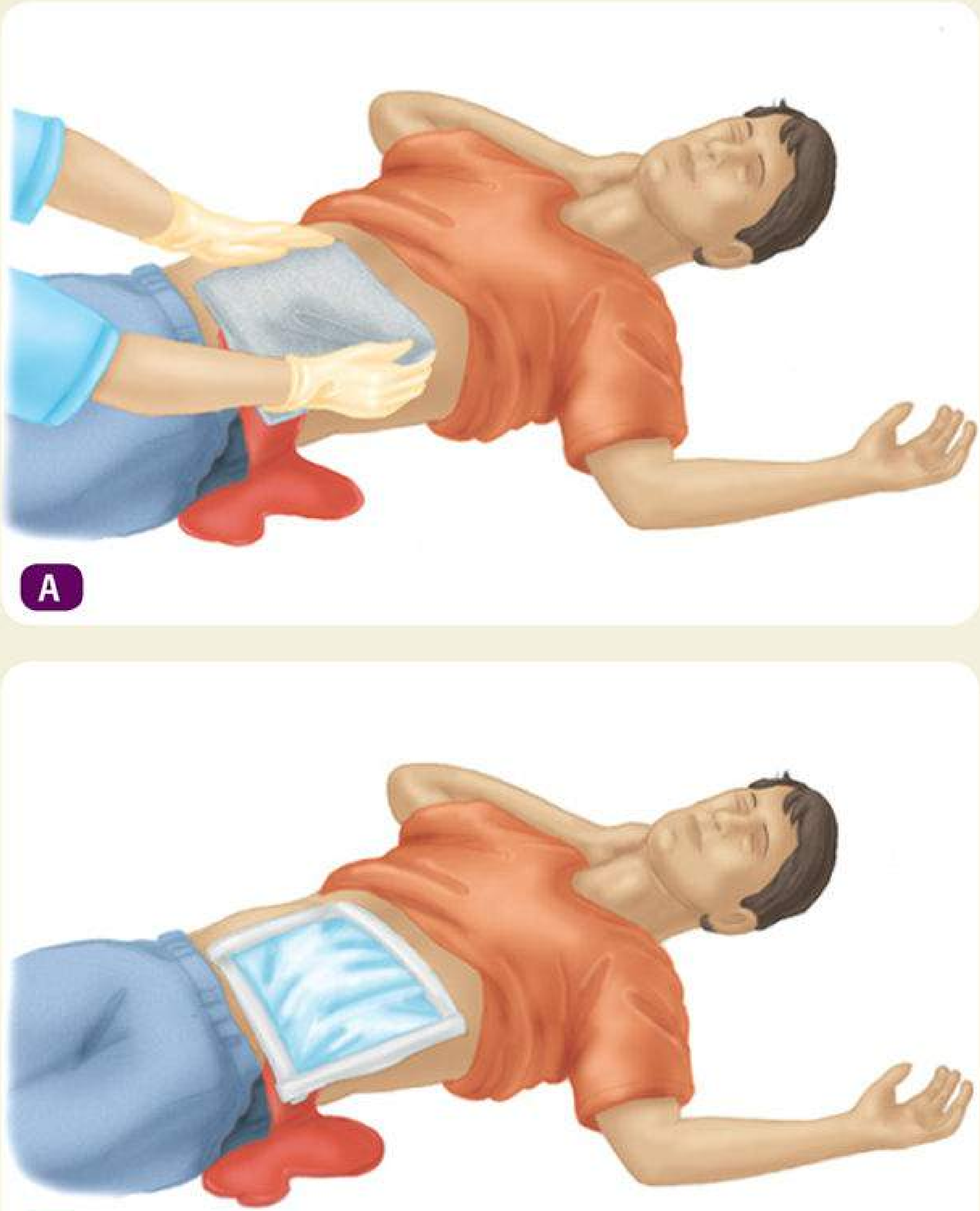


Figure 26-13

A. Cover exposed organs with sterile gauze compresses moistened with sterile saline solution. **B.** Place an occlusive dressing over the compresses, and secure it in place by taping all four sides.

Impaled Objects

Occasionally, a patient will have an object, such as a knife, fishhook, wood splinter, or piece of glass, impaled in his or her body. To treat this, follow the steps in **Skill Drill 26-1**:

1. Do not attempt to move or remove the object unless it is impaled through the cheek or mouth causing airway obstruction, or if the object is in the chest, or if the patient is pulseless and you must remove it to perform cardiopulmonary resuscitation (CPR). In most cases, a surgeon will have to remove the object; removing it in the field may cause more bleeding or damage nerves, blood vessels, or muscles within the wound. Stabilize the impaled body part Step 1.
2. Remove any clothing covering the injury. Control bleeding with direct pressure, and apply a bulky dressing to stabilize the object. If the object is in the chest, neck, or back, consider applying a base layer of occlusive dressing around the object to prevent air from entering the wound. Some combination of soft dressings, gauze, and tape may be effective, depending on the location and size of the object. To prevent further injury, manually secure the object by incorporating it into the dressing Step 2.
3. Protect the impaled object from being bumped or moved during transport by taping a rigid item such as a plastic cup, a section of a plastic water bottle, or a supply container over the stabilized object and its bandaging Step 3.

The only exceptions to the rule of not removing an impaled object are objects in the cheek or mouth that obstruct breathing and objects in the chest that directly interfere with performing CPR on a patient who is already in cardiac arrest. If the object is very long, cut off (shorten) the exposed portion, first securing it to minimize motion and, thus, internal damage and pain. Once the object has been properly secured and the bleeding is under control, provide prompt transport.

Skill Drill 26-1 Stabilizing an Impaled Object

Step 1

Do not attempt to move or remove the object. Stabilize the impaled body part.

Step 2

Control bleeding, and stabilize the object in place using soft dressings, gauze, and/or tape.

Step 3

Tape a rigid item over the stabilized object to prevent it from moving during transport.

Neck Injuries

An open neck injury can be life threatening. If the veins of the neck are open to the environment, they may suck in air **Figure 26-14**. If enough air is sucked into a blood vessel, it can actually block the flow of blood into the lungs and cause cardiac arrest. This condition is called *air embolism.* To control bleeding and prevent the possibility of air embolism, cover the wound with an occlusive dressing. Apply manual pressure, but do not compress both carotid vessels at the same time; if you do, this may impair circulation to the brain and cause a stroke. Secure a pressure dressing over the wound by wrapping roller gauze loosely around the neck and then firmly through the opposite axilla **Figure 26-15**.

Use caution with patients suffering from a neck injury depending on the MOI involved. Immobilize the C-spine if indicated, including placing a cervical collar. The cervical collar may assist with holding a dressing in place over a neck wound.

Figure 26-14 Open injuries to the neck can be very dangerous. If veins are open to the environment, they can suck in air, resulting in a potentially fatal condition called air embolism.

Figure 26-15 Cover neck wounds with an airtight dressing, and apply manual pressure. Do not compress both carotid arteries at the same time, as this may impair circulation to the brain.

Bites

Small Animal Bites and Rabies

At times you may be called to care for a person who has been bitten by a small animal such as a dog, cat, raccoon, squirrel, or other small nonlivestock animal. Be sure to consider scene and crew safety prior to entering the environment.

Most people who are bitten by small animals do not report the incident to a physician, believing that these bites are not serious; however, they can be very serious. A small animal's mouth is heavily contaminated with bacteria. You should consider all small animal bites as contaminated and potentially infected wounds that may require debridement (the removal of damaged tissue), antibiotics, and tetanus prophylaxis **Figure 26-16**. Occasionally, small animal bites result in mangled, complex wounds that require surgical repair. For these reasons, all small animal bites should be evaluated by a physician. Place a dry, sterile dressing over the wound, and promptly transport the patient to the ED. If an arm or leg was injured, splint that extremity. Often, the patient will be extremely upset and frightened, a situation that calls for reassurance on your part.

Figure 26-16 Small animal bite wounds should be examined at the hospital, as these wounds are heavily contaminated with bacteria. **A.** Dog bite. **B.** Cat bite.

A: Courtesy of Moose Jaw Police Service; B: © Chuck Stewart, MD.

A major concern with small animal bites is the spread of rabies, an acute, potentially fatal viral infection of the central nervous system that can affect all warm-blooded animals. Although rabies is extremely rare today, particularly with widespread vaccination of pets, it still exists. Stray dogs that have not been vaccinated can be carriers of the disease, as can squirrels, bats, foxes, skunks, and raccoons. The virus is in the saliva of a rabid, or infected, animal and is transmitted through biting or licking an open wound. Infection can be prevented in a person who has been bitten by such an animal only by a series of special vaccine injections, a painful procedure that must be started soon after the bite. Since animals that have rabies do not always demonstrate symptoms immediately, a person's only chance to avoid the vaccine is to find the animal and turn it over to the health department for observation and/or testing. Refer to your local animal control procedures.

Children, particularly young ones, may be seriously injured or even killed by dogs. These dogs are not always vicious or **rabid**; sometimes a child unknowingly provokes the animal. However, you must assume the animal may turn and attack you as well. Therefore, you generally should not enter the scene until the animal has been secured by the police or an animal control officer. Then you may carry out the necessary emergency care and transport the child to the ED.

Words of Wisdom

In many locations, reporting animal bites to public health officials is mandatory. Based on your protocols you may need to have law enforcement respond to the scene or to the hospital.

Human Bites

The human mouth, more so than even the small animal's mouth, contains an exceptionally wide range of bacteria and viruses. For this reason, you should regard any human bite that has penetrated the skin as a very serious injury. Similarly, any laceration caused by a human tooth can result in a serious, spreading infection **Figure 26-17**. Remember this if you treat someone who has been punched in the mouth; the person who delivered the punch may also need treatment.

Figure 26-17 Human bites can result in a serious, spreading infection. Thus, patients must be evaluated at the hospital.

The emergency treatment of bites consists of the following steps:

1. Apply a dry, sterile dressing.
2. Promptly immobilize the area with a splint or bandage.
3. Provide transport to the ED for surgical cleansing of the wound and antibiotic therapy.

Burns

As an EMT, you will often provide care to patients who have been burned. According to the American Burn Association, burns account for approximately 3,400 deaths per year. Burns are also among the most serious and painful of all injuries. A burn occurs when the body, or a body part, receives more radiant energy than it can absorb, resulting in an injury. Potential sources of this energy include heat, toxic chemicals, and electricity. The proper emergency care of a burn may increase a patient's chances of survival and decrease the risk or duration of a long-term disability. Although a burn may be the patient's most obvious injury, you should always perform a complete assessment to determine whether there are other serious injuries. Finally, keep in mind that children, older patients, and patients with chronic illnesses are more likely to experience shock from burn injuries. Be prepared to treat accordingly.

Safety Tips

Many fires generate toxic compounds such as cyanides, which are produced as a result of the combustion of synthetic materials. This environment is dangerous to all responders. You should enter only if you have been trained and are equipped to function in those areas.

Pathophysiology of Burns

Burns are soft-tissue injuries spread out over a large area created by the transfer of radiation, thermal, or electrical energy. Thermal burns can occur when skin is exposed to temperatures higher than 111°F (44°C). In general, the severity of a thermal injury directly correlates with temperature, concentration, or amount of heat energy possessed by the object or substance and the duration of exposure. For example, solids generally have higher heat content than gases, so exposure to a hot solid (such as the rack inside an oven) typically causes a more significant burn than exposure to hot gases (such as those coming out of an oven). Burn injuries are progressive—the greater the heat energy, the deeper the wound.

Exposure time is another important factor. Thermal injury can occur to unresponsive or paralyzed patients from seemingly innocent heat sources such as heating pads or heat lamps if the patient is left unattended and exposed for long periods of time. It may be difficult to evaluate the amount of heat energy or the amount of exposure time in many cases. There can be a vast difference in the temperature of a fire from the floor to the ceiling. Although most people naturally limit the amount of time they are exposed to such heat, if clothing is on fire or the person is trapped or unconscious, exposure time can be extended.

Complications of Burns

There are several complications that can result secondary to a burn injury, all of which can be life threatening. The skin serves as a barrier between the environment and the body. When a person is burned, this barrier is destroyed; the victim is now at a high risk for infection, hypothermia, hypovolemia, and shock. Burns to the airway are of significant importance because the loose mucosa in the hypopharynx can swell and lead to complete airway obstruction. Circumferential burns of the chest can compromise breathing. Circumferential burns of an extremity can lead to compartment syndrome, resulting in neurovascular compromise and irreversible damage if not appropriately treated. If you suspect any complications, call for ALS backup.

Words of Wisdom

Burns can cause hypothermia and acidosis and can prevent the blood from clotting effectively. These conditions increase the likelihood of death. Therefore, in the field and during transport, keep the patient warm and provide supplemental oxygen.

Words of Wisdom

Burn centers have different protocols and criteria for burn classification. If you have a burn center, pediatric hospital, or trauma center in your area, consult with them on how burns should be treated in the field and where these patients should be transported.

Burn Severity

The seriousness of a burn may influence the choice of a treatment facility. Five factors will help you to determine the severity of a burn.

1. What is the depth of the burn?
2. What is the extent of the burn?

These first two factors are the most important. After gauging these, ask yourself the following questions.

3. Are any critical areas (face, upper airway, hands, feet, genitalia) involved? Also included in critical areas are any

circumferential burns, which are burns that go completely around a body part such as an arm, foot, or chest.

4. Does the patient have any preexisting medical conditions or other injuries?
5. Is the patient younger than 5 years or older than 55 years?

If the answer to any of these three questions is yes, you should upgrade the classification Table 26-1.

Remember, burns to the face are of particular importance owing to the potential of airway involvement. Burns to the hands or feet or over joints are also considered serious because of a potential for loss of function as a result of scarring.

Special Populations

Abuse

When you are treating older adults, pediatric, or special needs patients with burns, it is important to be alert for the possibility of abuse. Older adult patients who are institutionalized, disoriented, or incapable of clear communication are particularly susceptible to abuse. Pediatric and special needs patients are similarly susceptible to abuse.

Signs of abuse include evidence of multiple injuries in various stages of healing (eg, multiple bruises of different colors, new and old fractures involving more than one extremity), injuries that do not seem to correspond to the history provided by caregivers, and burns associated with a suspicious history.

Burns that appear in a “pattern” are suspicious for intentional injuries. Multiple, small circular burns may be indicative of cigarette or cigar injuries. Other patterns may indicate irons, stovetops, or other hot surfaces not easily encountered accidentally. Scalding injuries to the buttocks, hands, or feet may also be indicative of abuse. Remember, these injuries are often inflicted in areas not readily seen. If you are suspicious that an older adult has been abused, fully examine the patient under his or her clothing for signs of abuse. As always, your priority is to provide appropriate support and transport the patient in a timely manner.

Table 26-1 Classification of Burns in Adults

Severe Burns

- Full-thickness burns involving the hands, feet, face, upper airway, or genitalia or circumferential burns of other areas
- Full-thickness burns covering more than 10% of the body's total surface area
- Partial-thickness burns covering more than 30% of the body's total surface area
- Burns associated with respiratory injury (smoke inhalation or inhalation injury)
- Burns complicated by fractures
- Burns on patients younger than 5 years or older than 55 years that would be classified as "moderate" on young adults

Moderate Burns

- Full-thickness burns involving 2% to 10% of the body's total surface area (excluding hands, feet, face, genitalia, and upper airway)
- Partial-thickness burns covering 15% to 30% of the body's total surface area
- Superficial burns covering more than 50% of the body's total surface area

Minor Burns

- Full-thickness burns covering less than 2% of the body's total surface area
- Partial-thickness burns covering less than 15% of the body's total surface area
- Superficial burns covering less than 50% of the body's total surface area

Depth

Burns are first classified according to their depth **Figure 26-18**. You must be able to identify the following three types of burns:

- **Superficial (first-degree) burns** involve only the top layer of skin, the epidermis. The skin turns red but does not blister or burn through this top layer. The burn site is often painful. Sunburn is a good example of a superficial burn.
- **Partial-thickness (second-degree) burns** involve the epidermis and some portion of the dermis. These burns do not destroy the entire thickness of the skin nor is the subcutaneous tissue injured. Typically, the skin is moist, mottled, and white to red. Blisters are present. Partial-thickness burns cause intense pain.
- **Full-thickness (third-degree) burns** extend through all skin layers and may involve subcutaneous layers, muscle, bone, or internal organs. The burned area is dry and leathery and may appear white, dark brown, or even charred. Some full-thickness burns feel hard to the touch. Clotted blood vessels or subcutaneous tissue may be visible under the burned skin. If the nerve endings have been destroyed, a severely burned area may not have feeling and the surrounding less severely burned areas may be extremely painful.

Words of Wisdom

The depth of burns can vary. A full-thickness burn may be surrounded by areas of partial-thickness and superficial burns. So, while the area of the full-thickness burn is painless, the patient can still experience pain due to the extent of damage to the surrounding tissues. Request ALS for assistance with pain management if appropriate.

A pure full-thickness burn is unusual. Severe burns are typically a combination of superficial, partial-thickness, and full-thickness burns. Superficial burns heal well without scarring. Small partial-thickness burns also heal without scarring. However, deep partial-thickness burns and all full-thickness burns are prone to scarring and may be best managed surgically.

Significant airway burns are also serious. They may be associated with singed hair within the nostrils, soot around the nose and mouth, hoarseness, and hypoxia. These patients should be rapidly transported to an ED or facility capable of advanced airway management. It becomes increasingly more difficult to achieve airway control once swelling begins.

It may be impossible to accurately estimate the depth of a particular burn shortly after injury. Even experienced burn surgeons sometimes underestimate or overestimate the extent of a particular burn.

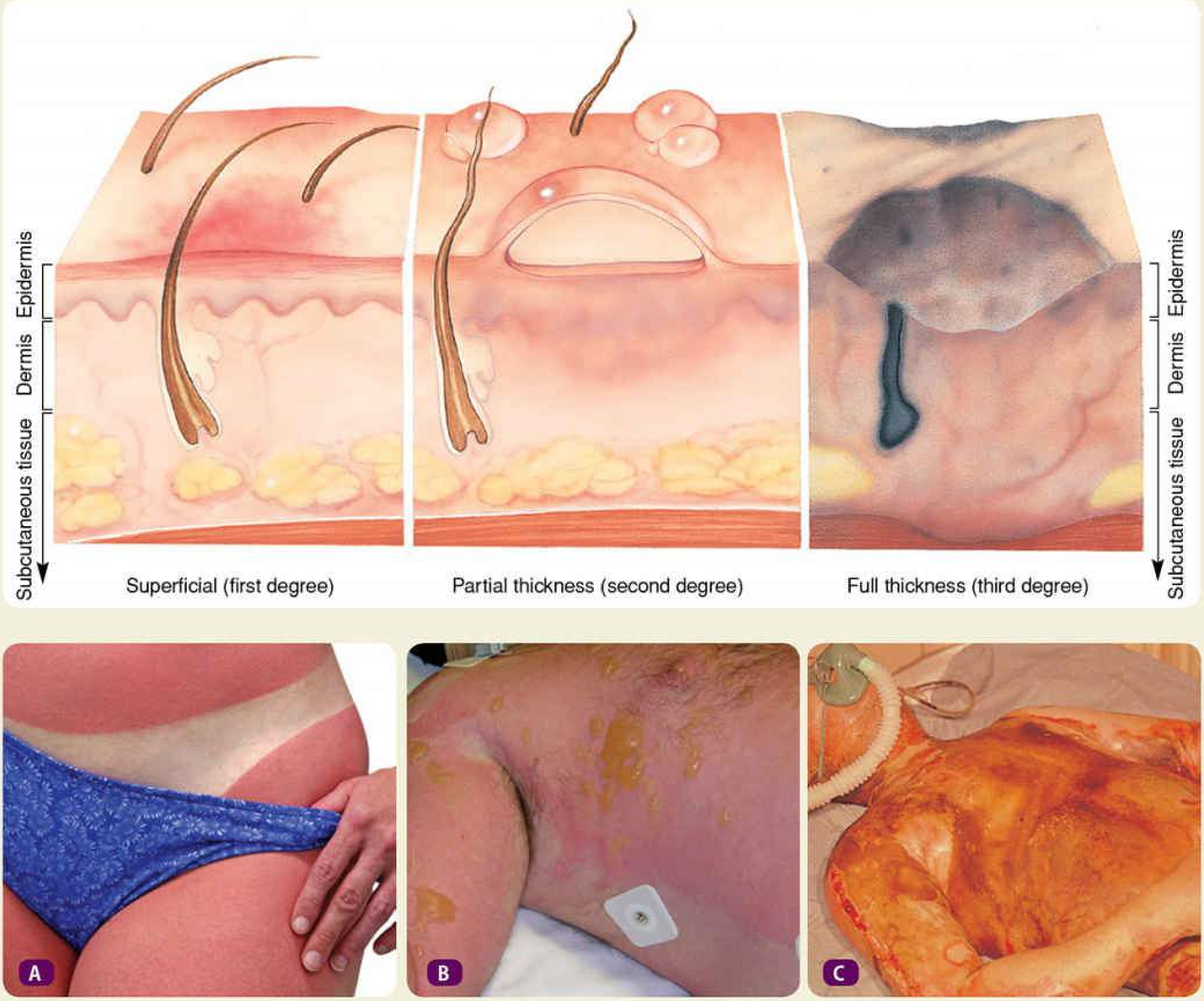


Figure 26-18 Classification of burns. **A.** Superficial or first-degree burns involve only the epidermis. The skin turns red but does not blister or actually burn through. **B.** Partial-thickness or second-degree burns involve some of the dermis, but they do not destroy the entire thickness of the skin. The skin is mottled, white to red, and is often blistered. **C.** Full-thickness or third-degree burns extend through all layers of the skin and may involve subcutaneous tissue and muscle. The skin is dry, leathery, and often either white or charred.

Extent

One quick way to estimate the surface area that has been burned is to compare it to the size of the patient's palm, which is roughly equal to 1% of the patient's total body surface area. This technique is called the rule of palm. Another useful measurement system is the rule of nines, which divides the body into sections, each of which is approximately 9% of the total surface area **Figure 26-19**. Remember that the head of an infant or child is relatively larger than the head of an adult, and the legs are relatively smaller. When you calculate the extent of burn injury, include only partial-thickness (second-degree) and full-thickness (third-degree) burns. Document superficial (first-degree) burns, but do not include them in the body surface area estimation of extent of burn injury.

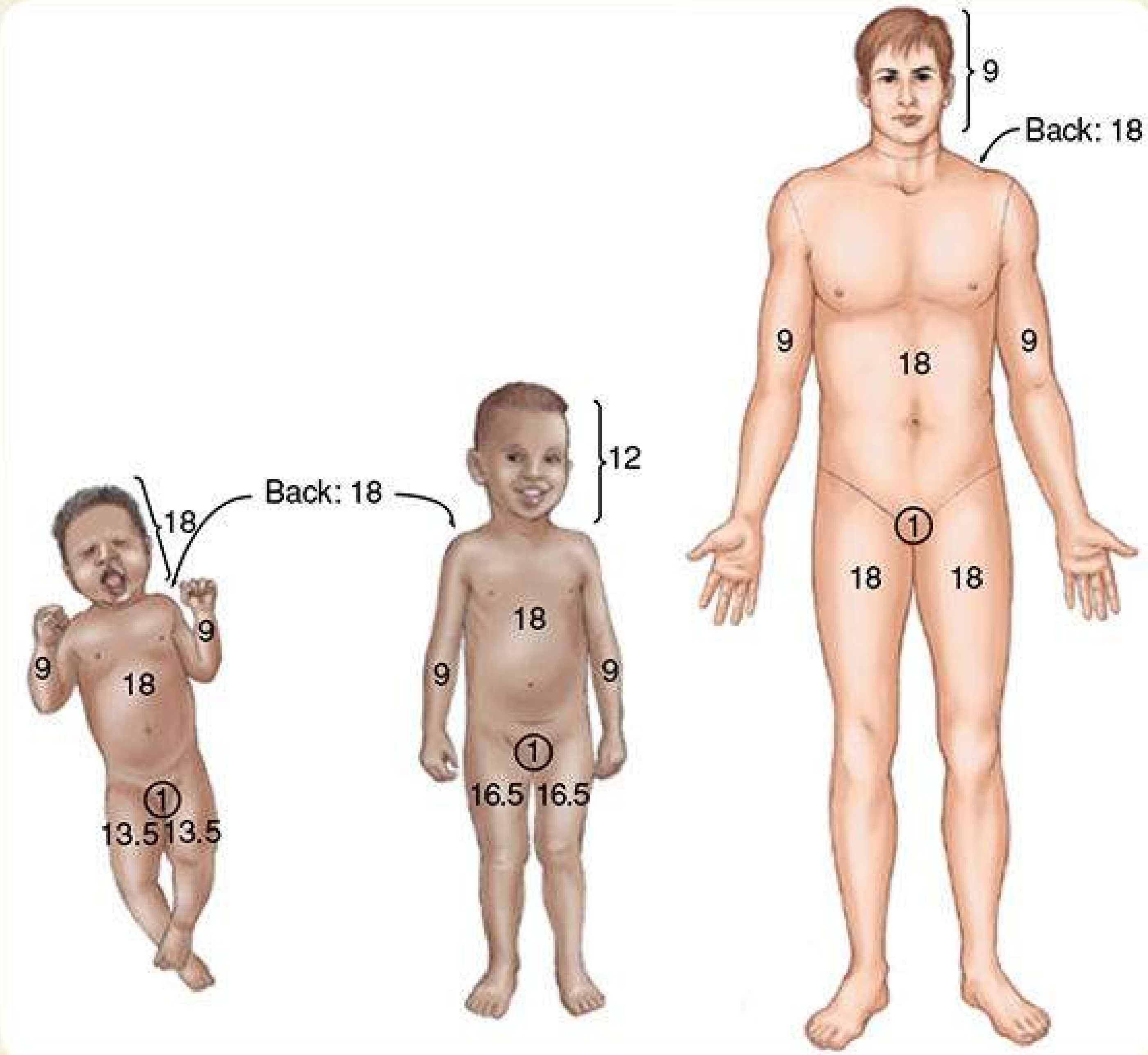


Figure 26-19 The rule of nines is a quick way to estimate the amount of surface area that has been burned; it divides the body into sections, each representing approximately 9% of the total body surface area. The proportions differ for infants, children, and adults.

Special Populations

Pediatric Needs

Burns to children are generally considered more serious than burns to adults Table 26-2. The reason is infants and children have more surface area relative to total body mass, which means greater fluid and heat loss. In addition, children do not tolerate burns as well as adults do. Children are also more likely to go into shock, have hypothermia develop, and experience airway difficulties because of the unique differences associated with their ages and anatomy.

Many burns in infants and children result from child abuse. The classic burn resulting from deliberate immersion involves the hands and wrists, as well as the feet, lower legs, and buttocks. Similarly, burns around the genitals and multiple cigarette burns should be viewed as possible abuse. Report all suspected cases of abuse to the proper authorities, especially those where a significant delay in evaluation and treatment is evident (see Chapter 34, *Pediatric Emergencies*).

Table 26-2 Classification of Burns in Infants and Children

Classification
Severe Burns
▪ Any full-thickness burn ▪ Partial-thickness burns covering more than 20% of the body's total surface area
Moderate Burns
▪ Partial-thickness burns covering 10% to 20% of the body's total surface area
Minor Burns
▪ Partial-thickness burns covering less than 10% of the body's total surface area

Patient Assessment of Burns

When you assess a burn, it is important to classify the patient's burns. Classifying burns involves determining the source of the burn, the depth of the burn, and its severity. Assessing a burn patient is essentially the same as assessing any other trauma patient. Again, be careful to focus not on the dramatic appearance of the injury, but, rather, on potential life threats that require treatment.

Scene Size-up

As you arrive on scene, observe the scene for hazards and threats to the safety of you and your crew, bystanders, and the patient. Ensure that the factors that led to the patient's burn injury do not pose a hazard to you and your crew. Is the electricity turned off? Is the chemical leak secure? Has the fire been extinguished? Is there any potential for violence? Has the patient been decontaminated, if needed?

When possible, determine the type of burn that has been sustained and the MOI. What the patient reports will often provide some important information about the extent of the injury. Burn patients can be a challenge to manage both physically and emotionally. It is easy to become overwhelmed by the sights, sounds, and smells of burn victims.

Assess the scene for any environmental hazards. If the patient is the victim of a lightning strike, is the weather still a threat to your safety? Wear gloves and eye protection when treating any burn patient and gowns when serious injuries are expected. Determine the number of patients; the possibility for multiple patients grows if you are responding to a lightning strike or a vehicle crash. At vehicle crashes, ensure the scene is safe from energized electrical lines or leaking fuel in the area where you will be working. If you determine the power company, the fire department, or ALS units are needed, call for additional resources early. Remember, the burn patient is a trauma patient. Consider the potential for spinal injuries, broken bones, inhalation injuries, and other injuries.

Primary Assessment

The primary assessment includes a rapid exam of the patient to identify and manage life-threatening concerns and to assist with transport decisions. The primary assessment begins when you approach the patient and form a general impression.

As you approach the burn trauma patient, simple clues can help identify how serious the injuries are and how quickly you need to assess and treat them. If your patient greets you with a hoarse voice or reports being in an enclosed space with a fire or intense heat source, these should be indications of a significant MOI. The presence of stridor means your patient's airway is significantly swollen and can signal impending complete airway obstruction. Similarly, if the patient has singed facial hair, eyebrows, or nasal hair, your initial general impression might be the patient has a potential airway and/or breathing problem.

Child abuse and elder abuse are unpleasant situations to handle. Unfortunately, they are often situations that involve burns. As you enter a scene where burns are involved, be suspicious of clues that may indicate abuse.

The burned patient you encounter may have graphic injuries; however, stay focused on the primary assessment. As you begin, always consider the need for manual spinal stabilization.

Check for responsiveness using the AVPU scale. Assess a patient's mental status by asking the patient about his or her chief complaint. If the patient is alert, this should help direct you to any apparent life threats. If the patient is not alert, determine if he or she responds to verbal or painful stimuli or if he or she is unresponsive. An unresponsive patient may indicate a life-threatening condition. In all patients whose level of consciousness is less than alert and oriented, you should administer high-flow oxygen via a nonrebreathing mask and provide immediate transport to the ED.

Ensure the patient has a clear and patent airway. If the patient is unresponsive or has a significantly altered level of consciousness, consider inserting a properly sized oropharyngeal or nasopharyngeal airway. Be alert to signs that the patient has inhaled hot gases or vapors, such as singed facial hair or soot present in or around the airway. Heavy amounts of secretions and frequent coughing may also indicate a respiratory burn.

Quickly assess for adequate breathing. Inspect and palpate the chest wall for DCAP-BTLS. Check for clear and symmetrical breath sounds and provide high-flow oxygen or provide assisted ventilations using a BVM as needed, depending on the level of consciousness and breathing rate/quality of your patient. Burn patients are trauma patients. Evaluate and treat them for spinal injuries and airway problems concurrently. How you open the airway depends on whether a neck injury is suspected. Could the patient have fallen? Do the circumstances surrounding the MOI suggest a possible spinal injury?

YOU are the Provider — PART 5

You reassess the patient and then call your radio report to the receiving facility. The patient is still experiencing respiratory distress, but he is moving air adequately. Your estimated time of arrival at the hospital is 6 minutes.

Recording Time: 17 Minutes	
Level of consciousness	Conscious and alert, but anxious
Respirations	22 breaths/min; labored; hoarse voice
Pulse	116 beats/min; strong and regular
Skin	Red, warm, and dry
Blood pressure	160/80 mm Hg
Spo_2	96% (on oxygen)

9. What, if any, additional treatment is indicated for this patient?

Quickly assess the pulse rate and quality and determine perfusion based on the patient's skin condition, color, temperature, and capillary refill time. If you see significant bleeding, take the necessary steps to control it. Significant bleeding is an immediate life threat. If the patient has obvious life-threatening external hemorrhage, control the bleeding first (before airway and breathing); then treat the patient for shock as quickly as possible. Shock frequently develops in burn patients. Treat the shock by preventing heat loss. This is very important because the damaged skin has only a limited ability to regulate body temperature. Cover the patient with a blanket to prevent heat loss.

If the patient you are treating has an airway or breathing problem, significant burn injuries, significant external bleeding, or signs and symptoms of internal bleeding, consider rapid transport to the nearest hospital, trauma center, or burn center for treatment. Consulting with ALS providers may be appropriate for burn patients with moderate or severe burns and burns of the airway or inhalation injury. ALS providers can treat these patients with endotracheal intubation and intravenous fluids to support airway, breathing, and circulation (shock) difficulties. These can progress so rapidly that immediate ALS assistance can make the difference between life and death.

History Taking

Investigate the chief complaint or history of present illness. Next, be alert for signs or symptoms of other injuries due to the MOI. If the patient was burned in a confined space, suspect an inhalation injury. When burns result from explosive forces, be alert for other internal injuries and fractures.

Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives such as no pain. Typical signs of a burn are pain, redness, swelling, blisters, or charring. Typically, symptoms include pain and/or burning at the injury site. Regardless of the type of burn injury, it is important to stop the burning process, apply dressings to prevent contamination, and treat the patient for shock.

Obtain a SAMPLE history from your patient. In addition, ask the following questions of a burn patient:

- Are you having any difficulty breathing?
- Are you having any difficulty swallowing?
- Are you having any pain?

When you assess a burn patient, check to see whether he or she has an emergency medical identification device—a wallet card, necklace, or bracelet—or ask the patient or a family member about preexisting conditions, which may increase the chances of a poor outcome. Remember that the environment, bystanders, and medical identification devices may provide important clues about your patient's condition.

Secondary Assessment

The secondary assessment is a more detailed, comprehensive, or focused examination of the patient that is conducted to reveal injuries that may have been missed during the primary assessment. In some instances where the patient is critically injured or the transport time is short, you may not have time to conduct a secondary assessment. In other instances, the secondary assessment may occur en route to the ED.

After you complete the primary assessment, perform an exam of the entire body. Quickly assess the patient from head to toe looking for DCAP-BTLS to ensure you have found all of the problems and injuries. Make a rough estimate, using the rule of nines, of the extent of the burned area to report to medical control. Determine what classification of burns the victim has sustained. The patient may report pain depending on the amount of nerve damage. Before you package your patient, determine the severity of the burns the victim has sustained. Severity is calculated by considering what caused the burn, the body region that is burned, the depth and extent of the burn, the patient's age, and preexisting illness or injuries. Follow your local protocols for criteria for transport to a burn center. Package the patient for transport based on your findings. Remember to immobilize your patient for spinal injuries as appropriate.

Assessing the respiratory system involves looking, listening, and feeling. A patient who is conscious, alert, and talking does not have immediate airway or breathing difficulties. When you assess the respiratory system of a burn patient, look specifically for the following findings:

1. Soot around the mouth
2. Soot around the nose
3. Singed nasal hairs

If any of these findings are present, open the patient's mouth and examine for burns or swelling of the tongue. Ask the patient to cough, and assess for black sputum, which indicates smoke inhalation.

Next, listen to breath sounds with a stethoscope. Breath sounds should be clear and equal bilaterally, anteriorly, and posteriorly. Determine the patient's rate and quality of respiration. Finally, assess the chest for DCAP-BTLS and asymmetrical chest wall movement. Burn patients who present with any type of airway problem should be considered critical.

Quickly assess pulse rate and quality; determine the skin condition, color, and temperature; and check the capillary refill time. If you see visible significant bleeding, you must begin the steps necessary to control bleeding. Significant bleeding, internal or external, is an immediate life threat. If the patient has obvious life-threatening bleeding, quickly control it and treat for shock as quickly as possible. Non-life-threatening bleeding, such as in abrasions, can be bandaged later in your assessment as necessary.

Assess the patient's neurologic system to formulate baseline data for further decisions on patient management. This examination should include assessing for the following:

- Level of consciousness—use AVPU
- Pupil size and reactivity
- Motor response
- Sensory response

Assess the musculoskeletal system by performing a detailed full-body scan. Assess all anatomic regions looking for DCAP-BTLS. Specifically look for the following features:

- In the head, check for singed nasal or facial hair, burns or swelling of the face or ears, or burns or swelling in the mouth. If the patient sustained electrical injury, examine the scalp for signs of entrance or exit wounds.
- In the neck, check for burns, especially if they encircle the entire neck, which can impair circulation.
- In the chest, check for burns that encircle the entire chest, which can impair normal chest rise.
- In the abdomen and pelvis, feel all four quadrants for tenderness or rigidity. If the abdomen is tender, expect internal bleeding. Look for burns of the genitalia, as burns to this area are considered high risk.
- Look for burns that encircle an extremity, as they can impair circulation. If the patient sustained an electrical injury, assess thoroughly for entry or exit burn wounds. This should include the axilla and the area between digits. Record pulse and motor and sensory function.
- Examine the posterior surface of the body, as large burns or electrical exit burns may be located in this body area.

A systematic examination helps you understand what has happened to the outside of your patient. Vital signs are a good indication of how your patient is doing on the inside. If you determine an early set of vital signs, you will know how your patient is tolerating his or her injuries while en route to the hospital. Because shock is often pronounced in a burn patient, blood pressure, pulse, and skin assessment for perfusion are important vital signs to obtain.

In addition to hands-on assessment, use monitoring devices, including oxygen saturation monitors and carbon monoxide monitors, to quantify oxygenation and circulatory status.

Reassessment

Repeat the primary assessment, and reassess the patient's vital signs. Reassess the patient's chief complaint. Reevaluate interventions and treatment you have provided to the patient, particularly those used to treat shock. Identify and treat any changes in the patient's condition.

The goals in treating patients with burns are to stop the burning process, assess and treat breathing, support circulation, and provide rapid transport. Because burn patients are also trauma patients, provide spinal immobilization consistent with your local protocol if you suspect spinal injuries. Oxygen is mandatory for inhalation burns and large body surface area burns. If the patient has signs of hypoperfusion, treat aggressively for shock and provide rapid transport to the appropriate hospital. Cover all burns according to your local protocols. The risk of infection is very high and can be reduced if you cover large burn areas with sterile burn sheets or clean linen. Do not delay transport of a seriously injured patient to complete nonlifesaving treatments in the field such as splinting extremity fractures. Instead, complete these types of treatment en route to the hospital.

Provide hospital personnel with a description of how the burn occurred. Many times the ED staff can determine the appropriate dilutant for chemical burns or calculate appropriate treatments for other types of burns with enough advanced notice. Report and document the extent of the burns. This should include the amount of body surface area involved, the depth of the burn, and the location. For example, you may say 10% full-thickness burns, 15% partial-thickness burns, and 25% superficial burns to the chest, abdomen, and left lower extremity. If special areas are involved (genitalia, feet, hands, face, or circumferential), they should be specifically mentioned and documented.

Emergency Medical Care for Burns

Your first responsibility in caring for a patient with a burn is to stop the burning process and prevent additional injury. When caring for a burn patient, follow the steps in **Skill Drill 26-2**:

1. Follow standard precautions. Because a burn destroys the patient's protective skin layer, always wear gloves and eye protection when treating a burn patient.
2. Move the patient away from the burning area. If any clothing is on fire, wrap the patient in a blanket or follow the specific guidelines outlined by your local fire department protocol to put out the flames, and then remove any smoldering clothing and/or jewelry.
3. If allowed by local protocol, immerse the area in cool, sterile water or saline solution, or cover with a clean, wet, cool dressing if the skin or clothing is hot. This not only stops the burning, it also relieves pain. Prolonged immersion, however, may increase the risk of infection and hypothermia. For this reason, you should not keep the affected part submersed in water for more than 10 minutes. If the burning has stopped before you arrive, do not immerse the affected part at all. As an alternative to immersion, irrigate the burned area until the burning stops; next apply a sterile dressing Step 1.

   Cover large (greater than 10%) BSA burns with a dry, sterile, nonadherent dressing (eg, a sterile burn sheet). Other than for the purpose of stopping the burning process, do not apply water or saline to large surface burn areas.
4. Provide high-flow oxygen. Also remember that more fire victims die of smoke inhalation than of skin burns. A patient who has facial burns or has inhaled smoke or fumes may experience respiratory distress. Therefore, provide high-flow oxygen to the patient. Keep in mind that a patient who appears to be breathing well at first may suddenly experience severe respiratory distress. Therefore, continually assess the airway for possible problems Step 2.
5. Rapidly estimate the burn's severity. Cover the burned area with a dry, sterile dressing to prevent further contamination. Sterile gauze is best if the area is not too large. You may cover larger areas with a clean, white sheet. Do not put anything else on the burned area. Never use ointments, lotions, or antiseptics of any kind and do not intentionally break any blisters.
6. Check for traumatic injuries or other medical conditions that may be immediately life threatening. Most patients who have been burned have normal vital signs and can communicate at first, which will make your assessment easier Step 3.
7. Treat the patient for shock.
8. An extensive burn can produce hypothermia (loss of body heat). Prevent further heat loss by covering the patient with warm blankets.
9. Provide prompt transport by local protocol. Do not delay transport to perform a prolonged assessment or to apply coverings to burns in a critical patient Step 4.

Words of Wisdom

The key to initial burn treatment is to stop the burning process and not to “cool” the skin. Using cool water and not cold water is crucial. Using cold water or ice water can cause further injury to the tissue.

Management of Specific Burns

Thermal Burns

Thermal burns are caused by heat (as opposed to electricity, chemicals, or radiation). Many different situations can cause thermal burns, and all pose a safety hazard to responding emergency care providers. Most commonly, thermal burns are caused by scalds or an open flame. A **flame burn** is very often a deep burn, especially if a person’s clothing catches fire. Hot liquids produce scald injuries. A **scald burn** is most commonly seen in children and handicapped adults but can happen to anyone, particularly while cooking. Scald burns often cover large surface areas of the body because liquids can spread quickly. Coming in contact with hot objects produces a **contact burn**. Ordinarily, reflexes protect a person from prolonged exposure to a very hot object, so contact burns are rarely deep unless the patient was prevented from drawing away from the hot object (for example, unconscious, intoxicated, restrained, or impaired).

Skill Drill 26-2 Caring for Burns

Step 1

Follow standard precautions to help prevent infection. If safe to do so, remove the patient from the burning area; extinguish or remove hot clothing and jewelry as necessary. If the wound is still burning or hot, immerse the hot area in cool, sterile water, or cover with a wet, cool dressing.

Step 2

Provide high-flow oxygen, and continue to assess the airway.

Step 3

Estimate the severity of the burn, and then cover the area with a dry, sterile dressing or clean sheet. Assess and treat the patient for any other injuries.

Step 4

Prepare for transport. Treat for shock. Cover the patient with blankets to prevent loss of body heat. Transport promptly.

A **steam burn** can produce a topical (scald) burn. Minor steam burns are common when uncovering the plastic wrap from microwaved food. When the plastic is peeled away, hot steam escapes directly onto the person's hand. Steam (that is, gaseous water) is also responsible for causing airway burns.

Another important source of thermal burns is the **flash burn** produced by an explosion, which may briefly expose a person to very intense heat. Lightning strikes can also cause a flash burn. These injuries are usually minor compared with the potential for trauma from whatever caused the flash.

Manage thermal burns largely the same as you would manage any other burn. Stop the burning source, cool the burned area if appropriate, and remove all jewelry. Maintain a high index of suspicion for inhalation injuries. Increased exposure time will increase damage to the patient. The larger the burn, the more likely the patient will be susceptible to hypothermia and/or hypovolemia. All patients with large surface burns should have a dry sterile dressing applied to help maintain body temperature, prevent infection, and provide comfort.

Inhalation Burns

Inhalation injuries can occur when burning takes place in enclosed spaces without ventilation. When the upper airway is exposed to excessive heat, the patient can experience rapid and serious airway compromise. The heat can be an irritant to the lungs and the airway, causing coughing, wheezing, and rapid swelling or edema of the mucosa of the upper airway tissues, often evidenced by stridor. Upper airway damage is often associated with the inhalation of superheated gases. Lower airway damage is more often associated with the inhalation of chemicals (eg, acids, aldehydes) and particulate matter. When treating a patient for inhalation injuries, you may encounter severe upper airway swelling which requires immediate intervention. Sometimes airway swelling and compromise will develop more slowly and not manifest until transport. You should consider requesting ALS backup if the patient has signs or symptoms of edema, such as stridor, a hoarse voice, singed nasal hairs, singed facial hairs, burns of the face, or carbon particles in the sputum. Apply cool mist, aerosol therapy, or humidified oxygen to help reduce some minor edema. Because most ambulances do not carry misters, apply an ice pack to the throat to help reduce the swelling, provided the tissue in that area does not have burns.

Inhalation of Toxic Gases

The combustion process produces a variety of toxic gases. The less efficient the combustion process, the more toxic the gases—such as carbon monoxide (CO) and carbon dioxide (CO_2)—that may be created. When furnaces, kerosene heaters, and other heating devices are in poor repair, they may emit unsafe levels of these toxic gases. Internal combustion engines may emit many of the same gases and, consequently, should always have their exhaust vented to the outdoors. A common cause of CO exposure is running a small engine in an enclosed space like a garage or basement. For this reason, many ambulance services and fire departments have added CO detectors to their garages or ambulance bays. Firefighters who are performing an overhaul after a fire may be exposed to high levels of CO, as may people who are exposed to large amounts of car exhaust (such as toll takers and auto mechanics).

CO intoxication should be considered whenever a group of people in the same place all report a headache or nausea (a malfunctioning furnace or car exhaust being sucked into the air-handling system can cause CO intoxication in groups of people). Similarly, you should be suspicious when people complain of feeling sick at home but not when they go to work or school.

CO can displace oxygen from the alveolar air and from its attachment sites on hemoglobin molecules contained in circulating red blood cells. Because CO binds to receptor sites on hemoglobin at least 250 times more easily than oxygen (O_2), the patient's hemoglobin may become saturated with the wrong chemical. Being exposed to relatively small concentrations of CO (such as in cigarette smoke) will result in progressively higher blood levels of CO. Most people have approximately 2% CO attached to their hemoglobin, but these levels may be as high as 4% to 8% in heavy smokers. Levels of 50% or higher may be fatal.

Traditional wisdom tells us that patients with CO intoxication will appear "cherry red." Most practitioners agree that cherry red skin, lips, and nail beds are more commonly observed in patients who have died and less often observed in patients who are alive after exposure to CO. So, never rule out CO intoxication because the patient's skin is not cherry red.

Patients with severe CO intoxication usually have an O_2 saturation (Spo_2) level that is normal. For this reason, you should be suspicious of pulse oximeter readings when you are dealing with a patient who is suspected of having CO poisoning. New devices that can measure a patient's CO level are becoming more widespread in EMS systems, allowing providers to recognize and treat low-level CO intoxication rapidly.

The gaseous form of cyanide is hydrogen cyanide (HCN). It is generated by the combustion of commonly encountered substances such as paper, cotton, and wool. HCN is colorless and has the smell of bitter almonds; however, it can be difficult to detect at the scene of a fire. Prehospital diagnosis of HCN poisoning is difficult because laboratory studies are necessary. Signs and symptoms involve the central nervous, respiratory, and cardiovascular systems of the body and include faintness, anxiety, abnormal vital signs, headache, seizures, paralysis, and coma.

In situations where you have patients who have sustained inhalation injuries, you must first ensure your own safety and the safety of your coworkers. Once you have taken precautions, prehospital treatment of a patient with suspected HCN poisoning may include decontamination and supportive care according to signs and symptoms displayed by the patient until an antidote can be administered by ALS providers.

Exposure to other toxic gases can also cause damage to organs and systems and may cause death. Care for any toxic gas exposure includes recognition, identification, and supportive treatment as necessary according to the patient's signs and symptoms.

Chemical Burns

A chemical burn can occur whenever a toxic substance contacts the body. Most chemical burns are caused by strong acids or strong alkalis. The eyes are particularly vulnerable to chemical burns **Figure 26-20**. Sometimes the fumes alone from strong chemicals can cause burns, especially to the respiratory tract. The severity of the burn is directly related to the type of chemical, the concentration of the chemical, and the duration of the exposure.

In cases of severe chemical burns or exposure, consider mobilizing a hazardous materials (HazMat) team, if appropriate. To prevent exposure to hazardous materials, determine if you can safely approach the patient. In some cases you will need to wait to provide care until hazardous materials technicians have decontaminated the patient. You must wear the appropriate chemical-resistant gloves and eye protection whenever you are caring for a patient with a chemical burn. Be particularly careful not to get any chemical, dry or liquid, on yourself or on your uniform; consider wearing a protective gown when this is a possibility. Remember that exposure risk is also present when you are cleaning up after a call.

Figure 26-20 The eyes are particularly vulnerable to chemical burns.

Treatment of chemical burns can be specific to the chemical agent. If available, read all of the labels of the chemical agent. Do not risk exposure while attempting to gather information on the chemical. If the exposure occurs at an industrial site, such as a chemical manufacturing plant, an expert should be on-site and should be able to provide you with valuable information on the chemical.

The emergency care of a chemical burn is basically the same as that for a thermal burn, discussed later in the chapter. The severity of the burn will depend on the type of chemical, its strength, the duration of exposure, and the area of the body exposed. To stop the burning process, remove any chemical from the patient. A dry chemical that is activated by contact with water may damage the skin more when it is wet than when it is dry. Therefore, always brush off dry chemicals from the skin and clothing before flushing the patient with water **Figure 26-21**. Remove the patient's clothing, including shoes, stockings, gloves, and any jewelry or eyeglasses, because there may be small amounts of chemicals in the creases. Take great care to ensure you do not come in contact with the chemical. The patient should be properly decontaminated by properly trained personnel.

For liquid chemicals, immediately flush the burned area with large amounts of water **Figure 26-22**. Take care not to contaminate uninjured areas or make the patient hypothermic. Never direct a forceful stream of water from a hose at the patient; the extreme water pressure may mechanically injure the burned skin. Continue flooding the area with gallons of water for 15 to 20 minutes after the patient says the burning pain has stopped. If the patient's eye has been burned, hold the eyelid open (without applying pressure over the globe of the eye) while flooding the eye with a gentle stream of water **Figure 26-23**. Flush the eyes from the inside corners to the outside to prevent cross contamination. If only one eye has been affected, turn the patient's head to that side and flush. If both eyes are affected, consider hooking up a nasal cannula to a bag of saline to flush both eyes simultaneously. The prongs can be placed on the bridge of the nose to flush from the inside corners of the eyes to the outside corners. Be careful not to touch the prongs to the eye or surrounding tissue. Continue flushing the contaminated area en route to the hospital.

Figure 26-21 Brush off dry chemicals before you flush the burned area with water.

Figure 26-22 Flush the burned area with large amounts of water for 15 to 20 minutes after the patient says that the burning pain has stopped. Avoid contaminating uninjured areas.

As with any substance, once the fluid has been contaminated with the chemical, collect it and properly dispose of it. Conduct a proper decontamination prior to loading any patient into the ambulance and again prior to entering a hospital.

Electrical Burns

Electrical burns may be the result of contact with high- or low-voltage electricity. High-voltage burns may occur when utility workers make direct contact with power lines. Ordinary household current is still powerful enough to cause severe burns as well as cardiac dysrhythmias.

Figure 26-23 Flood the affected eye with a gentle stream of water. Hold the eyelids open, a challenging task because the patient's reflex is to keep the eye shut. Take care to prevent any of the chemical from getting into the other eye during flushing.

There must be a complete circuit between the electrical source and the ground for electricity to flow. Any substance that prevents this circuit from being completed, such as rubber, is called an insulator. Any substance that allows a current to flow through it is called a conductor. The human body, which is primarily water, is a good conductor. Thus, electrical burns occur when the body, or a part of it, completes a circuit connecting a power source to the ground **Figure 26-24**.

The type of electric current, magnitude of current (amperage), and voltage have effects on the seriousness of burns. When an electric current enters the body, the skin is burned at the entrance wound as well as everywhere along the path until the current grounds and exits the body. In addition to tissues damaged by the heat, significant chemical changes take place in the nervous, cardiovascular, and muscular systems of the body, causing disruption of the body's normal functions and/or even system failure.

Your safety is particularly important when you are called to the scene of an emergency involving electricity. Obviously, you can be fatally injured by coming into contact with power lines. But you can also be fatally injured by touching a patient who is still in contact with a live power line or any other electrical source. For this reason, never attempt to remove someone from an electrical source unless you are specially trained to do so. Likewise, never move a downed power line unless you have the special training and equipment necessary for the job. Before even approaching someone who may still be in contact with a power line or an electrical appliance, make certain the power is turned off. Always assume that any downed power line is live.

Figure 26-24 The human body is a good conductor of electricity. An electrical burn usually occurs when the body, acting as a conductor, completes a circuit.

A burn injury appears where the electricity enters (an entrance wound) and exits (an exit wound) the body. The entrance wound may be quite small **Figure 26-25A**, but the exit wound can be extensive and deep **Figure 26-25B**. Always look for both entrance and exit wounds. There are two dangers specifically associated with electrical burns. First, there may be a large amount of deep tissue injury. Electrical burns are always more severe than the external signs indicate. The patient may have only a small burn to the skin but may have massive damage to the deeper tissues, organs, and the nervous system **Figure 26-26**. The force of the electrical energy can also cause fractures or joint dislocations. Second, the patient may go into cardiac or respiratory arrest from the electric shock; although, if the patient is not in cardiac arrest on your arrival, it is unlikely he or she will do so during transport.

Figure 26-25 Electrical burns, like gunshot wounds, have entrance and exit wounds. **A.** An entrance wound is often quite small. **B.** The exit wound can be extensive and deep.

A, B: © Chuck Stewart, MD.

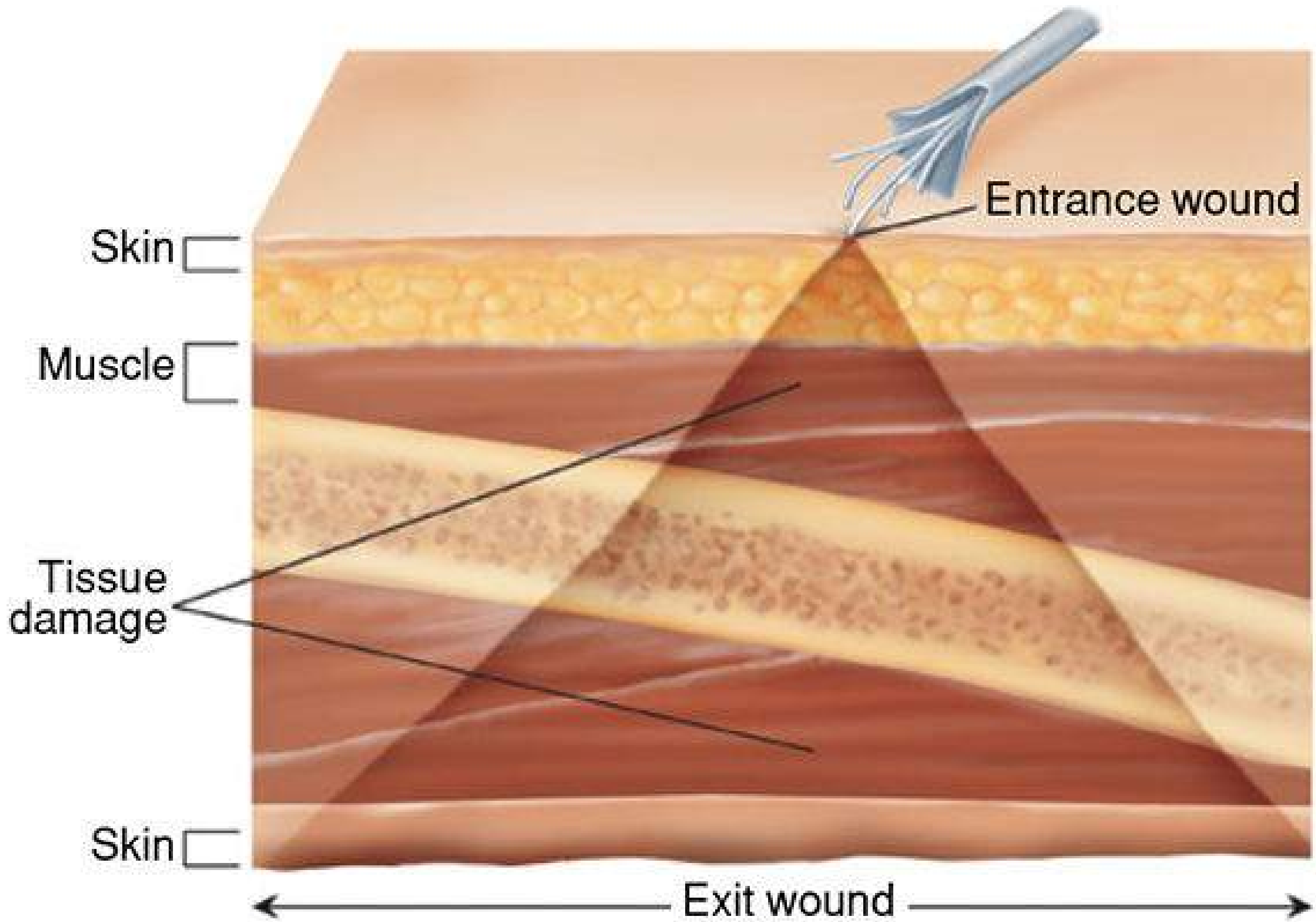


Figure 26-26 External signs of an electrical burn may be deceiving. The entrance wound may be a small burn, whereas the damage to deeper tissue may be massive.

Electrical current can cross the chest and cause cardiac arrest or dysrhythmias. Cardiac arrest can also occur after a lightning strike, which is a form of an electrical burn. If indicated, begin CPR on the patient and apply the automated external defibrillator. Although CPR may need to be quite prolonged in patients with electrical burns, it has a high success rate if started promptly. Be prepared to defibrillate if necessary. If neither CPR nor defibrillation is indicated, give supplemental oxygen, and monitor the patient closely for respiratory and cardiac arrest. Treat the soft-tissue injuries by placing dry, sterile dressings on all burn wounds and splinting suspected fractures. Provide prompt transport; all electrical burns are potentially severe injuries that require further treatment in the hospital.

Taser Injuries

In recent years, law enforcement has increased its use of Tasers. Two small darts (electrodes) that puncture the patient's skin are fired from these weapons. Injuries are generally treated as impaled objects and removed by a physician; although, in some jurisdictions, depending on local protocol, EMTs are permitted to remove these barbs from patients. The barbs are approximately 13 mm in length, and although they produce wounds, they are small and easily managed unless they penetrate the eye.

There are potential complications for the patient when these devices have been used, particularly when the patient is experiencing certain underlying disorders. Considerable attention has been focused on a condition known as **excited delirium**, which is often characterized by extreme agitation, reduced pain sensitivity, hallucinations, persistent struggling, and elevated temperature. This condition is commonly associated with illegal drug ingestion. Excited delirium is a true emergency and warrants assisted ALS response.

Using a Taser in patients with true excited delirium has been previously associated with dysrhythmias and sudden cardiac arrest. Other studies have found that the risk of sudden death is related to the excited delirium condition and is not associated with Taser use. Regardless, be aware of this and be certain you have access to an AED when you respond to calls for patients who have been exposed to Taser shots.

Radiation Burns

Acute radiation exposure has become more than a theoretical issue because the use of radioactive materials has increased in industry and medicine; therefore, you must understand it to effectively manage patients exposed to radiation. Potential threats include incidents related to the use and transportation of radioactive isotopes and intentionally released radioactivity in terrorist attacks. To be effective, first determine if there has been a radiation exposure, and then determine whether ongoing exposure, continues to exist. Increasingly, special response units are equipped with pager-sized radiation detectors, or such detection devices may be provided by other public safety services.

There are three types of ionizing radiation: alpha, beta, and gamma. Alpha particles have little penetrating energy and are easily stopped by the skin. Beta particles have greater penetrating power and can travel much farther in air than alpha particles. They can penetrate the skin but can be blocked by simple protective clothing designed for this purpose. The threat from gamma radiation is directly proportional to its wavelength. This type of radiation is very penetrating and easily passes through the body and solid materials.

Radiation is measured in units of radiation absorbed dose (rad) or radiation equivalent in man (rem): 100 rad = 1 gray (Gy). Small amounts of everyday background radiation are measured in rad; the amount of radiation released in a major incident may be measured in gray. The average human exposure from background radiation is 0.36 rem per year. Mild radiation sickness can be expected with exposures of 1 to 2 Gy (100 to 200 rad), moderate sickness at 2 to 5 Gy, and severe sickness at 4 to 6 Gy. Exposure to more than 8 Gy is immediately fatal.

Most ionizing radiation accidents involve gamma radiation, or x-rays. People who have sustained a radiation exposure generally do not pose a risk to the people around them. However, in some types of incidents—particularly those involving explosions—patients may be contaminated with radioactive particulate matter. It is speculated that after a nuclear explosion, most patients will have sustained some type of trauma in addition to the radiation exposure.

Being exposed to a radiation source does not make a patient contaminated or radioactive. However, when patients have a radioactive source on their body (such as debris from a bomb that dispersed radioactive material), they are contaminated and must be initially cared for by a HazMat responder. Maintain a safe distance and wait for the HazMat team to decontaminate the patient before initiating care. Once decontaminated by the HazMat team, care is often transferred to the EMT. Most contaminants can be removed by simply removing the patient's clothes. Call for additional resources to manage this situation. Once the patient is decontaminated and there is no threat to you, begin treating the ABCs and treat the patient for any burns or trauma.

Irrigate open wounds. Washing should be gentle to avoid further damage to the skin, which could result in additional internal radiation absorption. Irrigate the head and scalp the same way. The ED should be notified as soon as practical if you are transporting a potentially contaminated patient. In contrast with other types of contamination, radioactive particulate matter probably poses a relatively small risk to the provider. Consider providing basic care to the patient before decontamination if you are wearing protective clothing.

Increasing your and the patient's distance from the source by even a few feet may dramatically decrease your exposure. Therefore, it is important to identify the radioactive source and the length of the patient's exposure to it, if this information is available without putting you or your patient at risk for exposure. If not readily available, rely on the HazMat team to obtain this information. Limit your duration of exposure, increase your distance from the source, and attempt to place shielding between yourself and sources of gamma radiation.

With contact radiation burns, decontaminate the wound as if it were a chemical burn to remove any radioactive particulate matter, then treat it as a burn.

Many radioactive isotopes are used in medicine and industry, some of which can be absorbed or have their toxic effects blunted by another substance. Like their radioactive effects, the toxic effects of these isotopes vary. Antidotes may help bind an isotope, enhance its elimination from the body, or reduce the toxic effects on other organs. Such antidotal therapy should be considered only under the guidance of a knowledgeable physician or public health agency.

Dressing and Bandaging

All wounds require bandaging. In most instances, splints help to control bleeding and provide firm support for the dressing. There are many different types of dressings and bandages **Figure 26-27**. You should be familiar with the function and proper application of each.

In general, dressings and bandages have three primary functions:

- To control bleeding
- To protect the wound from further damage
- To prevent further contamination and infection

Sterile Dressings

Universal dressings, conventional 4-inch × 4-inch and 4-inch × 8-inch gauze pads, and assorted small adhesive-type dressings and soft self-adherent roller dressings will cover most wounds. The universal dressing measures 9 inches × 36 inches, is made of thick, absorbent material, and is ideal for covering large open wounds. It also makes an efficient pad for rigid splints. These dressings are available in compact, commercially sterilized packages.

Gauze pads are appropriate for smaller wounds, and adhesive-type dressings are useful for minor wounds. **Occlusive dressings**, made of petroleum (Vaseline) gauze, aluminum foil, or plastic, prevent air and liquids from entering (or exiting) the wound. They are used to cover sucking chest wounds, abdominal eviscerations, penetrating back wounds, and neck injuries.

Figure 26-27 **A.** Many types of sterile dressings are used for covering open wounds, including universal dressings, gauze pads, adhesive dressings, and occlusive dressings. **B.** Bandages keep dressings in place and include soft roller bandages, triangular bandages, and adhesive tape. Splints may also be used to hold dressings in place.

A, B: © Jones & Bartlett Learning. Courtesy of MIEMSS.

Bandages

To keep dressings in place during transport, you can use soft roller bandages, rolls of gauze, triangular bandages, or adhesive tape. The self-adherent, soft roller bandages are probably easiest to use. They are slightly elastic, which makes them easy to apply, and you can tuck the end of the roll into a deeper layer to secure it in place. The layers adhere somewhat but should not be applied too tightly to one another.

Adhesive tape holds small dressings in place and helps secure larger dressings. Some people, however, are allergic to adhesive tape. If you know your patient is allergic, use paper or plastic tape instead.

Do not use elastic bandages to secure dressings. If the injury swells, the bandage may become a tourniquet and cause further damage. Any improperly applied bandage that impairs circulation can result in additional tissue damage or even the loss of a limb. Always check a limb distal to a bandage for signs of impaired circulation and loss of sensation. Air splints and vacuum splints are useful in stabilizing broken extremities, and they can be used with dressings to help control bleeding from soft-tissue injuries.

As discussed in Chapter 25, *Bleeding*, if a wound continues to bleed despite the use of direct pressure, quickly use a tourniquet. Research from the Iraq war has taught us that use of a tourniquet is rarely as harmful to the patient as it was once thought. If you cannot control bleeding from a major vessel in an extremity, a properly applied tourniquet may save a patient's life. Specifically, the tourniquet is useful if a patient is bleeding severely from a partial or complete amputation.

YOU are the Provider — SUMMARY

1. What should be your most immediate priority?

As with any patient, your first priority is to prevent further harm. Although the patient was brought to you wrapped in a blanket, this does not mean that his skin or clothing have stopped burning. First, remove the blanket, to ensure that his clothes are not smoldering and that the burning process has stopped.

If the patient's clothes are still smoldering or if there is any other evidence to indicate the burning process is ongoing, pour sterile water or saline over the affected areas. Alternatively, apply moist, sterile dressings to extinguish the burning areas. These actions not only stop the burning process, they also help relieve pain. If the burning process has stopped, do not apply any water, saline, or moist dressings until you further assess the patient.

2. What is a thermal burn? What are the causes of thermal burns?

A thermal burn is a burn caused by heat—as opposed to radiation, chemicals, or electricity; however, many different situations can cause thermal burns.

Most commonly, thermal burns are caused by an open flame (flame burn), but thermal burns can result whenever the skin is exposed to temperatures higher than 111°F (44°C). In general, the severity of a thermal burn correlates directly with the temperature of the heat source, the amount of heat energy possessed by the object or substance, and the duration of exposure.

Other sources of heat energy, other than fire, include scald burns, which occur from exposure to boiling liquids; contact burns, which occur when a person comes in contact with a heated surface; steam burns, which occur when the body is exposed to superheated gaseous water; and flash burns, which occur when a person is briefly exposed to very intense heat (eg, explosion).

3. What additional information should you obtain from the firefighters who rescued the patient?

It has already been established that the patient was trapped in an enclosed space because the firefighters rescued him from the structure. However, you should determine an approximate length of exposure; this is usually a gross estimate at best.

Determine if the patient was conscious or unconscious when he was found. Conscious patients are often able to extinguish themselves, unless they are completely engulfed in flames. If the patient is unconscious, however, he or she does not have control over the duration of exposure to the fire itself or the quantity of superheated air that he or she inhales.

Determine how the patient was found. Was the patient in an open area of a room or was he or she trapped beneath a collapsed ceiling beam or other heavy structure? Although you should always assess the patient for traumatic injuries, information provided by the firefighters regarding any MOI can help you focus on a particular area (or areas) of the body. Do not assume the patient's injuries are limited to skin burns and toxic gas exposure; the patient may have experienced other injuries (eg, blunt trauma with internal bleeding, head injury) that could be life threatening.

4. How are thermal burns classified? What are the characteristics of each type of burn?

Burns are classified according to their depth—that is, how far the burn injury extends through the layers of the skin (ie, epidermis, dermis). The types of burns you must be able to identify are superficial (first degree), partial-thickness (second degree), and full-thickness (third degree).

Superficial (first-degree) burns involve only the outer layer of the skin—the epidermis. The skin turns red and is often painful, but it does not blister or burn through the epidermis.

Partial-thickness (second-degree) burns involve the epidermis and some portion of the dermis. These burns do not destroy the entire thickness of the skin, nor is the subcutaneous (fatty) tissue injured.

Full-thickness (third-degree) burns extend through all layers of the skin and may involve the subcutaneous layers, muscle, bone, or internal organs. The burned area may appear dry and leathery and may appear white, dark brown, or even charred.

5. What percentage of the patient's body surface area has been burned?

After you identify the depth of a burn, you must rapidly estimate the extent of the burns—that is, the percentage of the patient's body surface area (BSA) that is burned.

Your patient has experienced burns to his anterior torso (chest and abdomen); this represents 18% of his BSA. Additionally, both upper extremities are burned, which represents 18% (9% per extremity) of his BSA. Therefore, *your patient has burns that cover approximately 36% of his BSA*.

6. What factors should you consider to determine the severity of a burn?

When determining the severity of a burn, the two most important factors to consider initially are the depth and extent of the burn.

The American Burn Association classifies burns as being minor, moderate, and severe. However, your local protocols or regional burn center may have slightly different criteria.

Minor burns in an adult include full-thickness burns that cover less than 2% of the BSA, partial-thickness burns that cover less than 15% of the BSA, and superficial burns that cover less than 50% of the BSA. Moderate burns include full-thickness burns that cover between 2% to 10% of the BSA (excluding burns to critical areas of the body), partial-thickness burns that cover 15% to 30% of the BSA, and superficial burns that cover more than 50% of the BSA. Severe burns include *any* full-thickness burn to a critical area of the body, full-thickness burns that cover more than 10% of the BSA to noncritical areas of the body, and partial-thickness burns that cover more than 30% of the BSA.

In addition to the depth and extent of the burn, you must also determine if the burns are located in any critical areas of the body. Critical areas of the body include the face, upper airway, hands, feet, and genitalia.

7. What is the proper treatment of the patient's burns?

Large (greater than 10%) BSA burns should be covered with a dry, sterile, nonadherent dressing (eg, a sterile burn sheet); *your patient has burns that cover approximately 36% of his BSA*. Other than for the purpose of stopping the burning process, do not apply water or saline to large surface area burns. The larger the burn area, the greater the risks of hypothermia, hypovolemia, and infection.

Dry, sterile dressings applied to large surface area burns help maintain body temperature (reduce the risk of hypothermia), prevent further contamination of the burn (reduce the risk of infection), and provide comfort.

Use further treatment to prevent hypothermia (cover the patient with a blanket); closely monitor the patient's airway and ventilation status, and monitor for signs of shock.

8. How has the patient's condition changed? What should you do now?

The patient's breathing is becoming labored. Respiratory distress in a burn patient, especially in a patient without other injuries that would cause breathing difficulties (eg, blunt chest trauma), indicates upper airway swelling secondary to inhaling excessive heat (inhalation injury).

Patients who are trapped in an enclosed space with poor ventilation, especially if they have a loss of consciousness, are at highest risk for an inhalation injury.

Although your patient denies a loss of consciousness, you should still suspect some degree of upper airway swelling because he was in an enclosed space.

If the patient is breathing adequately, continue to administer high-flow oxygen and closely observe the patient. Cool mist or aerosol therapy may help reduce mild airway swelling; however, if this is not available, apply an ice pack to the throat area. If the patient is not breathing adequately (eg, shallow breathing [reduced tidal volume], labored respirations, falling oxygen saturation, decreasing level of consciousness), assist his or her ventilations with a BVM.

Depending on your transport time to the closest appropriate hospital and the availability of ALS resources in your area, you should consider an intercept with an AEMT or paramedic unit. Some patients with inhalation injuries require advanced airway management, such as endotracheal intubation, to protect the airway before it closes completely.

9. What, if any, additional treatment is indicated for this patient?

Continuous, careful monitoring of this patient is essential. Although his condition does not seem to have worsened, it also has not improved. Continue to administer high-flow oxygen, closely monitor the adequacy of his breathing, and be prepared to assist his ventilations. Monitor him for signs of shock and treat accordingly.

Any patient who is experiencing respiratory distress will be anxious. Provide emotional support and let the patient assume a position of comfort; this is usually a full Fowler (90-degree angle) position.

EMS Patient Care Report (PCR)

Date: 10-14-16	**Incident No.:** 012309	**Nature of Call:** Burns		**Location:** 511 Bandera Rd.	
Dispatched: 1500	**En Route:** 1500	**At Scene:** 1500	**Transport:** 1514	**At Hospital:** 1530	**In Service:** 1541

Patient Information

Age: 45 **Sex:** M **Weight (in kg [lb]):** 77 kg (170 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** None **Chief Complaint:** Burns to the torso and arms

Vital Signs

Time: 1506	**BP:** 166/86	**Pulse:** 108	**Respirations:** 14	**Spo_2:** 98%
Time: 1512	**BP:** 158/84	**Pulse:** 120	**Respirations:** 22	**Spo_2:** 95%
Time: 1517	**BP:** 160/80	**Pulse:** 116	**Respirations:** 22	**Spo_2:** 96%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC** **NRM** **BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Thermal management, sterile burn sheet application

Narrative

Medic 4 was standing by at the scene of a residential fire when firefighters rescued a 45-year-old man from the burning structure. They presented the patient wrapped in a blanket; he was ambulatory and the burning process was stopped before EMS contact was made. The approximate time of exposure to the burning environment was 8 to 10 minutes. The patient was conscious and alert, his airway was patent, his breathing was adequate, and his face was covered with soot. He reported severe pain to his chest, abdomen, and arms. Immediately moved patient into ambulance, applied high-flow oxygen via nonrebreathing mask, and assessed his burns. Assessment revealed burns that covered approximately 36% of his BSA. Partial-thickness burns were noted to the entire anterior torso, and partial- and full-thickness burns were noted to both of his upper extremities. Additional assessment revealed that his facial hair and the hair just above his hairline were singed; no facial skin burns were noted. The patient denied shortness of breath or any other symptoms other than severe pain from his burns. Secondary assessment did not reveal any other obvious injuries. Patient denies significant past medical history and states he does not take any medications. During the patient's entrapment, he stated he did not have a loss of consciousness. Applied dry, sterile burn sheets to patient's burns, covered him with a blanket for warmth, and began transport to the hospital. En route, notified medical control, who advised us to transport to the ED because the closest burn center was located 75 miles away. Reassessment revealed that the patient's respirations were becoming labored and his voice was becoming hoarse. Continued high-flow oxygen, applied ice pack to the patient's throat area, and continued to monitor his airway and breathing status. Notified the receiving facility of the patient's status and our impending arrival. The patient's vital signs remained stable throughout the duration of the transport, and his oxygen saturation never fell below 95%. Delivered patient to the ED without incident and gave verbal report to the attending physician. Medic 4 returned to service at 1541.**End of report**

Prep Kit

Ready for Review

- The skin protects the body by keeping pathogens out and water in and assisting in body temperature regulation.
- There are three types of soft-tissue injuries:
  - Closed injuries (Soft-tissue damage occurs beneath the skin or mucous membrane but the surface remains intact.)
  - Open injuries (There is a break in the surface of the skin or the mucous membrane, exposing deeper tissue to potential contamination.)
  - Burns (The soft tissue receives more energy than it can absorb without injury; the source of this energy can be thermal, toxic chemicals, electricity, or radiation.)
- Closed soft-tissue injuries are characterized by a history of blunt trauma, pain at the site of injury, swelling beneath the skin, and discoloration. Contusions, hematomas, and crushing injuries are classified as closed injuries. Treat a closed soft-tissue injury by applying the mnemonic RICES: *Rest, Ice, Compression, Elevation*, and *Splinting*.
- Open injuries differ from closed injuries in that the protective layer of skin is damaged. Abrasions, lacerations, avulsions, and penetrating wounds are classified as open injuries. Treat an open soft-tissue injury by applying direct pressure with a sterile bandage using a roller bandage, and splint the extremity. Use a tourniquet when necessary to control bleeding.
- It is generally easier to assess an open injury than it is to assess a closed injury because you can see the injury.
- Burns are serious and painful soft-tissue injuries caused by heat (thermal), chemicals, electricity, and radiation.
- Burns are classified primarily by the depth and extent of the burn injury and the body area involved.
- Burns are considered to be superficial, partial-thickness, or full-thickness based on the depth involved.
- When providing emergency care for burns, do the following:
  - Use standard precautions to protect yourself from potentially contaminated body fluid and to protect the patient from potential infection.
  - Ensure you have cooled the burned area to prevent further cellular damage.
  - Remove jewelry and constrictive clothing; never attempt to remove any synthetic material that may have melted into the burned skin.
  - Ensure an open and clear airway, provide high-flow oxygen, and be alert to signs and symptoms of inhalation injury such as difficulty breathing, stridor, or wheezing.
  - Place sterile dressings over the burn areas; to prevent hypothermia, cover the patient with a clean blanket. Provide prompt transport.
- Small animal and human bites can lead to serious infection and must be evaluated by a physician. Small animals can carry rabies.
- Dressings and bandages are designed to control bleeding, protect the wound from further damage, prevent further contamination, and prevent infection.

Vital Vocabulary

abrasion Loss or damage of the superficial layer of skin as a result of a body part rubbing or scraping across a rough or hard surface.

amputation An injury in which part of the body is completely severed.

avulsion An injury in which soft tissue is torn completely loose or is hanging as a flap.

burns Injuries in which soft-tissue damage occurs as a result of thermal heat, frictional heat, toxic chemicals, electricity, or nuclear radiation.

closed injuries Injuries in which damage occurs beneath the skin or mucous membrane but the surface of the skin remains intact.

compartment syndrome Swelling in a confined space that produces dangerous pressure; may cut off blood flow or damage sensitive tissue.

contact burn A burn caused by direct contact with a hot object.

contamination The presence of infective organisms or foreign bodies such as dirt, gravel, or metal.

contusion A bruise from an injury that causes bleeding beneath the skin without breaking the skin.

crush syndrome Significant metabolic derangement that develops when crushed extremities or body parts remain trapped for prolonged periods. This can lead to renal failure and death.

crushing injury An injury that occurs when a great amount of force is applied to the body.

dermis The inner layer of the skin, containing hair follicles, sweat glands, nerve endings, and blood vessels.

ecchymosis Discoloration associated with a closed wound; signifies bleeding.

epidermis The outer layer of skin that acts as a watertight protective covering.

evisceration The displacement of organs outside the body.

excited delirium A serious behavioral condition in which a person exhibits agitated behavior combined with disorientation, hallucinations, or delusions; also called agitated delirium or exhaustive mania.

fascia The fiberlike connective tissue that covers arteries, veins, tendons, and ligaments.

flame burn A burn caused by an open flame.

flash burn A burn caused by exposure to very intense heat, such as in an explosion.

full-thickness (third-degree) burns Burns that affect all skin layers and may affect the subcutaneous layers, muscle, bone, and internal organs, leaving the area dry, leathery, and white, dark brown, or charred.

hematoma Blood collected within the body's tissues or in a body cavity.

impaled objects Objects that penetrate the skin but remain in place.

incision A sharp, smooth cut in the skin.

laceration A deep, jagged cut in the skin.

mucous membranes The linings of body cavities and passages that are in direct contact with the outside environment.

occlusive dressings Dressings made of petroleum (Vaseline) gauze, aluminum foil, or plastic that prevent air and liquids from entering or exiting a wound.

open injuries Injuries in which there is a break in the surface of the skin or the mucous membrane, exposing deeper tissue to potential contamination.

partial-thickness (second-degree) burns Burns that affect the epidermis and some portion of the dermis but not the subcutaneous tissue, characterized by blisters and skin that is white to red, moist, and mottled.

penetrating wound An injury resulting from a sharp, piercing object.

rabid Infected with rabies.

rule of nines A system that assigns percentages to sections of the body, allowing calculation of the amount of skin surface involved in the burn area.

scald burn A burn caused by hot liquids.

steam burn A burn caused by exposure to hot steam.

superficial (first-degree) burns Burns that affect only the epidermis, characterized by skin that is red but not blistered or actually burned through.

thermal burns Burns caused by heat.

Assessment *in Action*

You are dispatched to a bar to respond to a fight. The police have cleared the scene and it is safe for you to enter. You see a man, conscious and alert. His face is mottled with blisters and abrasions, and he has blood on his shirt. He tells you he was trying to stop the fight when he was hit in the face with scalding hot coffee and then he fell backward into a chair. Physical examination shows a jagged laceration measuring approximately 2 inches on his abdomen.

It is still bleeding, and you notice bruising on the right lateral chest. Vital signs are stable.

1. What is the classification of this burn?

   A. Superficial
   B. Partial-thickness
   C. Full-thickness
   D. Thermal

2. The priority in treating this patient is to:

   A. clean any open wounds.
   B. take vital signs.
   C. stop the burning process.
   D. keep the airway open.

3. What kind of burn is this?

   A. Inhalation burn
   B. Thermal burn
   C. Radiation burn
   D. Chemical burn

4. According to the rule of nines, what percentage of the patient's skin surface is burned?

   A. 4.5%

B. 7.5%
C. 9%
D. 18%

5. What is the priority for treating an open wound on the patient's abdomen?

   A. Clean it.
   B. Flush it with sterile saline.
   C. Probe it.
   D. Stop the bleeding.

6. Which of the patient's soft-tissue injuries is least likely to result in infection?

   A. Contusion on the right lateral chest
   B. Abdominal laceration
   C. Burns to the face
   D. Abrasions to the face

7. Is this a severe burn? Why or why not?

8. What is the rule of nines?

9. What are the steps to take to control bleeding?

10. How should you treat a closed injury?

CHAPTER
27

Face and Neck Injuries

National EMS Education Standard Competencies

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Diseases of the Eyes, Ears, Nose, and Throat

Recognition and management of
› Nosebleed (pp 965–967)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Head, Facial, Neck, and Spine Trauma

› Recognition and management of:
  • Life threats (pp 950–956)
  • Spine trauma (Chapter 28, *Head and Spine Injuries*)
› Pathophysiology, assessment, and management of:
  • Penetrating neck trauma (pp 950–956, 970–972)
  • Laryngotracheal injuries (pp 950–956, 971–972)
  • Spine trauma (Chapter 28, *Head and Spine Injuries*)
  • Facial fractures (pp 950–956, 969–970)

- Skull fractures (Chapter 28, *Head and Spine Injuries*)
- Foreign bodies in the eyes (pp 950–960)
- Dental trauma (pp 950–956, 970)

Knowledge Objectives

1. Describe the anatomy and physiology of the head, face, and neck; include major structures and specific important landmarks of which EMTs must be aware. (pp 947–950)
2. Describe the factors that may cause the obstruction of the upper airway following a facial injury. (pp 950–951)
3. Discuss the different types of facial injuries and patient care considerations related to each one. (pp 950–951)
4. Explain the emergency care of a patient who has sustained face and neck injuries; include assessment of the patient, review of signs and symptoms, and management of care. (pp 950–956)
5. Explain emergency medical care of a patient with soft-tissue wounds of the face and neck. (pp 955–956)
7. Describe the three different causes of a burn injury to the eye and patient management considerations related to each one. (pp 959–961)
8. Explain emergency medical care of a patient with injuries of the nose. (pp 965–967)
9. Explain the emergency medical care of a patient with injuries of the ear, including lacerations and foreign body insertions. (pp 967–969)
10. Explain the physical findings and emergency care of a patient with a facial fracture. (pp 969–970)
11. Explain the emergency medical care of the patient with dental and cheek injuries; include how to deal with an avulsed tooth. (p 970)
12. Explain the emergency medical care of a patient with an upper airway injury caused by blunt trauma. (pp 970–971)
13. Explain the emergency medical care of the patient with a penetrating injury to the neck; include how to control regular and life-threatening bleeding. (pp 971–972)

Skills Objectives

1. Demonstrate the removal of a foreign object from under a patient's upper eyelid. (pp 956–958, Skill Drill 27-1)
2. Demonstrate the stabilization of a foreign object that has been impaled in a patient's eye. (pp 959–960, Skill Drill 27-2)
3. Demonstrate irrigation of a patient's eye using a nasal cannula, bottle, or basin. (pp 960–962)
4. Demonstrate the care of a patient who has a penetrating eye injury. (p 962)
5. Demonstrate how to control bleeding from a neck injury. (pp 971–972, Skill Drill 27-3)

Introduction

The face and neck are particularly vulnerable to injury because of their relatively unprotected positions on the body. Soft-tissue injuries and fractures to the bones of the face are common and vary greatly in severity. Some are potentially life threatening, and many leave disfiguring scars if not treated properly. Penetrating trauma to the neck may cause severe bleeding. An open injury may allow an air embolism to enter the circulatory system. If a hematoma forms in this area, it may stop or slow blood flow to the brain, causing a stroke. With appropriate prehospital and hospital care, a patient with a seemingly devastating injury can have a surprisingly good outcome.

As an EMT, your objectives when treating a patient with face and neck injuries include prevention of further injury, particularly to the cervical spine, managing any acute airway problems, and controlling bleeding. This chapter first reviews the anatomy of the head and neck and then examines the factors that can produce upper airway obstruction. A discussion follows that includes emergency medical care of soft-tissue wounds of the face, nose, and ear; facial fractures; penetrating injuries of the neck; and dental injuries.

Anatomy and Physiology

The head is divided into two parts: the cranium and the face. The cranium, or skull, contains the brain, which connects to the spinal cord through the foramen magnum, a large opening at the base of the skull. The most posterior portion of the cranium is called the occiput. On each side of the cranium, the lateral portions are called the temples or temporal regions. Between the temporal regions and the occiput lie the parietal regions. The forehead is called the frontal region. Just anterior to the ear, in the temporal region, you can feel the pulse of the superficial temporal artery.

The face is composed of the eyes, ears, nose, mouth, and cheeks. Six bones—the nasal bone, the two maxillae (upper jaw bones), the two zygomas (cheek bones), and the mandible (jaw bone)—are the major bones of the face **Figure 27-1**.

The orbit of the eye is composed of the lower edge of the frontal bone of the skull, the zygoma, the maxilla, and the nasal bone. The bony orbit protects the eye from injury. By viewing the face from the side, you can see the eyeball recessed in the orbit. Only the proximal third of the nose—the bridge—is formed by bone. The remaining two-thirds are composed of cartilage.

The exposed portion of the ear is composed entirely of cartilage that is covered by skin. The external, visible part of the ear is called the **pinna** **Figure 27-2**. The ear lobes are the fleshy portions at the bottom of each ear. The **tragus** is a small, rounded, fleshy bulge immediately anterior to the ear canal. The superficial temporal artery can be palpated just anterior to the tragus. About 1 inch posterior to the external opening of the ear is a prominent bony mass at the base of the skull called the **mastoid process**.

The jaw is the lower border of the mouth, where the tongue and 32 teeth are located. Motion of the mandible occurs at the **temporomandibular joint**, which lies just in front of the ear on either side of the face. Below the ear and anterior to the mastoid process, the angle of the mandible is easily palpated.

The neck also contains many important structures. It is supported by the cervical spine, or the first seven vertebrae in the spinal column (C1 through C7). The spinal cord exits from the foramen magnum and lies within the spinal canal formed by the vertebrae. The upper part of the esophagus and the trachea lie in the midline of the neck. The carotid arteries are found on either side of the trachea, along with the jugular veins and several nerves.

YOU are the Provider — PART 1

At 1926 hours, you are dispatched to the parking lot of a convenience store at 1505 Eagle Rock Drive for a patient who was allegedly assaulted. You and your partner respond to the scene, which is located about 3 miles away. Law enforcement personnel, who are on scene, advise you that the scene has been secured, and that your patient, a young man, is conscious but has severe trauma to his face.

1. What should be your most immediate concern after receiving this initial patient information?
2. What should your initial actions consist of when you arrive at the scene?

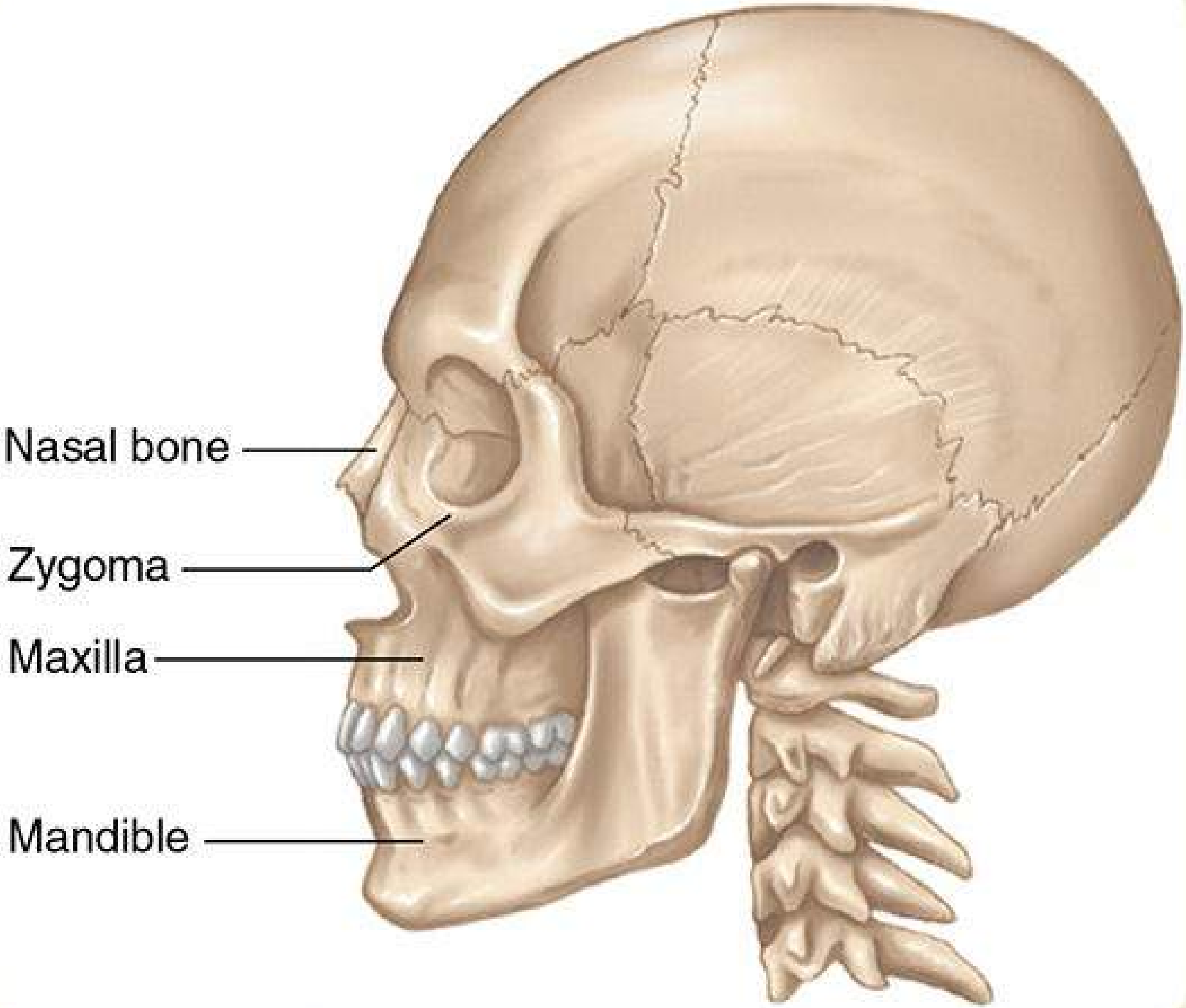


Figure 27-1 The face is composed of six bones: the nasal bone, two maxillae, two zygomas, and the mandible.

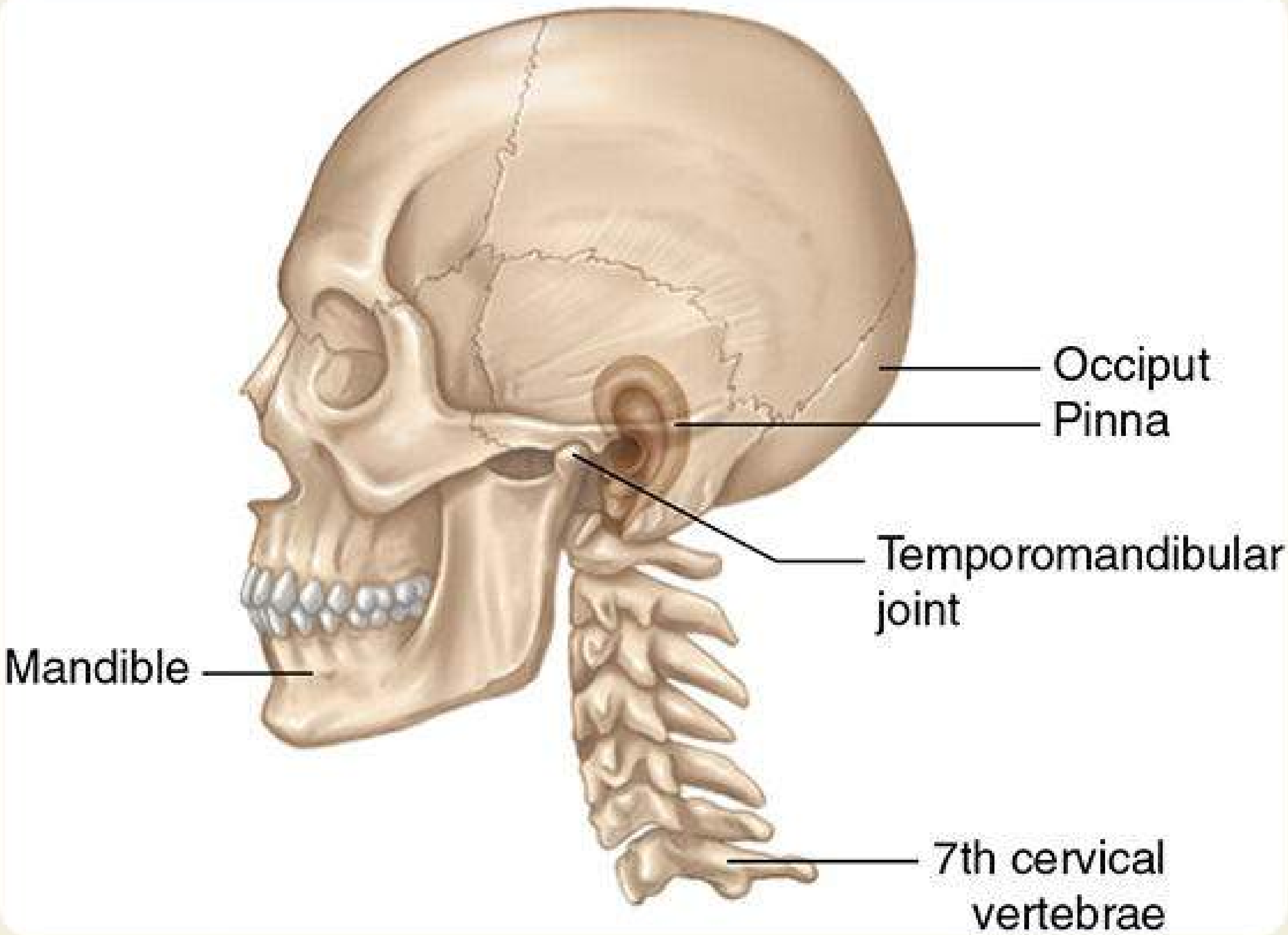


Figure 27-2 Specific landmarks of the head and neck include the pinna, the mandible, the occiput, the seventh cervical vertebra, and the temporomandibular joint.

Several useful landmarks can be palpated and seen in the neck **Figure 27-3**. The most obvious is the firm prominence in the center of the anterior surface, commonly known as the Adam's apple. Specifically, this prominence is the upper part of the larynx, formed by the thyroid cartilage. It is more prominent in men than in women. The other portion of the larynx is the cricoid cartilage, a firm ridge of cartilage (the only complete circular cartilage structure of the trachea) below the thyroid cartilage, which is somewhat more difficult to palpate. Between the thyroid cartilage and the cricoid cartilage in the midline of the neck is a soft depression, the cricothyroid membrane. This is a thin sheet of connective tissue (fascia) that joins the two cartilages Figure 27-4. The cricothyroid membrane is covered at this point only by skin.

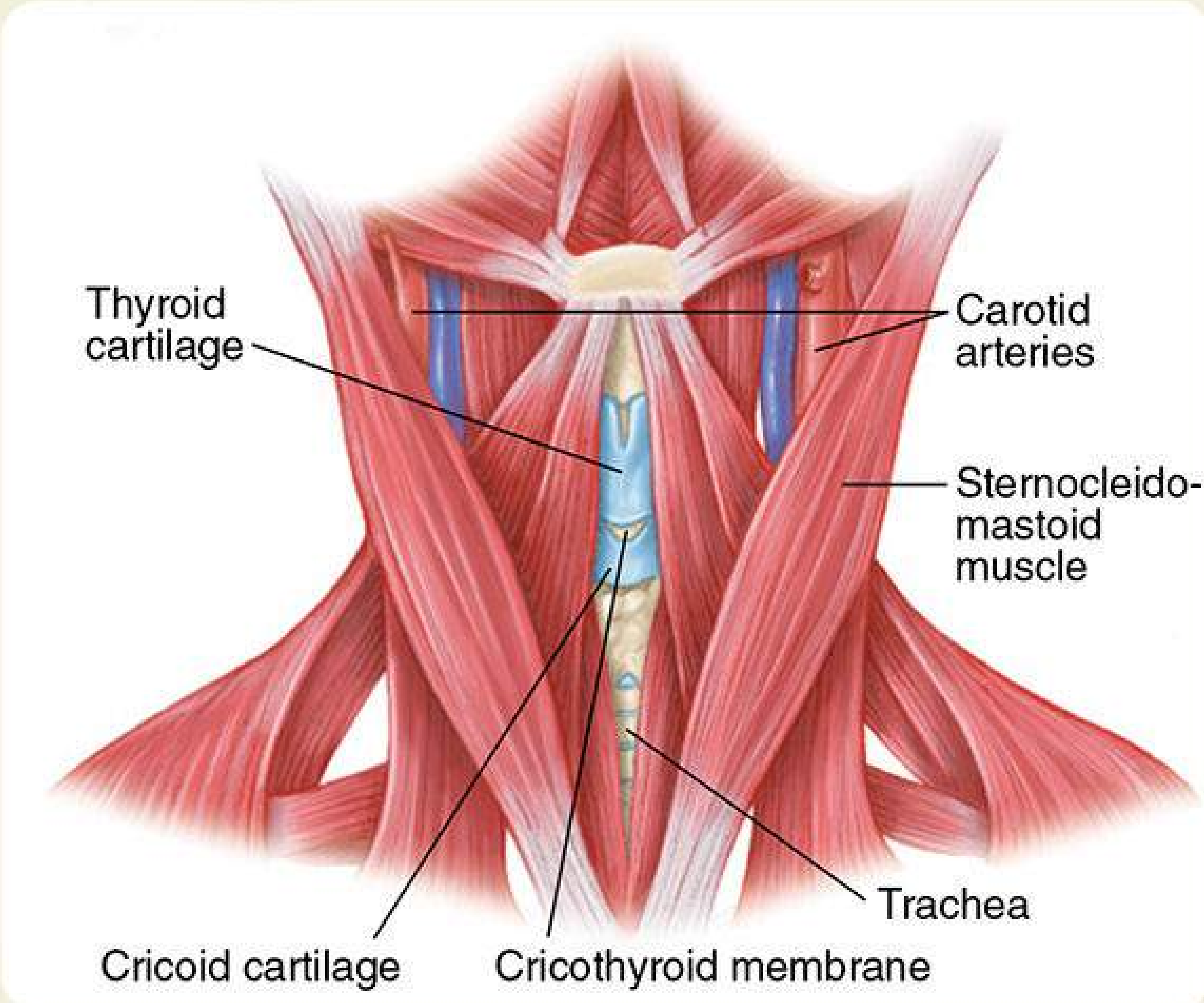


Figure 27-3 Important landmarks in the neck include the cricoid cartilage, the thyroid cartilage, the carotid arteries, the cricothyroid membrane, and the sternocleidomastoid muscles.

Below the larynx, several additional firm ridges are palpable in the anterior midline. These ridges are the cartilage rings of the trachea. The trachea connects the oropharynx and the larynx with the main air passages of the lungs (the bronchi). On either side of the lower larynx and the upper trachea lies the thyroid gland. Unless it is enlarged, this gland is usually not palpable.

Pulsations of the carotid arteries are easily palpable in a groove approximately 0.5 inch lateral to the larynx. Lying immediately adjacent to these arteries, but not palpable, are the internal jugular veins and several important nerves. Lateral to these vessels and nerves lie the **sternocleidomastoid muscles**. These muscles originate from the mastoid process of the cranium and insert into the medial border of each collarbone and the sternum at the base of the neck. They allow movement of the head.

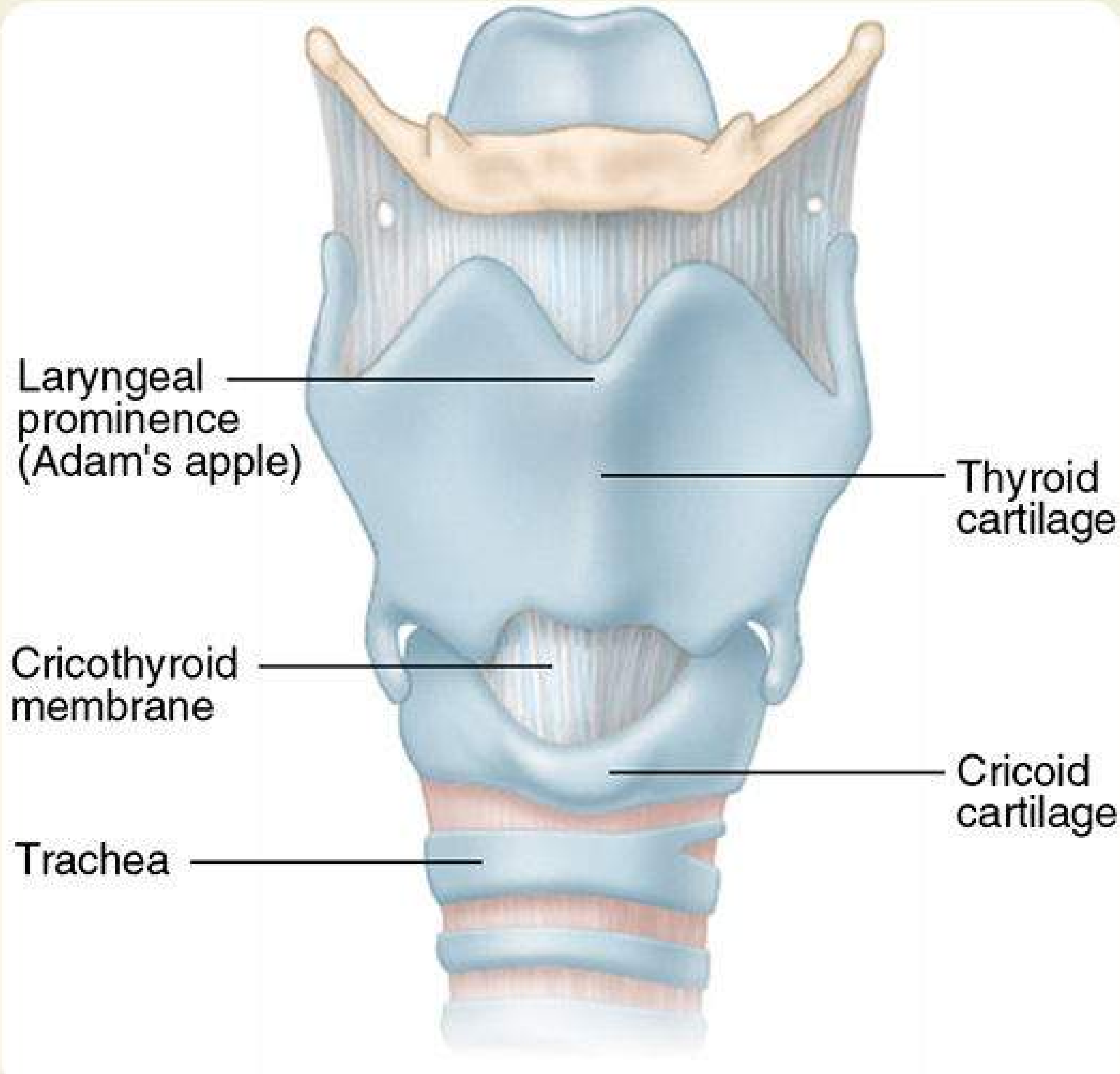


Figure 27-4 The larynx.

A series of bony prominences lie posteriorly, in the midline of the neck. They are the spines of the cervical vertebrae. The lower cervical spines are more prominent than the upper ones. They are more easily palpable when the neck is in flexion. At the base of the neck posteriorly, the most prominent spine is the seventh cervical vertebra.

The eye is globe-shaped, approximately 1 inch in diameter, and located within a bony socket in the skull called the orbit Figure 27-5. The orbit is composed of the adjacent bones of the face and skull; the orbit forms the base of the floor of the cranial cavity, and directly above it are the frontal lobes of the brain. In the adult, more than 80% of the eyeball is protected within this bony orbit. Between and below the orbits are the nasal bone and the sinuses, respectively. Therefore, any severe injury to the face or head can potentially damage the eyeball or the muscles attached to the eyeball that cause the eye to move.

The Eye

The eyeball, or **globe**, keeps its global shape as a result of the pressure of the fluid contained within its two chambers. The clear, jellylike fluid near the back of the eye is called the vitreous humor. In front of the lens is a clear fluid called the aqueous humor, named for its watery appearance; in Latin, *aqua* means water. In penetrating injuries of the eye, aqueous humor can also leak out, but with time and appropriate medical treatment, the body can make more.

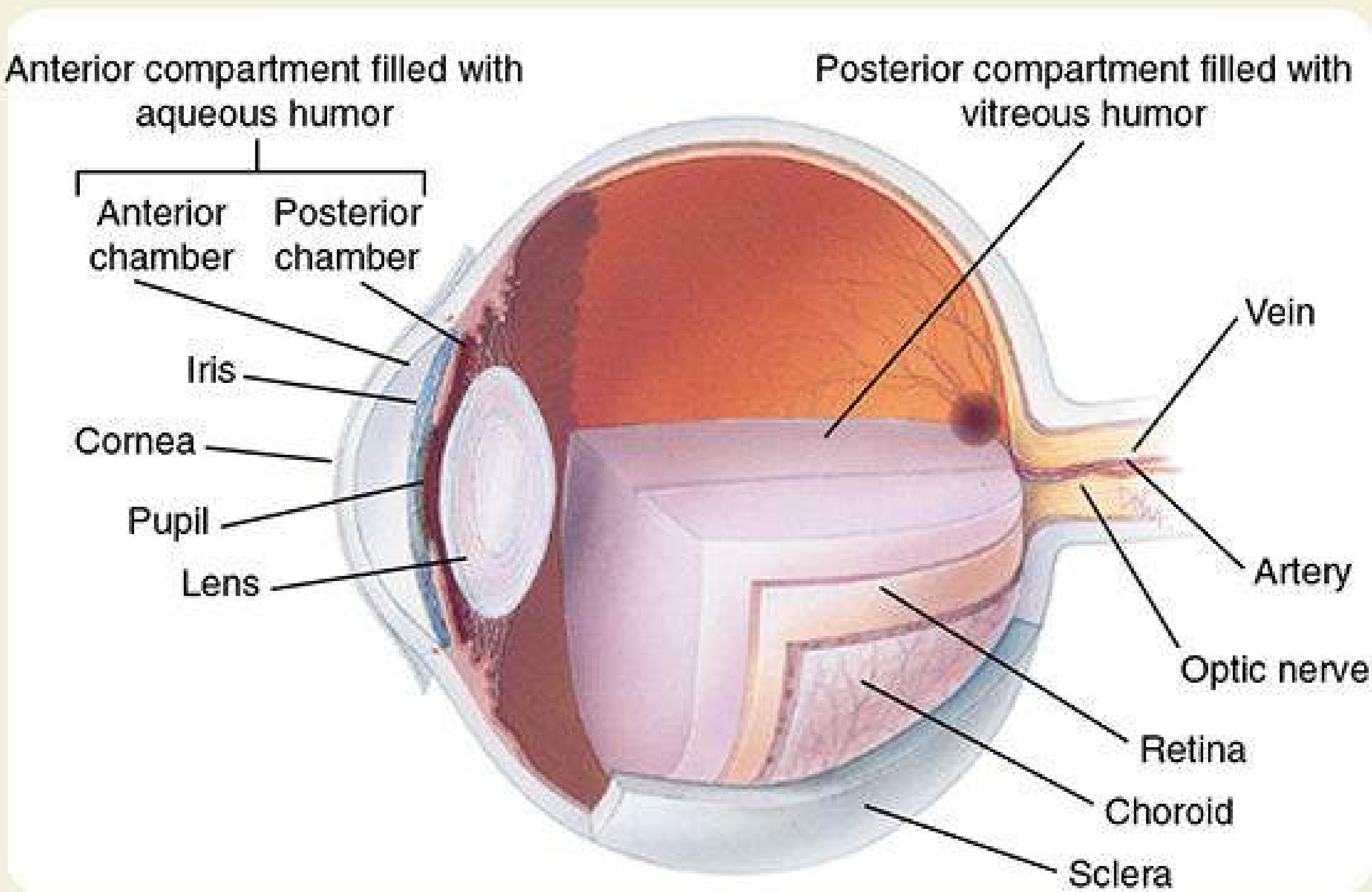


Figure 27-5 The major components of the eye.

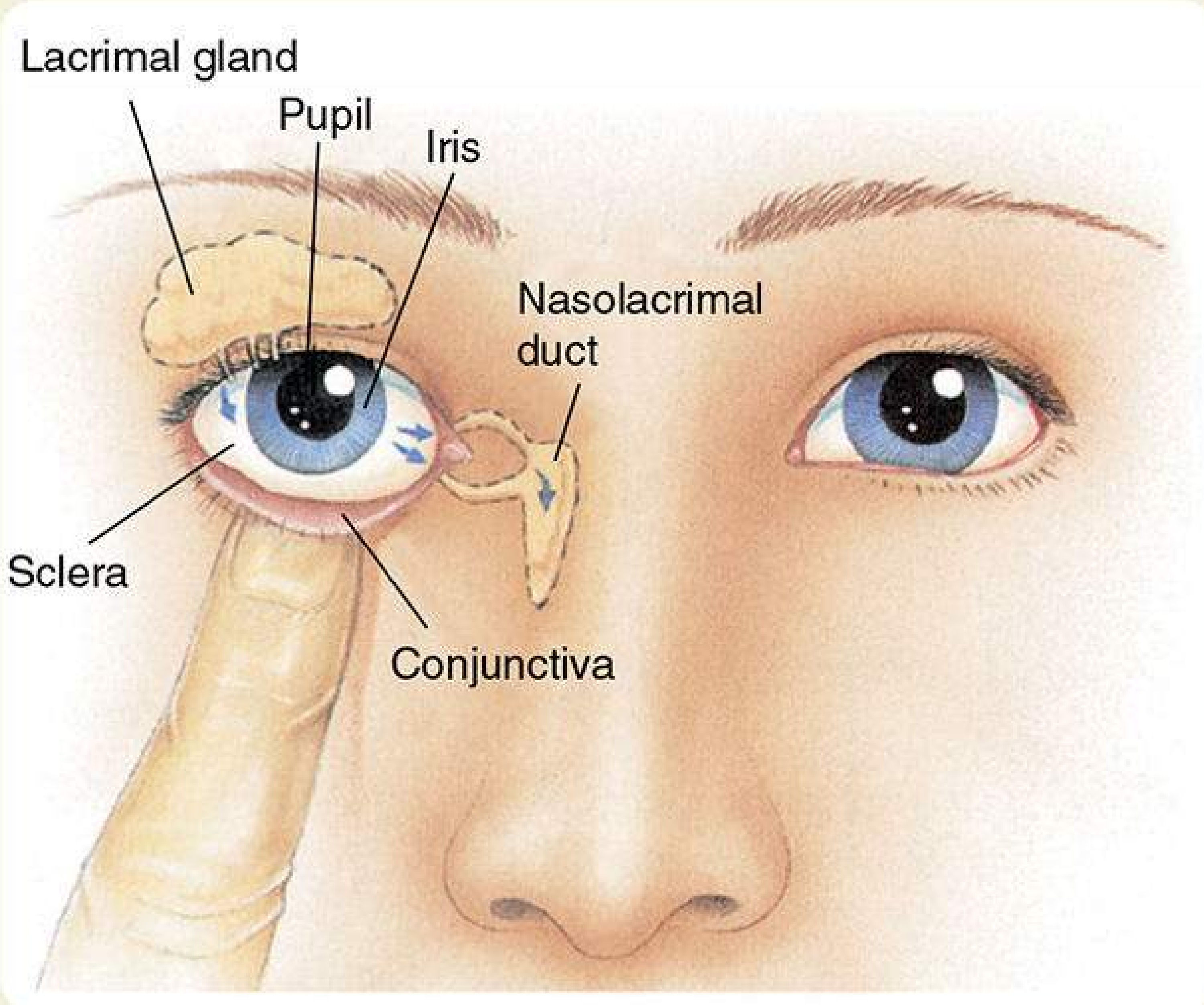


Figure 27-6 The lacrimal system consists of tear glands and ducts. Tears act as lubricants and keep the front of the eye from drying out.

The inner surface of the eyelids and the exposed surface of the eye itself, which are covered by a delicate membrane, the **conjunctiva**, are kept moist by fluid produced by the **lacrimal glands**, often called tear glands **Figure 27-6**. Humans blink unconsciously many times per minute. This action sweeps fluid from the lacrimal glands over the surface of the eye, cleaning it. The tears drain on the inner side of the eye through two lacrimal (tear) ducts into the nasal cavity. This is why, when people cry, they sometimes need to blow their nose.

The white of the eye, called the **sclera**, extends over the surface of the globe. This is extremely tough, fibrous tissue that helps maintain the eye's globular shape and protect the more delicate inner structures. On the front of the eye, the sclera is replaced by a clear, transparent membrane called the **cornea**, which allows light to enter the eye. A circular muscle lies behind the cornea with an opening in its center. Like the shutter in a camera, this muscle adjusts the size of the opening to regulate the amount of light that enters the eye. This circular muscle and surrounding tissue are called the **iris**. The iris is pigmented, giving the eye its characteristic brown, green, or blue color.

The opening in the center of the iris, which allows light to move to the back of the eye, is called the **pupil**. Normally, the pupil appears black. Like the opening in a camera, the pupil becomes smaller in bright light and larger in dim light. The pupil also becomes smaller and larger when the person is looking at objects near at hand and farther away; these adjustments occur almost instantaneously. Normally, the pupils in both eyes are equal in size. Some people are born with pupils that are not equal (**anisocoria**); however, particularly in unconscious patients, unequal pupil size may indicate serious injury or illness of the brain or eye.

Behind the iris is the **lens**. Like the lens of a camera, this lens focuses images on the light-sensitive area at the back of the globe, called the **retina**. Within the retina are numerous nerve endings, which respond to light by transmitting nerve impulses through the **optic nerve** to the brain. In the brain, the impulses are interpreted as vision.

The retina is nourished by a layer of blood vessels between it and the sclera at the back of the globe. This layer is called the choroid. If, as sometimes happens, the retina detaches from the underlying choroid and sclera, the nerve endings are not nourished, and the patient experiences blindness. This may be partial blindness, depending on how much of the retina is separated. This condition is called **retinal detachment**.

Words of Wisdom

The eye can see objects directly in front (central line vision) and objects to the side (peripheral vision).

Injuries of the Face and Neck

Injuries about the face and neck can often lead to partial or complete obstruction of the upper airway. Several factors may contribute to the obstruction. Bleeding from facial injuries can be very heavy, producing large blood clots in the upper airway. These clots can lead to complete obstruction, particularly in a patient who is not fully conscious. In particular, direct injuries to the nose and mouth, the larynx, or the trachea are often the source of significant bleeding and/or respiratory compromise. You may need to suction the airway if you are unable to control the bleeding. In addition, the injuries may cause loosened teeth or dentures to become dislodged into the throat where they may be swallowed or aspirated.

YOU are the Provider — PART 2

When you arrive at the scene, you find the patient, a 30-year-old man, sitting on the ground. He is conscious and alert and tells you, "They hurt me bad!" His face is swollen and covered with blood, he keeps spitting out small amounts of blood from his mouth, and his voice is hoarse. As your partner manually stabilizes his head, you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Face is covered with blood; appears anxious
Level of consciousness	Conscious and alert
Airway	A small amount of blood in the mouth, which he is spitting out
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, increased rate and strong; skin is pink, warm, and dry

3. Does this patient have a patent airway? How can you tell?
4. What should be your initial treatment priorities for this patient?

Figure 27-7

Facial hematoma.

The airway may also be affected when the patient's head is turned to the side, as often is done when the patient has an altered level of consciousness or is unconscious. Other factors that interfere with normal respirations include possible injuries to the brain and/or cervical spine that may be associated with facial injuries. If the great vessels in the neck are injured, significant bleeding and pressure on the upper airway are common; these can result in airway obstruction as well.

Depending on the mechanism of injury, there may be a cervical spine injury. If there is significant impact to the face, suspect accompanying cervical spine injury and follow your agency's protocol for cervical injuries.

▶ Soft-Tissue Injuries

Soft-tissue injuries of the face and neck are very common. Because the face and neck are extremely vascular, swelling from soft-tissue injuries in this area may be more severe than in other injured parts of the body. The skin and underlying tissues in these areas have a rich blood supply, so bleeding from penetrating injuries may be heavy. Even minor soft-tissue wounds of the face and neck may bleed profusely. A blunt injury that does not break the skin may cause a break in a blood vessel wall, leading blood to collect under the skin; this is called a hematoma **Figure 27-7**. In some situations, a flap of skin is peeled back, or avulsed, from the underlying muscle and fascia **Figure 27-8**.

Dental Injuries

Mandible (lower jaw) fractures are relatively common because of the prominence of the mandible itself. These fractures are second only to nasal fractures in frequency. Most of these fractures are the result of vehicle collisions and assaults. If your patient has a mandibular fracture, then consider the major force necessary to cause that fracture—there is a strong probability your patient will have additional facial trauma and/or cervical injuries. Signs of a mandibular fracture include a misalignment of the teeth, numbness of the chin, and an inability to open the mouth. The patient will most likely have swelling, bruising, and loosened or missing teeth.

Figure 27-8 A major avulsion injury is characterized by a large flap of skin that is peeled back from the underlying muscle and tissue.

Maxillary fractures are predominantly found after blunt-force, high-energy impacts such as an unrestrained driver striking the steering wheel, a fall, or a direct blow from an object such as a pipe. The signs include massive facial swelling, instability of the facial bones, and misalignment of the teeth.

Fractured and avulsed teeth are common following facial trauma. Dental injuries may be associated with motor vehicle crashes or an assault. Always assess the patient's mouth following a facial injury, especially if your examination reveals fractured or avulsed teeth. Teeth fragments (or even whole teeth) can become an airway obstruction and should be removed from the patient's mouth immediately.

Patient Assessment

Scene Size-up

As you arrive on the scene, observe for hazards and threats to the safety of the crew, bystanders, and the patient. Assess the impact of hazards on patient care and address those hazards. Assess for the potential for violence and assess for environmental hazards.

Patients who are conscious and supine and have oral or facial bleeding may protect their airway by coughing, projecting the blood at you. Therefore, standard precautions require eye protection and a face mask. Also, put several pairs of gloves in your pocket for easy access in the event your gloves tear or there are multiple patients with bleeding.

If your response is to a motor vehicle crash, you may be confronted with more than one patient in a vehicle. Determine the number of patients and consider if you need additional or specialized resources on the scene.

As you observe the scene, look for indicators of the mechanism of injury (MOI). This assessment helps you develop an early index of suspicion for underlying injuries in the patient who has sustained a significant MOI. As you put together information from dispatch and your observations of the scene, consider how the MOI produced the injuries expected. Common MOI for face and neck injuries include motor vehicle collisions, sports, falls, penetrating trauma, and blunt trauma. In motor vehicle collisions, the probability of injury increases if the vehicle rolled over or came to an abrupt stop when striking an immovable object, such as a tree. Injuries sustained during sports participation may include a player without a helmet who was struck by a baseball or two players who sustained a helmet-to-helmet collision in football.

Primary Assessment

As you approach the patient, look for important indicators to alert you to the seriousness of the patient's condition. Is the patient interacting with the environment or lying still, making no sounds? Does the patient have any apparent life threats such as significant bleeding? How is the patient's skin color? The general impression will help you develop an index of suspicion for serious injuries and determine your sense of urgency for medical intervention.

Injuries to the face and throat may be very obvious, such as bleeding and significant swelling, but may also be hidden under collars and hats. Because of the likelihood of respiratory distress with these injuries, they should be recognized as early as possible.

As with any injury with life-threatening bleeding, control the blood loss with direct pressure. Always consider the need for manual spinal stabilization and check for responsiveness using the AVPU scale.

Ensure that the patient has a clear and patent airway. If the patient is unresponsive or has a significantly altered level of consciousness, consider inserting a properly sized oropharyngeal airway. The use of a nasopharyngeal airway is controversial, as many believe that inserting a nasopharyngeal airway into the nare of a patient with facial or head trauma carries the risk of introducing the device into the cranial vault and brain tissue. However, recent research suggests this risk is extremely small. As always, be aware of and follow your local protocols.

Quickly assess for adequacy of breathing. Palpate the chest wall for DCAP-BTLS. If penetrating trauma is discovered, place an occlusive dressing on the wound. Maintain the airway, provide supplemental oxygen, and initiate bag-valve mask (BVM) ventilation if necessary. Check for breath sounds and provide rapid transport to the hospital without delay if breath sounds are abnormal. Splinting or otherwise attempting to restrict chest wall motion is not indicated as it is ineffective and can actually impair air exchange in the lungs.

Words of Wisdom

Face and throat injuries increase the need for airway and breathing maintenance, so do not hesitate to place a nonrebreathing mask over facial injuries. The seal may not be as easy to maintain, but airway and breathing take priority over soft-tissue injuries.

Quickly assess the pulse rate and quality; determine the skin condition, color, and temperature; and check the capillary refill time. Significant bleeding is an immediate life threat. If the patient has obvious life-threatening bleeding, you must control it quickly.

If the patient you are treating has an airway or a breathing problem or significant bleeding, you must consider quickly transporting the patient to the hospital for treatment. Stabilization and maintenance of an airway and breathing and controlling bleeding can be very difficult in patients with facial or neck injuries. Avoid delays in transport and consider advanced life support backup if the transport time is long. A patient with signs and symptoms of internal bleeding must be transported quickly to the appropriate hospital for treatment by a physician. Internal bleeding in face and throat injuries may compromise blood flow to the brain. Bleeding from major vessels of the throat can have a serious impact on the patient's airway. The condition of a patient with visible significant bleeding or signs of significant internal bleeding may quickly become unstable. Treatment is directed at quickly addressing life threats and providing rapid transport to the closest appropriate hospital. Signs such as tachycardia, tachypnea, low blood pressure, weak pulse, and cool, moist, pale skin are signs of hypoperfusion and imply the need for rapid transport. The patient who has a significant MOI but whose condition appears stable should also be transported promptly to the closest appropriate hospital. Remember that any significant blow to the face or throat should increase your suspicion of spinal or brain injury. Be alert to these signs and reconsider your priority and transport decision if they develop.

Even if the patient has no signs of hypoperfusion or other life-threatening injuries, there is the possibility of eye injuries, which are considered serious. Therefore, the patient should be transported to the hospital as quickly and as safely as possible. In some situations, surgery and/or restoration of circulation to the eye will need to be accomplished within 30 minutes or permanent blindness may result. Consider transporting the patient with serious, isolated eye injuries to an eye care specialty center depending on local protocol. Do not delay transport of a seriously injured patient, particularly one with significant bleeding even if controlled, to take a patient's history or perform a secondary assessment. Further assessment can continue during transport.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint or history of present illness. Obtain a medical history and be alert for injury-specific signs and symptoms, as well as any pertinent negatives such as no pain or no loss of sensation.

Next, obtain a SAMPLE history from your patient. If the patient is not responsive, attempt to obtain the SAMPLE history from friends or family members who may be present.

In an unresponsive patient you will only be able to notice the signs of the patient's injuries. Any other information will need to be obtained by someone who is knowledgeable about the patient. Keep in mind that the information you obtain may or may not be accurate and may be incomplete. The person providing the information may not be able to give you the actual names of the patient's medications but might be able to provide some pertinent medical history and possibly known allergies.

Secondary Assessment

The secondary assessment is a more detailed, comprehensive examination of the patient that is used to uncover injuries that may have been missed during the primary assessment. In some instances, such as a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

If there is significant trauma that likely affects multiple systems, start with an assessment of the entire body looking for DCAP-BTLS to be sure that you have found all life threats and injuries. When this is completed, perform a detailed examination of specific areas. However, do not delay transport to complete a thorough physical examination.

In the responsive patient who has an isolated injury with a limited MOI, consider focusing your physical examination on the isolated injury, the patient's chief complaint, and the body region affected, which, in this case, is the face and throat. Ensure that control of bleeding is maintained and note the location of the injury. Inspect open wounds for any foreign matter and stabilize impaled objects.

During the physical examination, use both your eyes and hands. Your eyes will be looking for swelling, deformities of the bones, contusions, and discoloration whereas your hands will be gently palpating the face, looking and feeling for any abnormalities such as deformity or tenderness. Ask yourself the following questions:

1. Do the facial bones seem to be in alignment?
2. Does the nasal bone seem to deviate from the midline?
3. Note any variations from the normal facial examination; is there any facial drooping?
4. Does one eye appear to be lower than the other? If so, this is an indication of an orbital fracture.
5. Does the mandible appear to deviate toward one side or the other?

If your patient is responsive, explain exactly what you are doing and what you are looking for. Your discovery of an abnormality may actually be an old injury that the patient can tell you more about.

Assess all underlying systems. This should include the neurologic system, including brain and major nerves; sensory organs, including the eyes and nose; respiratory system, including mouth, nose, sinuses, and airway; and circulatory system, particularly focusing on the carotid arteries and jugular veins.

When you are evaluating the eyes, start on the outer aspect of the eye and work your way in toward the pupils. Examine the eye for any obvious foreign matter. Your patient may relay this information to you also ("I have something in my eye."). Visual acuity, or the clarity of the patient's vision in each eye, is considered the vital sign of the eye. Quickly assess the patient's visual acuity by gently covering one eye and holding fingers up at arm's length in front of the open eye. Test for the ability to see fingers in both the injured and uninjured eye and document your findings. Note any discoloration of the eye, bleeding in the iris area, or redness. Look for eye symmetry because asymmetry is a possible indication of a brain injury.

Look at each pupil for equal size and reaction to light. If the pupils are not symmetric, ask the patient if he or she has had any previous eye surgeries or injuries. Previous surgery or injury, rather than brain injury, may be the root cause of the pupils not appearing the same. Cataract surgery can cause unequal pupils, but when you have a patient with a suspected head injury or ocular injury, anisocoria (unequal pupils in dim light) may be present. Determine whether the unequal pupils are caused by physiologic or pathologic issues. Use of over-the-counter eye drops can change pupil size, and certain asthma inhalers can have the same effect if inadvertently sprayed into the eye. Brain injury, nerve disease, glaucoma, and meningitis are all possible causes of unequal pupils.

Does the patient have the ability to follow your finger from side to side as well as up and down? Can the patient read normal print? Does the patient report blurry vision in either eye? Is there a new sensitivity to light?

Assess vital signs to obtain a baseline so that you can observe any changes a patient may display during treatment. A systolic blood pressure reading of less than 100 mm Hg with a weak, rapid pulse and cool, moist skin that is pale or gray should alert you to the presence of hypoperfusion in a patient who may have significant bleeding. Remember, you must be concerned with visible bleeding and unseen bleeding inside a body cavity. With facial and throat injuries, baseline information about the rate and quality of respirations and pulse is very important, as is monitoring throughout patient care.

In addition to hands-on assessment, use monitoring devices to quantify your patient's oxygenation and circulatory status. You may also use noninvasive methods to monitor the blood pressure. It is recommended that you always assess the patient's first blood pressure manually with a sphygmomanometer (blood pressure cuff) and stethoscope.

YOU are the Provider — PART 3

As your partner continues to manually stabilize his head, you perform a secondary assessment of the entire body, which reveals bruising and mild swelling to the anterior part of the neck, directly over the trachea. The remainder of your assessment does not reveal any obvious injuries. You apply a cervical collar and assess his vital signs. One of the police officers is asked to retrieve the long backboard and other spinal immobilization equipment.

The patient tells you that he was struck in the face with a steel pipe. After he fell to the ground, he was kicked in the face and throat several times. His face is severely swollen, three of his front teeth are missing, and he tells you that it "doesn't feel right" when he closes his mouth.

Recording Time: 5 Minutes	
Respirations	22 breaths/min; adequate depth
Pulse	118 breaths/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	132/68 mm Hg
Oxygen saturation (Spo_2)	97% (on oxygen)

5. On the basis of the mechanism of injury, what type of injuries should you suspect and assess for?

Reassessment

Repeat the primary assessment. Reassess vital signs and the chief complaint. Continually reassess the adequacy of the patient's airway, breathing, and circulation. Recheck patient interventions. Are the treatments you provided for problems with the ABCs still effective? This is particularly important in patients with facial or neck injuries because of the ease in which injuries can affect associated systems, such as the respiratory (airway and breathing), circulatory, and nervous systems. The patient's condition should be reassessed at least every 5 minutes.

Provide complete spinal immobilization to any patient with suspected spinal injuries. Spinal injuries should be suspected any time there is significant trauma to the face or neck. Maintain an open airway, be prepared to suction the patient, and consider an oropharyngeal airway. Whenever you suspect significant bleeding, provide high-flow oxygen. Oxygen and airway maintenance are important for all patients with face and neck injuries. If needed, provide assisted ventilation using a BVM with high-flow oxygen.

Control any significant visible bleeding. If the patient has signs of hypoperfusion, treat the patient aggressively for shock and provide rapid transport to the appropriate hospital. Do not delay transport of a seriously injured trauma patient to complete nonlifesaving treatments in the field, such as splinting extremity fractures. Instead, complete these treatments en route to the hospital. If there is no cervical spine injury suspected, the patient may be more comfortable in the sitting position during transport.

In your documentation, describe the MOI and the position in which you found the patient when you arrived at the scene. Document the method used to remove the patient from the vehicle, for example, "prolonged extrication." In patients with severe external bleeding, it is important to recognize, estimate, and report the amount of blood loss that has occurred and how rapidly or how much time has passed since the bleeding started. This can be a challenge for you, especially if the surface the patient is on is wet or absorbs fluids or the environment is dark. Inform the hospital personnel about all of the injuries involving the patient's head and neck. Specialists may need to be called to manage injuries involving the eyes, ears, teeth, mouth, sinuses, larynx, esophagus, or large vessels. These specialists are not always in the hospital, especially during the evening or night, or in smaller hospitals, so informing emergency department personnel of all injuries involving the face and throat can save valuable time.

Emergency Medical Care

The emergency care of soft-tissue injuries to the face and neck is the same as treatment of soft-tissue injuries elsewhere on the body. You should assess the ABCs and care for any life threats first. Remember also to follow standard precautions in all cases.

In the absence of life-threatening bleeding, your first step is to open and clear the airway. Securing and maintaining a patent airway is paramount. Remember that blood draining into the throat can produce vomiting and airway obstruction; therefore, the patient may need frequent suctioning. Take appropriate precautions if you suspect that the patient has sustained a cervical spine injury; be sure to avoid moving the neck. Use the jaw-thrust maneuver to open the patient's airway, and then suction the mouth. Once the patient is immobilized in a cervical collar and on a backboard, you can turn the backboard to one side to allow any blood or vomitus to drain out of the mouth rather than pool in the pharynx and obstruct the airway.

Control bleeding by applying direct manual pressure with a dry, sterile dressing. Use roller gauze, wrapped around the circumference of the head, to hold a pressure dressing in place **Figure 27-9**. Do not apply excessive pressure if there is a possibility of an underlying skull fracture. When an injury exposes the brain, eye, or other structures, cover the exposed parts with a moist, sterile dressing to protect them from further damage. For injuries in which the skin is not broken, apply ice locally to help control the swelling of bruised tissues.

Figure 27-9 Use roller gauze, wrapped around the circumference of the head, to hold a pressure dressing in place.

For soft-tissue injuries around the mouth, always check for bleeding inside the mouth. Broken teeth and lacerations to the tongue may cause profuse bleeding and obstruction of the upper airway **Figure 27-10**. Often, the patient will swallow the blood from lacerations inside the mouth, so the hemorrhage may not be apparent. You should also inspect the inside of the mouth for bleeding and hidden injuries in patients who have sustained facial trauma. Remember that patients who swallow blood are prone to vomiting.

Figure 27-10 Soft-tissue injuries around the mouth can be associated with profuse bleeding inside the mouth and obstruction of the airway.

Figure 27-11 If avulsed skin is still attached, place the flap in a position that is as close to normal as possible, and hold it in place with a dry, sterile dressing.

Often, physicians will be able to graft a piece of avulsed skin back into the appropriate position. For this reason, if you find portions of avulsed skin that have become separated, wrap them in a sterile dressing, place them in a plastic bag, and keep them cool. Never place tissue directly on ice because freezing will destroy the tissue and make it unusable. Deliver the bag labeled with the patient's name to the emergency department along with the patient. In many avulsion injuries, the skin will still be attached in a loose flap **Figure 27-11**. Place the flap in a position that is as close to normal as possible, and hold it in place with a dry, sterile dressing. These steps will help to increase the patient's chances of having his or her normal appearance restored.

Emergency Medical Care for Specific Injuries

Injuries of the Eyes

Eye injuries are common, particularly in sports. An eye injury can produce severe, lifelong complications, including blindness. Proper emergency treatment will minimize pain and may very well help to prevent a permanent loss of vision.

In a normal, uninjured eye, the entire circle of the iris is visible. The pupils are round, usually equal in size, and react equally when exposed to light **Figure 27-12**. Both eyes move together in the same direction when following your moving finger. After an injury, pupil reaction or shape and eye movement are often disturbed. Any of these conditions should cause you to suspect an injury of the globe or its associated tissues. Remember, though, that abnormal pupil reactions sometimes are a sign of brain injury rather than eye injury.

Treatment starts with a Always perform your examination using standard precautions, taking great care to avoid aggravating any problems. You are looking for specific abnormalities or conditions that may suggest the nature of the injury **Figure 27-13**. For example, blunt or penetrating injuries can produce swollen or lacerated eyelids. Bleeding soon after irritation or injury can result in a bright red conjunctiva. A damaged cornea quickly loses its smooth, wet appearance.

Foreign Objects

Large objects are prevented from penetrating the eye by the protective orbit that surrounds it. However, moderately sized and smaller foreign objects of many different types can enter the eye and cause significant damage. Even a very small foreign object, such as a grain of sand lying on the surface of the conjunctiva, may produce severe irritation **Figure 27-14**. The conjunctiva becomes inflamed and red—a condition known as **conjunctivitis**—almost immediately, and the eye begins to produce tears in an attempt to flush out the object. Irritation of the cornea or conjunctiva causes intense pain. The patient may have difficulty keeping the eyelids open, because the irritation is further aggravated by bright light.

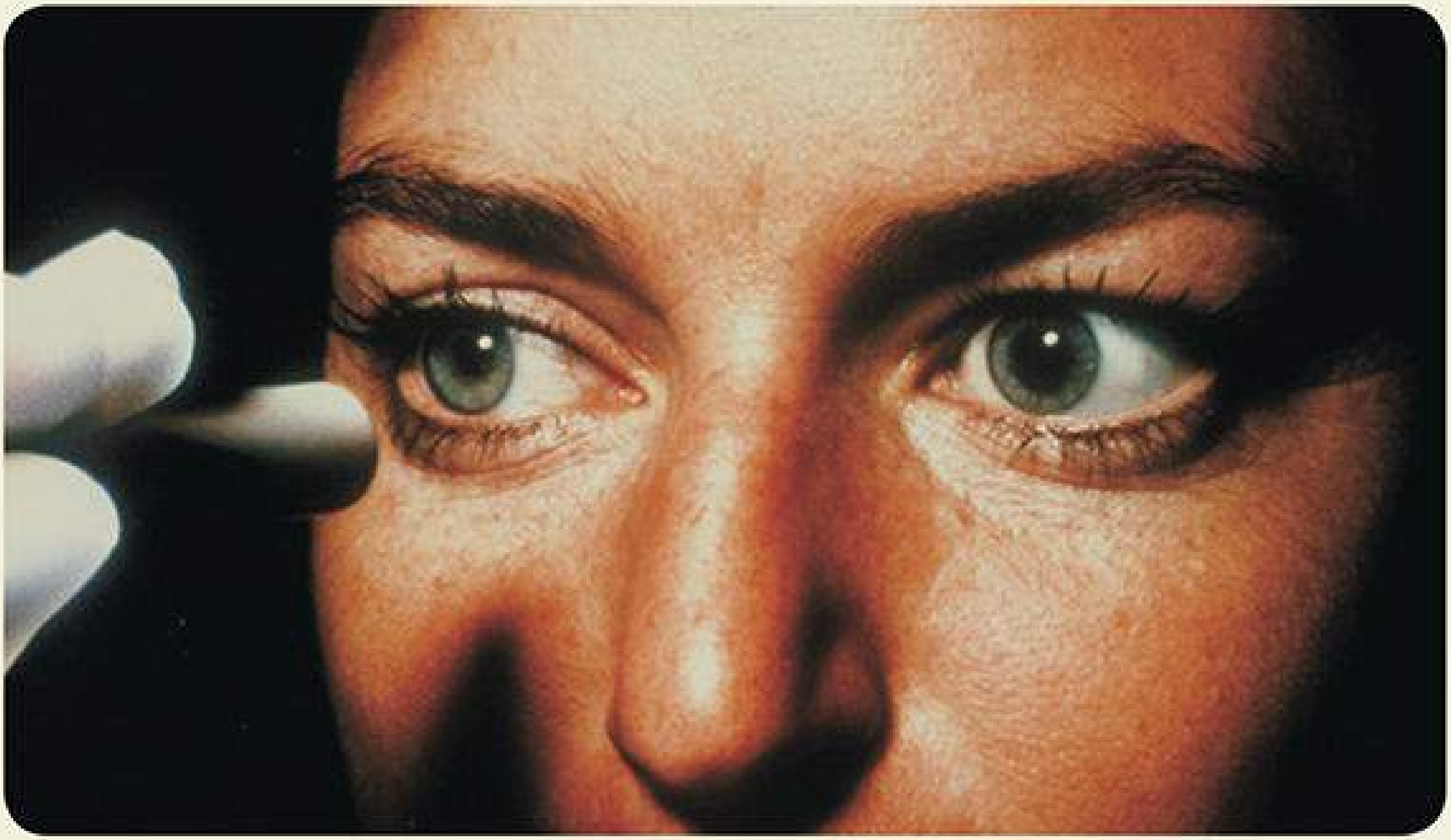


Figure 27-12 Normally, the pupils are round, equal in size, and equally reactive when exposed to light. The pupils shown here appear unequal.

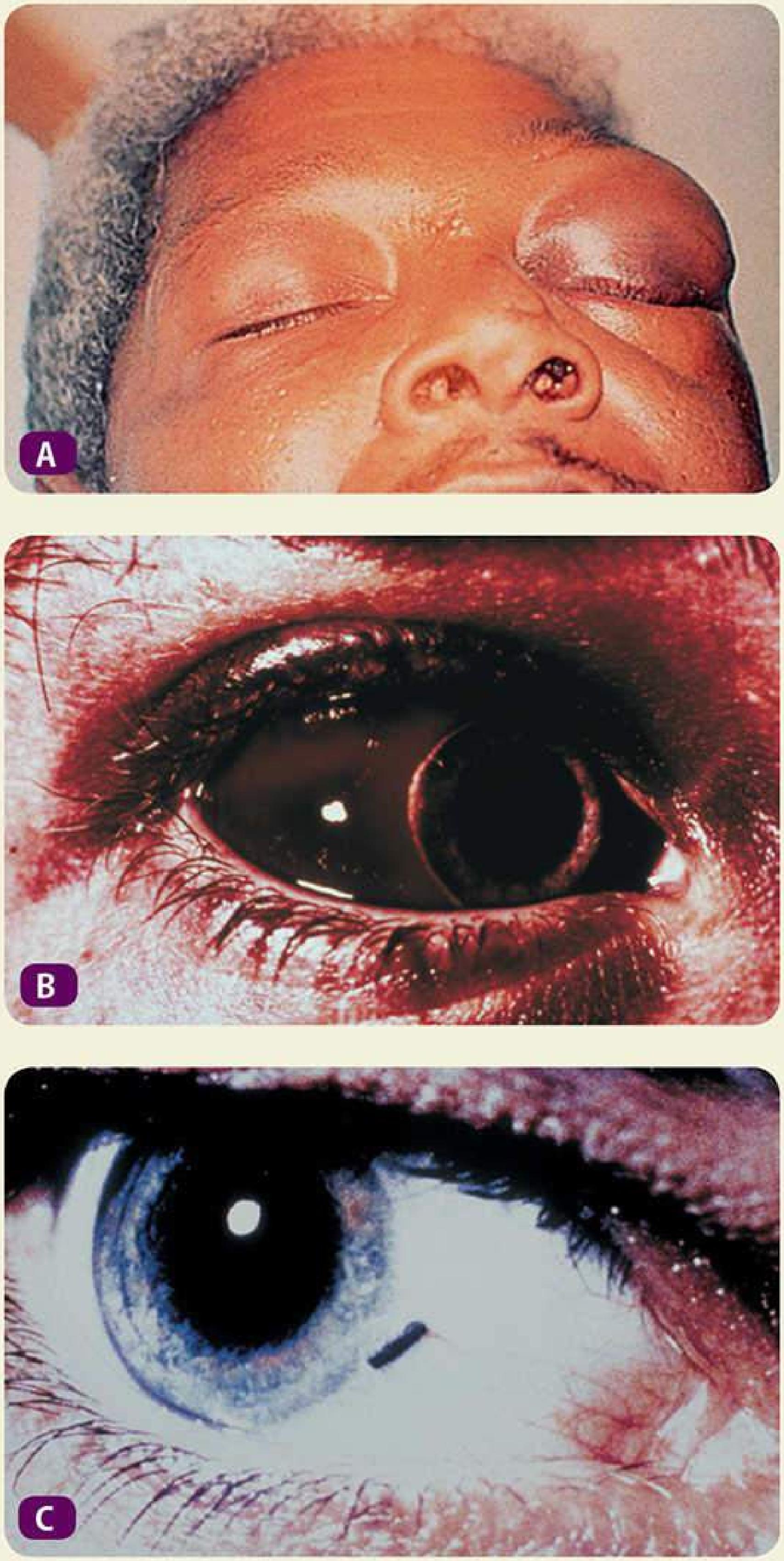


Figure 27-13 Injuries to the eyes are easily detected by swelling **(A)**, bleeding **(B)**, and the presence of foreign objects in the eye **(C)**.

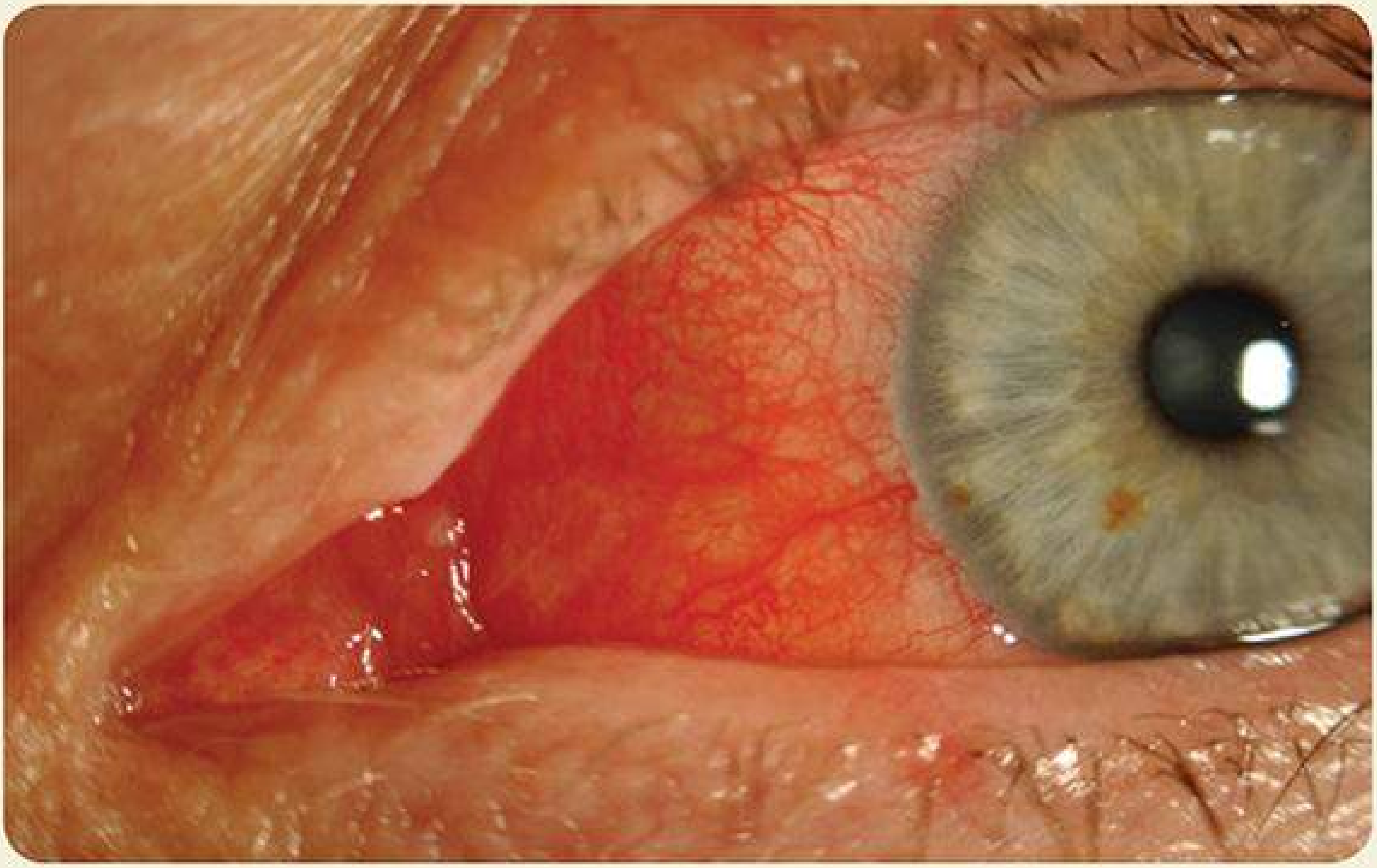


Figure 27-14 Conjunctivitis is often associated with the presence of a foreign object in the eye.

Courtesy of John T. Halgren, MD., University of Nebraska Medical Center.

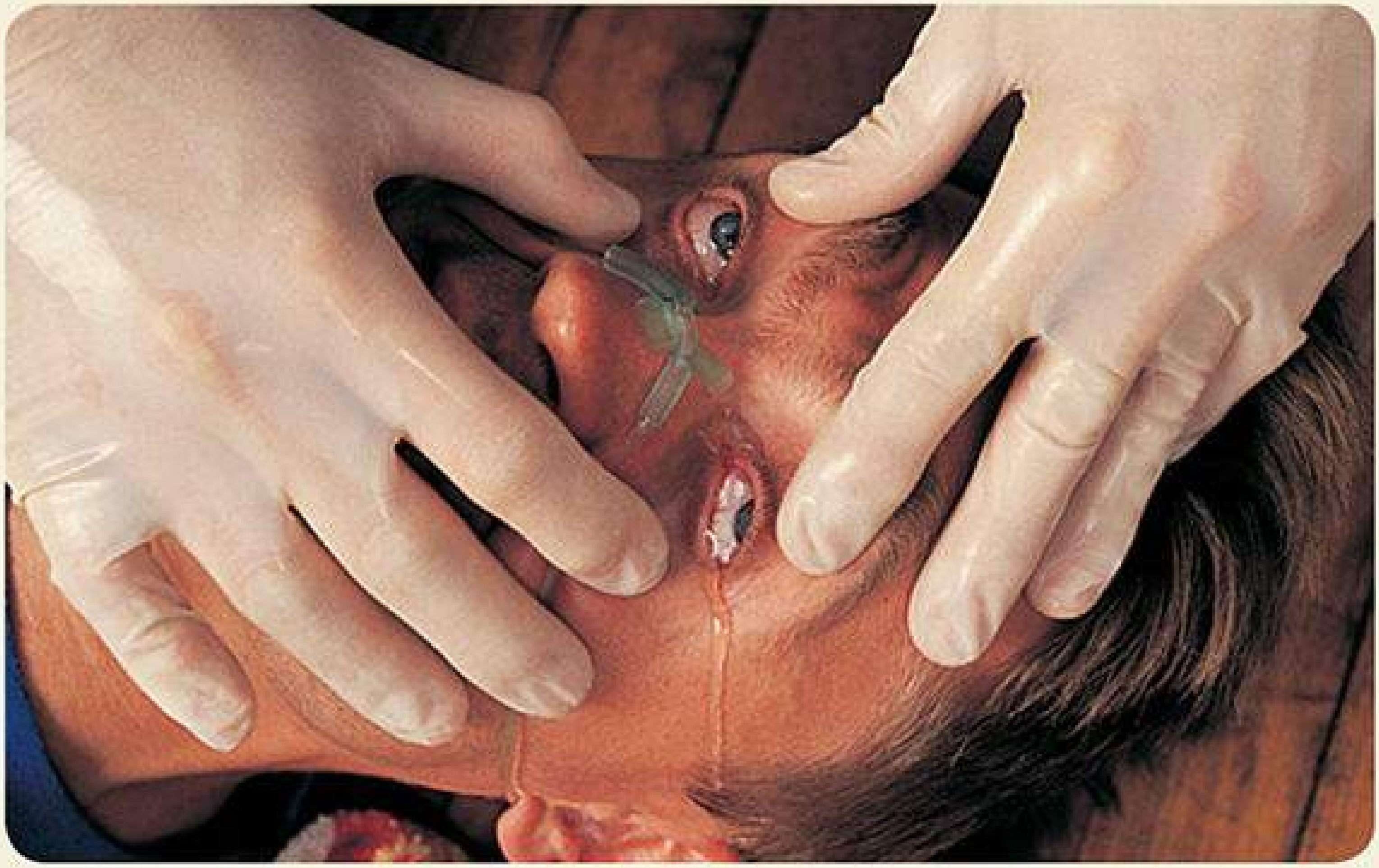


Figure 27-15 One method of irrigation is to direct saline into the injured eye using a round nasal airway or cannula. Always flush from the nose side of the eye toward the outside to avoid flushing material into the other eye.

If a small foreign object is lying on the surface of the patient's eye, you should use a normal saline solution to gently irrigate the eye. Irrigation with a sterile saline solution will frequently flush away loose, small particles. If a small bulb syringe is available, you can use this, or a nasal airway or cannula, to direct the saline into the affected eye Figure 27-15. Always flush from the nose side of the eye toward the outside to avoid flushing material into the other eye. After it has been flushed away, a foreign body will often leave a small abrasion on the surface of the conjunctiva. For this reason, the patient will report irritation even when the particle itself is gone. It is always a good idea to transport the patient to the hospital for further assessment to ensure appropriate medical care to the affected eye.

Gentle irrigation usually will not wash out foreign bodies that are stuck to the cornea or lying under the upper eyelid. To examine the undersurface of the upper eyelid, pull the lid upward and forward. If you spot a foreign object on the surface of the eyelid, you may be able to remove it with a moist, sterile, cotton-tipped applicator **Skill Drill 27-1**. Never attempt to remove a foreign body that is stuck to the cornea.

1. Tell the patient to look down while you grasp the lashes of the upper eyelid with your thumb and index finger. Gently pull the eyelid away from the eyeball **Step 1**.
2. Gently place a cotton-tipped applicator horizontally along the center of the outer surface of the upper eyelid **Step 2**.
3. Pull the eyelid forward and up, which causes it to roll or fold back over the applicator, exposing the undersurface of the eyelid **Step 3**.
4. If you see a foreign object on the surface of the eyelid, gently remove it with a moistened, sterile, cotton-tipped applicator **Step 4**.

Skill Drill 27-1 Removing a Foreign Object From Under the Upper Eyelid

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Step 1

Have the patient look down, grasp the upper lashes, and gently pull the lid away from the eye.

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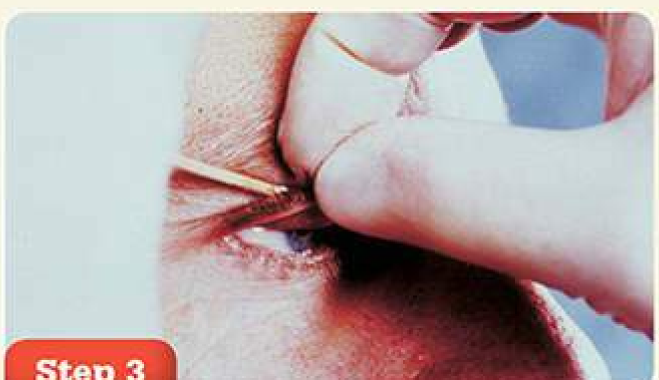
Step 2

Place a cotton-tipped applicator on the outer surface of the upper lid.



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Step 3

Pull the lid forward and up, folding it back over the applicator.

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Step 4

Gently remove the foreign object from the eyelid with a moistened, sterile, cotton-tipped applicator.

Foreign bodies ranging in size from a pencil to a sliver of metal may be impaled in the eye **Figure 27-16**. These objects must be removed by a physician. Your care involves stabilizing the object and preparing the patient for transport to definitive care. The greater the length of the foreign object you can see sticking out of the eye, the more important stabilization becomes in avoiding further damage. Bandage the object in place to support it. Cover the eye with a moist, sterile dressing, and then surround the object with a doughnut-shaped collar made from roller gauze or a small gauze pack. Follow the steps in **Skill Drill 27-2**:

Figure 27-16 Any number of objects can become impaled in the eye. **A.** Fishhook. **B.** Sharp, metal sliver. **C.** Knife blade.

1. Begin to prepare the doughnut ring by wrapping a 2-inch gauze roll circumferentially around your fingers and thumb enough times to make a thick dressing layer. You can adjust the inner diameter of what will become the ring by spreading your fingers or squeezing them together Step 1.
2. Remove the gauze from your hand and wrap the remainder of the gauze roll radially around the ring that you have created Step 2.
3. Work your way around the ring until you have wrapped all the way around it and finished the "doughnut" Step 3.
4. Carefully place the ring over the eye and impaled object, without bumping the object. You can then stabilize the object and the gauze collar with a roller bandage surrounding the head. Bandage both the injured and uninjured eyes to minimize eye movement and prevent further damage to the globe because when one eye moves, so does the other. Transport to an appropriate medical facility for treatment Step 4.

Sometimes, a variety of types of large and small foreign bodies, particularly small metal fragments, become completely embedded within the eye itself. The patient may not even be aware of the cause of the problem. Suspect such an injury when the history includes metal work (such as hammering, exposure to splinters, grinding, vigorous filing) and when there are other signs of ocular injury. When you see or suspect an impaled object in the eye, bandage both eyes with soft, bulky dressings to prevent further injury to the affected eye. Your bandage should be loose enough to hold the eyelid closed but not cause pressure on the eye itself. Using this technique prevents sympathetic motion (the movement of one eye causing both eyes to move), which may cause additional damage to the injured eye. This type of injury must be handled by an ophthalmologist on an urgent basis. X-rays and special equipment may be required to find the foreign body.

Burns of the Eye

Chemicals, heat, and light rays all can burn the delicate tissues, such as the cornea, often causing permanent damage. Your role is to stop the burn and prevent further damage.

Skill Drill 27-2 Stabilizing a Foreign Object Impaled in the Eye

Step 1

To prepare a doughnut ring, wrap a 2-inch roll around your fingers and thumb seven or eight times. Adjust the diameter by spreading your fingers or squeezing them together.

Step 2

Remove the gauze from your hand and wrap the remainder of the gauze roll radially around the ring that you have created.

Step 3

Work around the entire ring to form a doughnut.

Step 4

Place the dressing over the eye and impaled object to hold the impaled object in place, and then secure it with a roller bandage.

Chemical Burns. Chemical burns, usually caused by acid or alkaline solutions, require immediate emergency care Figure 27-17. This consists of flushing the eye with water or a sterile saline irrigation solution. If sterile saline is not available, you can use any clean water.

The idea is to direct the greatest amount of irrigating solution or water into the eye as gently as possible Figure 27-18. Because opening the eye spontaneously may cause the patient pain, you may have to force the lids open to irrigate the eye adequately. Ideally, you will use a bulb or irrigation syringe, a nasal cannula, or some other device that will allow you to control the flow. In some circumstances, you may have to resort to pouring water into the eye by holding the patient's head under a gently running faucet. You can even have the patient immerse his or her face in a large pan or basin of water and rapidly blink the affected eyelid. If only one eye is affected, care must be taken to avoid contaminated water from getting into the unaffected eye.

Be sure to flush from the inner corner of the affected eye toward the outside corner. Never flush from the outside corner as this may cause the substance to contaminate the unaffected eye. If the burn was caused by an alkali or a strong acid, irrigate the eye continuously for 20 minutes. Follow local protocols on whether to try to irrigate while transporting or to stay on scene until flushing is complete. Strong acids and all alkaline solutions can penetrate deeply, requiring a prolonged flush. Again, always take care to protect the uninjured eye and prevent irrigation fluid from running into it.

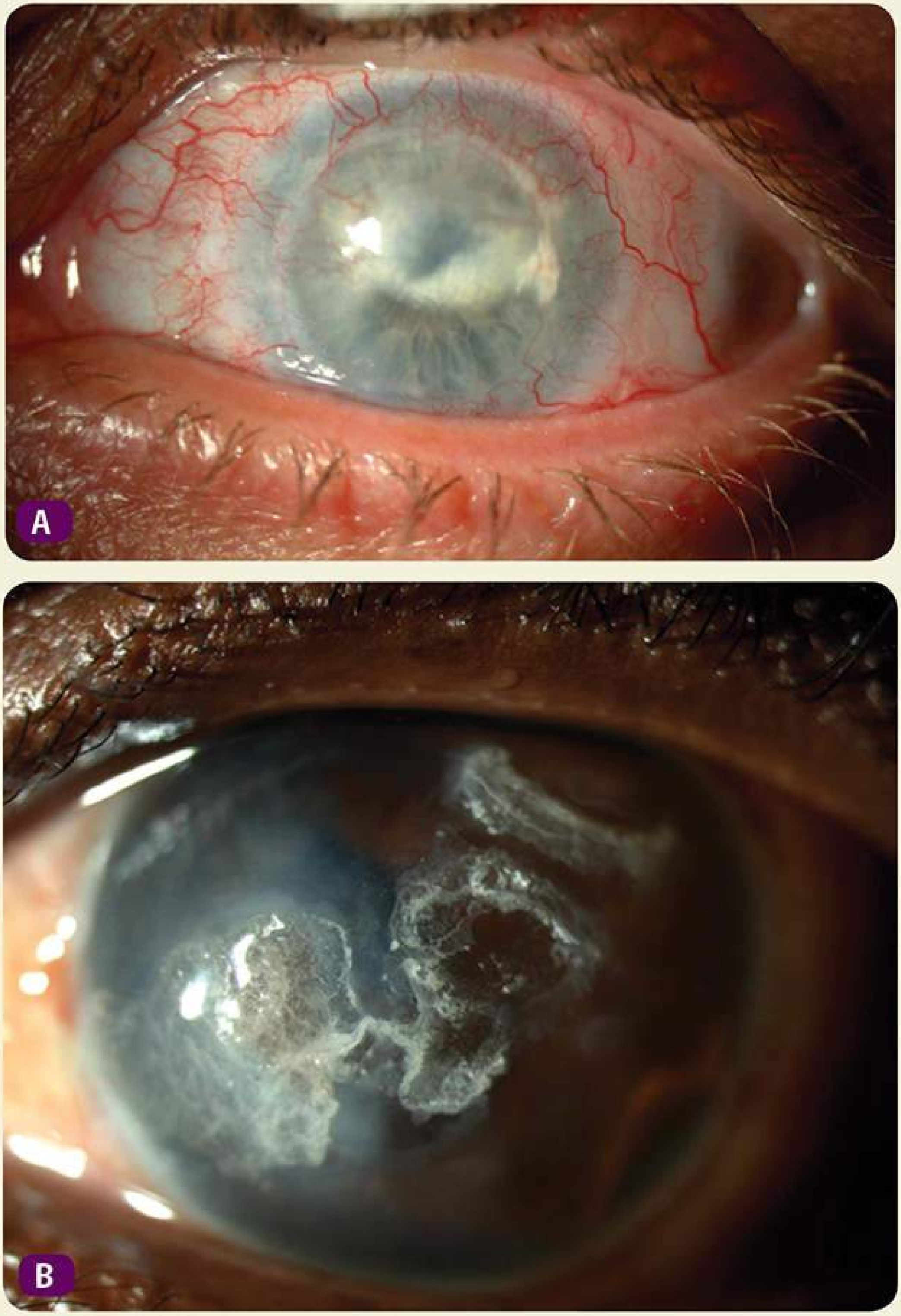

Figure 27-17 **A.** Chemical burns typically occur when an acid or alkali is splashed into the eye. **B.** This figure shows a chemical burn from lye, an alkaline solution. Because lye can continue to damage the eye even when diluted, fast action is needed.

After you have completed irrigation, apply a clean, dry dressing to cover the eye, and transport the patient promptly to the hospital for further care **Figure 27-19**. If the irrigation can be carried out satisfactorily in the ambulance, it should be done during transport to save time.

Thermal Burns. When a patient is burned on the face during a fire, the eyes usually close rapidly because of the heat. This reaction is a natural reflex to protect the eye from further injury. However, the eyelids remain exposed and are frequently burned **Figure 27-20**. Burns of the eyelids require very specialized care. It is best to provide prompt transport for these patients without further examination. First, however, you should cover both eyes with a sterile dressing moistened with sterile saline. You may apply eye shields over the dressing.

Words of Wisdom

With thermal burns to the face, inhalation burns may also occur.

Light Burns. Infrared rays, eclipse light (if the patient has looked directly at the sun), and laser burns all can cause significant damage to the sensory cells of the eye when rays of light become focused on the retina. Retinal injuries that are caused by exposure to extremely bright light are generally not painful but may result in permanent damage to vision.

Superficial burns of the eye can result from ultraviolet rays from an arc welding unit, light from prolonged exposure to a sun lamp, or reflected light from a bright, snow-covered area (snow blindness). This kind of burn often is not painful at first but may become so 3 to 5 hours later, when the damaged cornea responds to the injury. Severe conjunctivitis usually develops, with redness, swelling, and excessive tear production. You can ease the pain from these corneal burns by covering each eye with a sterile, moist pad and an eye shield. Have the patient lie down during transport to the hospital, and protect him or her from further exposure to bright light.

The patient should be examined by a physician as soon as possible.

Lacerations

Lacerations of the eyelids require very careful repair to restore appearance and function **Figure 27-21**. Bleeding may be heavy, but it usually can be controlled by gentle, manual pressure. If there is a laceration of the globe itself, apply no pressure to the eye. Compression can interfere with the blood supply to the back of the eye and result in loss of vision from damage to the retina. Furthermore, pressure may squeeze the vitreous humor, iris, lens, or even the retina out of the eye and cause irreparable damage or blindness.

Figure 27-18 The following are four ways to effectively irrigate the eye. **A.** Nasal cannula. **B.** Shower. **C.** Bottle. **D.** Basin. Remember, you must protect the uninjured eye from the irrigating solution to prevent exposure of the unaffected eye to the substance.

Figure 27-19 Apply a clean, dry dressing to cover the eye after you have finished irrigation.

Follow these three important guidelines in treating penetrating injuries of the eye:

1. Never exert pressure on or manipulate the injured eye (globe) in any way.
2. If part of the eyeball is exposed, gently apply a moist, sterile dressing to prevent drying.
3. Cover the injured eye with a protective metal eye shield, cup, or sterile dressing. Apply soft dressings to both eyes, and provide prompt transport to the hospital.

On rare occasions following a serious injury, the eyeball may be displaced out of its socket. Do not attempt to reposition it. Simply cover the eye and stabilize it with a moist, sterile dressing Figure 27-22. Remember to cover both eyes to prevent further injury because of sympathetic movement. Have the patient lie in a supine position en route to the hospital to prevent further loss of fluid from the eye.

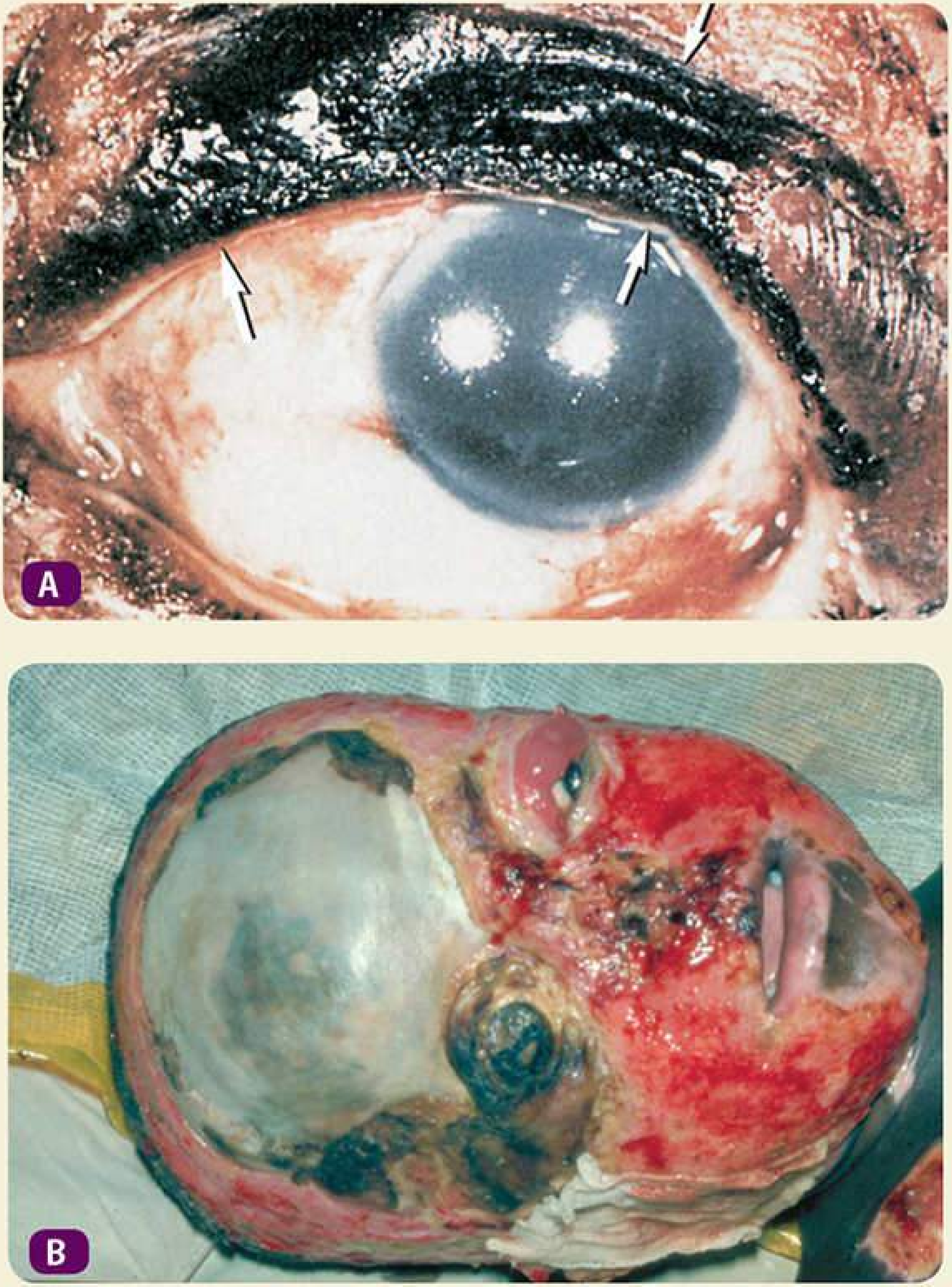

Figure 27-20 Thermal burns occasionally cause significant damage to the eyelids. **A.** Arrows show some full-thickness burns. **B.** Burns of the eyelids require immediate hospital care.

Blunt Trauma

Blunt trauma can cause a number of serious eye injuries. These range from the ordinary "black eye," a result of bleeding into the tissue around the orbit, to a severely damaged globe **Figure 27-23**. You may see an injury called hyphema, or bleeding into the anterior chamber of the eye, that obscures part or all of the iris **Figure 27-24**. This injury is common in blunt trauma and may seriously impair vision. Twenty-five percent of hyphemas are globe injuries, a serious injury to the eye. Cover the eye to protect it from further injury and provide transportation to the hospital for further medical evaluation.

Blunt trauma can also cause a fracture of the orbit, particularly of the bones that form its floor and support the globe. This injury is called a **blow-out fracture**. The fragments of fractured bone can entrap some of the muscles that control eye movement, causing double vision **Figure 27-25**. Any patient who reports pain, double vision, or decreased vision following a blunt injury about the eye should be placed on a stretcher and transported promptly to the emergency department. Protect the eye from further injury with a metal shield; cover the other eye to minimize movement on the injured side.

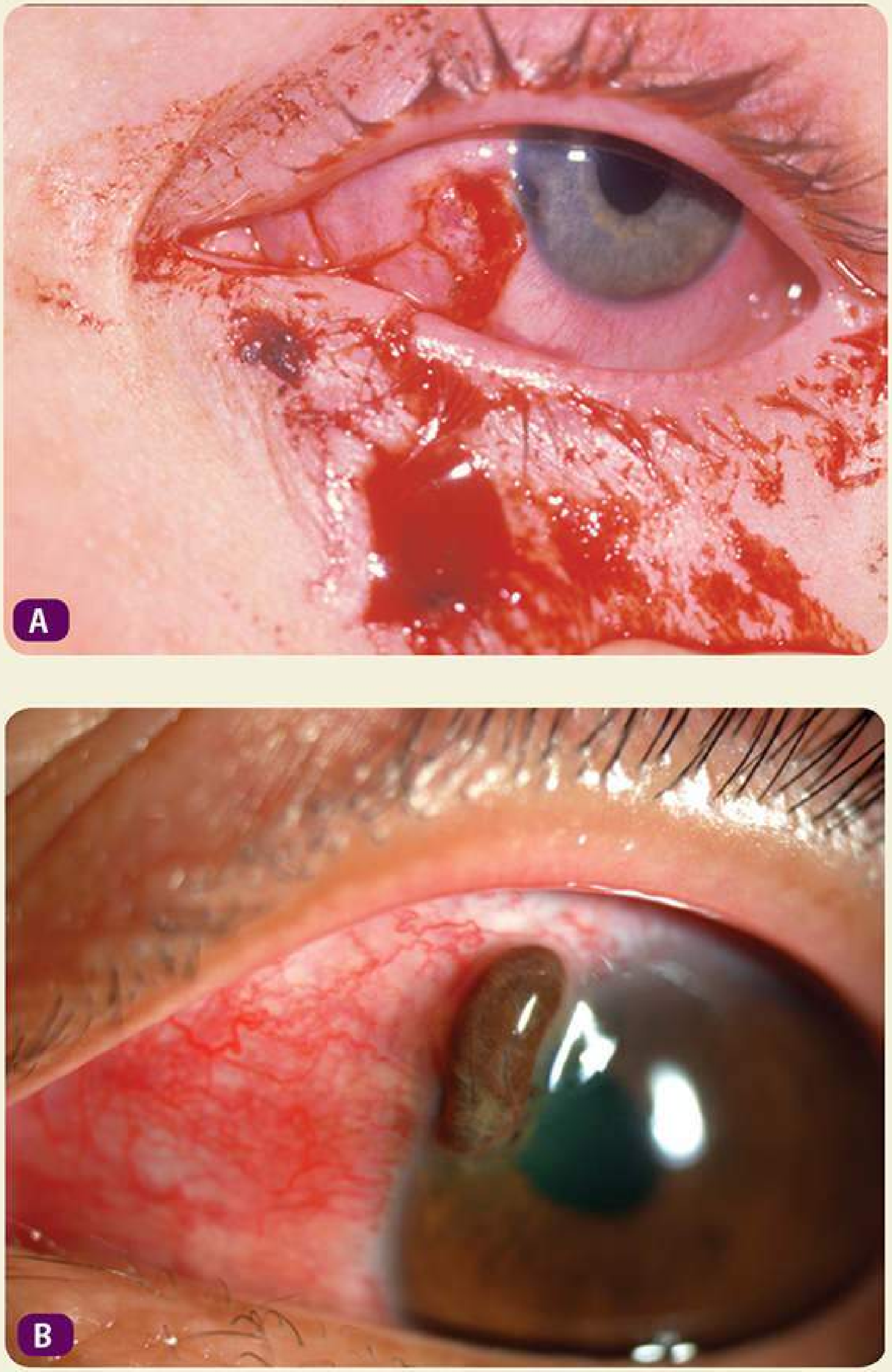

Figure 27-21 Lacerations are serious injuries that require prompt transport. **A.** Although bleeding can be heavy, never exert pressure on the eye. **B.** Pressure may squeeze the vitreous humor, iris, lens, or even the retina out of the eye.

A: © Chris Barry/Phototake; B: Paul Whitten/Science Source.

Another possible result of blunt eye injury is retinal detachment. This injury is often seen in sports, especially boxing. It is painless but produces flashing lights, specks, or "floaters" in the field of vision and a cloud or shade over the patient's vision. Because the retina is separated from the nourishing choroid, this injury requires prompt medical attention to preserve vision in the eye.

Eye Injuries Following Head Injury

Abnormalities in the appearance or function of the eyes often occur following a closed head injury. Any of the following eye findings should alert you to the possibility of a head injury:

- One pupil larger than the other Figure 27-26
- The eyes not moving together or pointing in different directions
- Failure of the eyes to follow the movement of your finger as instructed
- Bleeding under the conjunctiva, which obscures the sclera (white portion) of the eye
- Protrusion or bulging of one eye

Record any of these observations, along with the time that you make them. For an unconscious patient, remember to keep the eyelids closed; drying of the ocular tissue can cause permanent injury and may result in blindness. Cover the lids with moist gauze, or hold them closed with clear tape. Normal tears will then keep the tissues moist.

Blast Injuries

The signs and symptoms of blast injuries range from severe pain and loss of vision to foreign bodies within the globe. Before responding to patients after the blast, first ensure that the scene is safe.

Management of blast injuries to the eye depends on the severity of the injury. If there is a foreign body within the globe, do not attempt to remove it. Use a clean cup or similar item to protect the area. If only one eye is injured, follow local protocol, which may include covering the other eye to eliminate sympathetic motion. Patients with a sudden loss or decrease of vision will need to be verbally instructed on what actions are taking place around them. If the patient has severe swelling or a hematoma to the eyelid, do not attempt to force the eyelid open to examine the eye because this increases the pressure already present within the globe.

Contact Lenses and Artificial Eyes

Small, hard contact lenses usually are tinted, making them relatively easy to see. Large, soft contact lenses are clear and can be very difficult to see. In general, you should not attempt to remove either kind of lens from a patient. You should never attempt to remove a lens from an eye that has been—or may have been—injured because manipulating the lens can aggravate the problem. The only time that contact lenses should be removed immediately in the field is in the case of a chemical burn of the eye. In this situation, the lens can trap the chemical and make irrigation difficult.

YOU are the Provider — PART 4

After applying full spinal immobilization, you place the patient onto the stretcher and load him into the ambulance. You recovered his teeth and placed them in a commercial tooth-saver container. While you reassess the interventions you have performed thus far, your partner reassesses the patient's vital signs.

Recording Time: 11 Minutes	
Level of consciousness	Conscious and alert
Respirations	20 breaths/min; adequate depth
Pulse	108 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	128/62 mm Hg
Spo_2	98% (on oxygen)

Reassessment of the patient's mouth reveals that it is clear of blood. You begin transport to a trauma center, which is located 15 miles away. En route, the patient tells you that he is becoming nauseated. You call in your radio report and give an estimated time of arrival of 18 to 20 minutes.

6. What should you do if this patient begins to vomit?

7. How should you treat a patient with active oral bleeding *and* inadequate ventilation?

If it is necessary to remove a hard contact lens, use a small suction cup, moistening the end with saline **Figure 27-27A**. To remove soft lenses, place one to two drops of saline in the eye **Figure 27-27B**, gently pinch it between your gloved thumb and index finger, and lift it off the surface of the eye **Figure 27-27C**. Place the contact lens in a container filled with sterile saline solution to prevent damage to the contact lens. Always advise the emergency department staff if a patient is wearing contact lenses.

Figure 27-22 An injury that exposes the brain, eye, or other structures **(A)** should be covered with a moist, sterile dressing to prevent further damage **(B)**.

Occasionally, you may find yourself caring for a patient who is wearing an eye prosthesis (an artificial eye). Many people are surprised to find that it can be difficult to distinguish a prosthesis from a natural eye. You should suspect an eye of being artificial when it does not respond to light, move in concert with the opposite eye, or appear quite the same as the opposite eye. If you think that a patient may have an artificial eye but you are not sure, go ahead and ask about it. Although no harm will be done if you care for an artificial eye as you would a normal one, you need to clearly understand the patient's eye function.

Figure 27-23 The typical "black eye" is caused by bleeding into the tissue around the orbit.

Injuries of the Nose

Nosebleeds (epistaxis) are a common problem that can occur spontaneously or from trauma. One of the most common causes of nosebleeds is digital trauma (picking the nose with a finger). Nosebleeds are further classified into anterior and posterior epistaxis. Anterior nosebleeds usually originate from the area of the septum and bleed fairly slowly. These are usually self-limited and resolve quickly. Posterior nosebleeds are usually more severe and often cause blood to drain into the patient's throat, causing nausea and vomiting. Trauma to the face and skull that results in a basilar skull fracture often will cause the posterior wall of the nasal cavity to become unstable. Attempting to place a nasopharyngeal airway in a patient with a suspected basilar skull fracture or with facial injuries is controversial because many believe that insertion may permit the airway to enter through the unstable wall of the nasal cavity into the cranial vault. However, recent research suggests this risk is extremely small. As always, be aware of and follow your local protocols.

The nose often takes the brunt of deliberate physical assaults and car crashes. Blunt injuries to the nose caused by a fist or a dashboard may be associated with fractures and soft-tissue injuries of the face, head injuries, and/or injuries to the cervical spine. Penetrating injuries to the nose can be seen when air guns and BB pellets are fired from a close range, resulting in pellets lodging in the nasal septum and sinuses. Another type of penetrating injury to the nose is a self-inflicted one that occurs when a person attempts to insert a foreign body into the nose, such as a pencil.

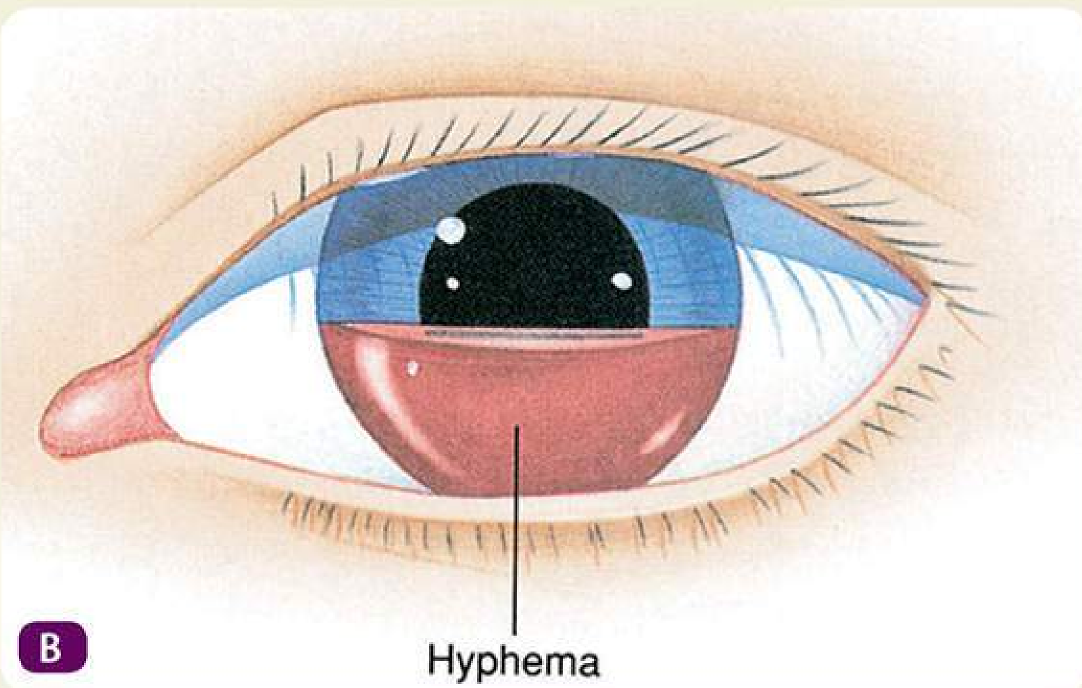

Figure 27-24 **A.** A hyphema, characterized by bleeding into the anterior chamber of the eye, is common following blunt trauma to the eye. This condition may seriously impair vision and should be considered a sight-threatening emergency. **B.** Illustration of hyphema.

Figure 27-25 A patient with a blow-out fracture may not move his or her eyes together because of muscle entrapment. Therefore, the patient sees double images of any object.

Figure 27-26 Variation of pupil size may indicate a head injury.

When you are assessing injuries involving the nose, it helps to picture the inside of the nose itself **Figure 27-28**. The nasal cavity is divided into two sections or chambers by the nasal septum, which is made of cartilage. Within each nasal chamber, there are layers of bone called the **turbinates**, which are covered with a moist lining. Both chambers have a superior turbinate, a middle turbinate, and an inferior turbinate. As a person breathes, air moves through the nasal chambers and is humidified as it passes over the turbinates. Directly above the nose are the frontal sinuses and, on either side, the orbit of the eye.

All of these structures should be assessed for injury. In patients with severe injury, there may also be injury to the cervical spine. Keep in mind that cerebrospinal fluid (CSF) may escape down through the nose (or ears) following a fracture at the base of the skull. If blood or drainage contains CSF, a characteristic staining of the dressing will occur. This can be seen by using a piece of gauze to absorb blood that is flowing from the nose or ears. If CSF is present, the blood will be surrounded by a lighter ring of fluid. This is often called the halo test.

You can control bleeding from abrasions and lacerations to the nose by applying a sterile dressing. If the patient is bleeding heavily from the nose, this is most likely caused by significant trauma and you must consider cervical spine injury. The patient should not be moved if the airway can be managed in the patient's present position. For a nontrauma patient who is bleeding from the nose, you should place the patient in a sitting position, leaning forward, and pinch his or her nostrils together **Figure 27-29**. For a detailed discussion of the care for epistaxis, see Chapter 25, *Bleeding*.

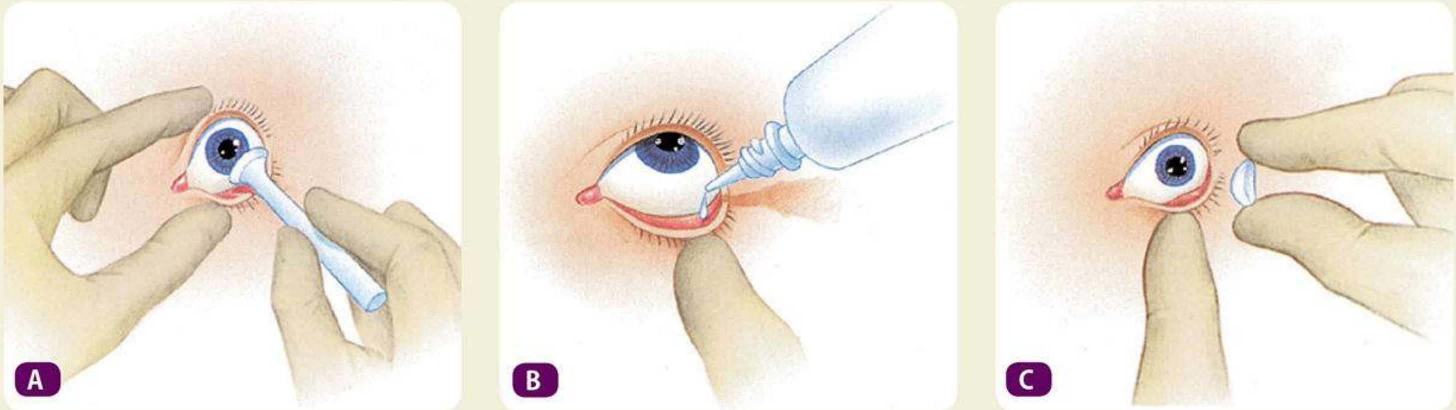

Figure 27-27 Removing contact lenses should be limited to patients with chemical burn injuries to the eye. **A.** To remove hard contact lenses, use a specialized suction cup moistened with sterile saline solution. **B.** To remove soft contact lenses, instill one or two drops of saline or irrigating solution. **C.** Next, pinch off the lens with your gloved thumb and index finger.

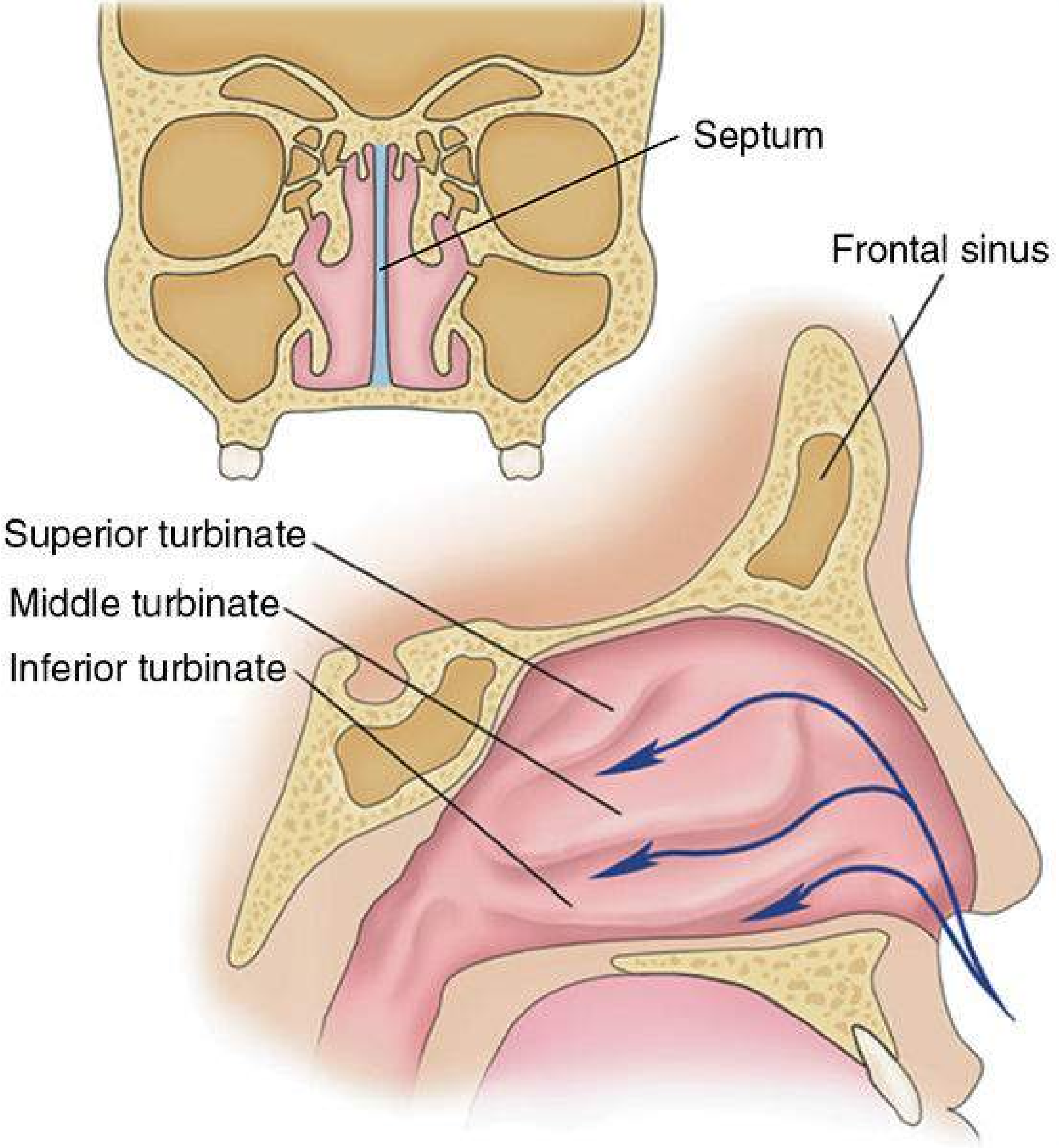

Figure 27-28 The nose has two chambers, divided by the septum. Each chamber is composed of layers of bone called turbinates. Above the nose are the frontal sinuses and, on either side, the orbit of the eye.

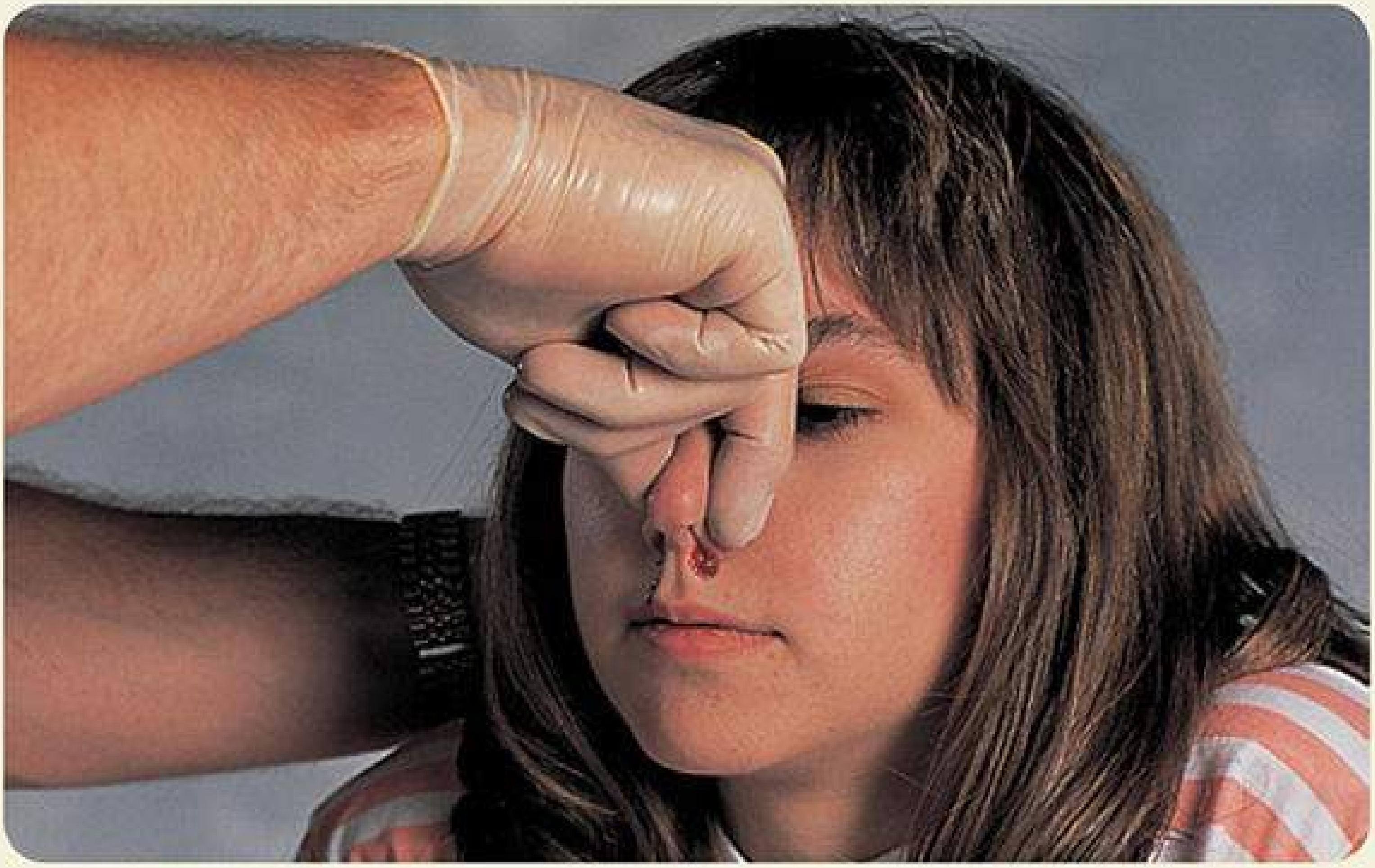

Figure 27-29 Control bleeding from the nose by pinching the nostrils together.

Injuries of the Ear

The ear is a complex organ that is associated with hearing and balance. The ear is divided into three parts **Figure 27-30**. The external ear is composed of the pinna, or auricle, which is the part lying outside of the head, and the **external auditory canal**, which leads in toward the **tympanic membrane**, or eardrum. The middle ear contains three small bones (the hammer, anvil, and stirrup) that move in response to sound waves hitting the tympanic membrane. This is the mechanism by which sounds are heard and differentiated. The middle ear is connected to the nasal cavity by the **eustachian tube**, which is the internal auditory canal. This connection permits equalization of pressure in the middle ear when external atmospheric pressure changes. The inner ear is composed of bony chambers filled with fluid. As the head moves, so does the fluid. In response, fine nerve endings within the fluid send impulses to the brain indicating the position of the head and the rate of change of position.

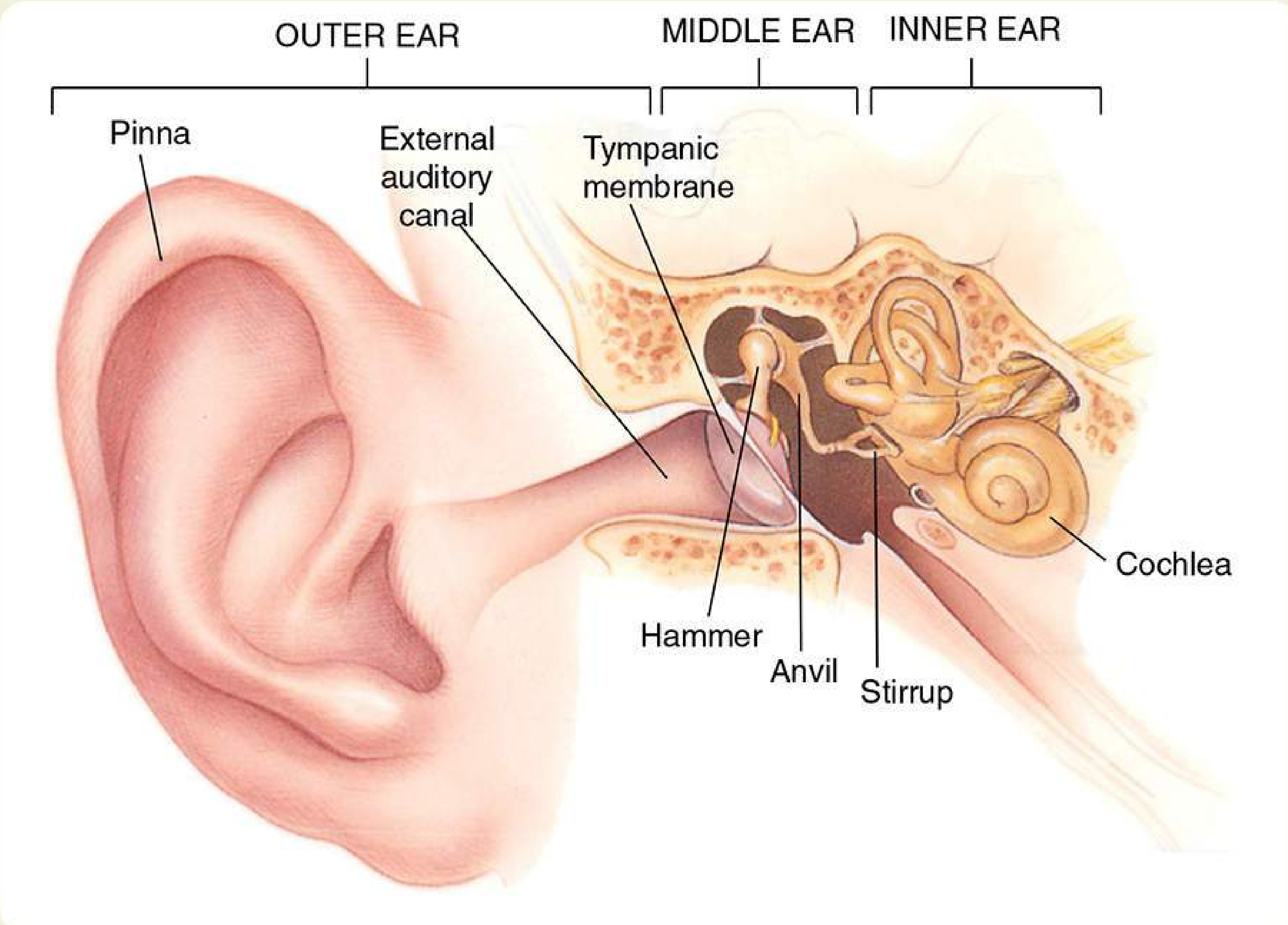

Figure 27-30 The ear has three principal parts: the external, or outer, ear, composed of the pinna, external auditory canal, and tympanic membrane; the middle ear, including the hammer, anvil, and stirrup; and the inner ear, composed of bony chambers filled with fluid.

YOU are the Provider — PART 5

You reassess the patient en route, including his vital signs, and note that his breathing is becoming increasingly labored. His airway remains clear of secretions and blood, but his neck appears to be more swollen than it was during previous assessments.

Recording Time: 16 Minutes	
Level of consciousness	Conscious and alert; anxious
Respirations	26 breaths/min; labored
Pulse	124 beats/min; strong and regular
Skin	Cool and moist; perioral cyanosis is developing
Blood pressure	122/58 mm Hg

Spo_2	88% (on oxygen)

The hospital staff are notified of the change in the patient's condition. The nurse tells you to bring him straight to the trauma room on your arrival.

8. What is the most likely cause of your patient's labored breathing?

9. What adjustments, if any, should you make to your current treatment?

Ears are often injured, but they usually do not bleed very much. If local pressure does not control the bleeding, you can apply a roller dressing **Figure 27-31**. First, however, you should place a soft, padded dressing between the back of the ear and the scalp because bandaging the ear against the tender underlying scalp can be extremely painful for the patient. In the case of an ear avulsion, you should wrap the avulsed part in a moist, sterile dressing and put it in a plastic bag labeled with the patient's name. Keep the avulsed part cool and transport to the hospital with the patient. Often, avulsed tissue from the ear can be reattached.

Figure 27-31 **A.** A major laceration of the ear. **B.** Proper treatment includes use of a soft, sterile pad behind the ear, between it and the scalp. Then wrap a roller gauze dressing around the head to include the entire ear.

Sudden changes in pressure created by a blast wave may rupture one or both tympanic membranes. Patients with a ruptured tympanic membrane will often report severe ear pain, difficulty hearing, or ringing in the affected ear. The tympanic membrane may also be perforated by insertion of objects (like a cotton swab) too far into the ear. Any patient with a suspected tympanic membrane injury should be transported to the hospital for a more detailed evaluation.

The external auditory canal is a favorite place for children to place foreign bodies such as peanuts or candy. All such items should be removed by a physician in the emergency department. Never try to manipulate the foreign body because you may press it further into the auditory canal and cause permanent damage to the tympanic membrane.

Again, note any clear fluid coming from the ear of a severely injured patient because this may indicate a fracture at the base of the skull.

Facial Fractures

Fractures of the facial bones typically result from blunt impact. For example, the patient's head collides with a steering wheel or windshield in an automobile crash or is hit by a baseball bat or pipe in an assault. You should assume that any patient who has sustained a direct blow to the mouth or nose has a facial fracture. Other clues to the possibility of fracture include bleeding in the mouth, inability to swallow or talk, absent or loose teeth, and/or loose or movable bone fragments. Patients may also report that "it doesn't feel right" when they close their jaw, signaling an irregularity of bite.

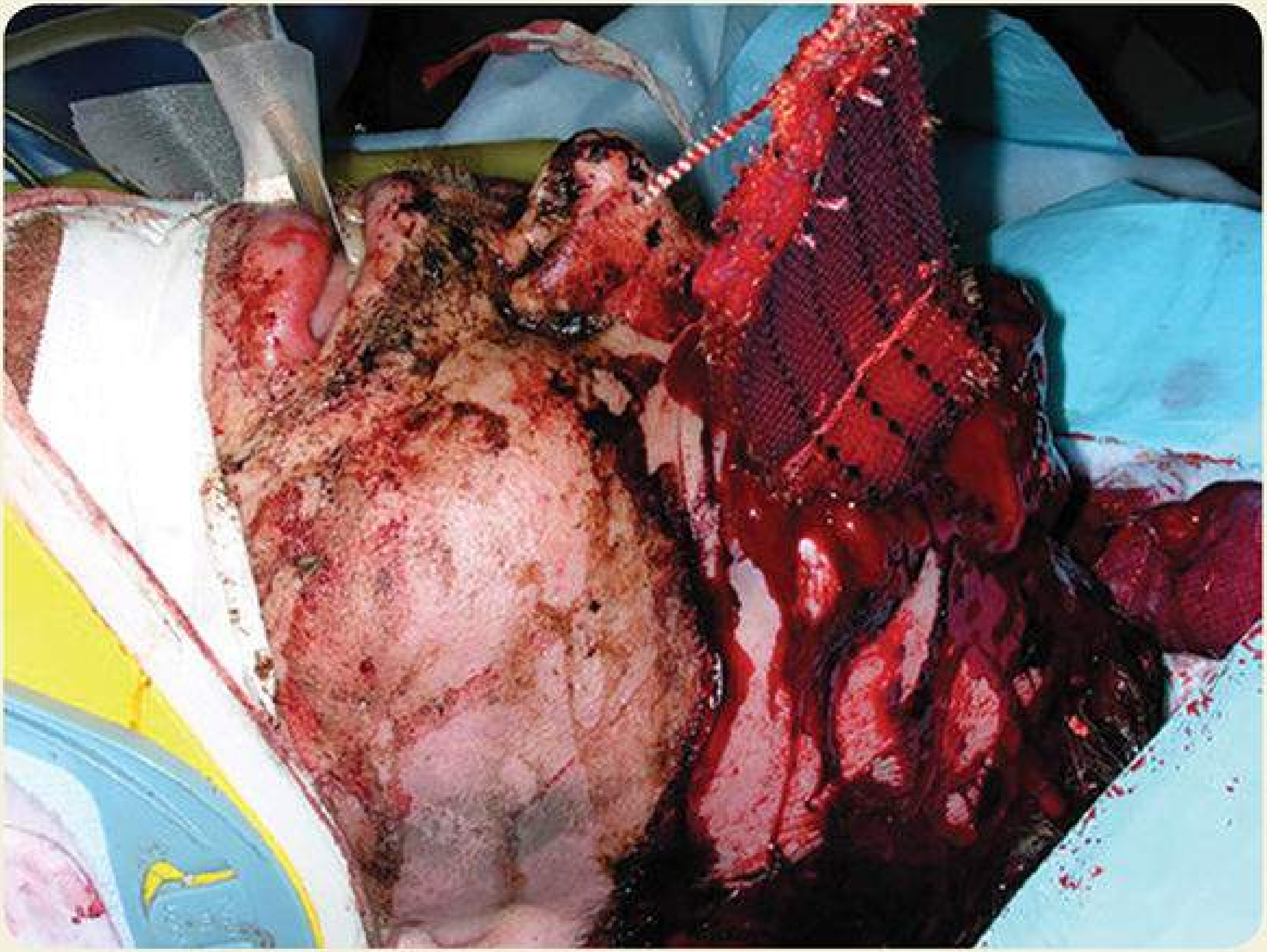

Figure 27-32 Bleeding following a crushing injury to the face can be life threatening because, in addition to the external hemorrhage, blood clots in the airway can cause a complete obstruction.

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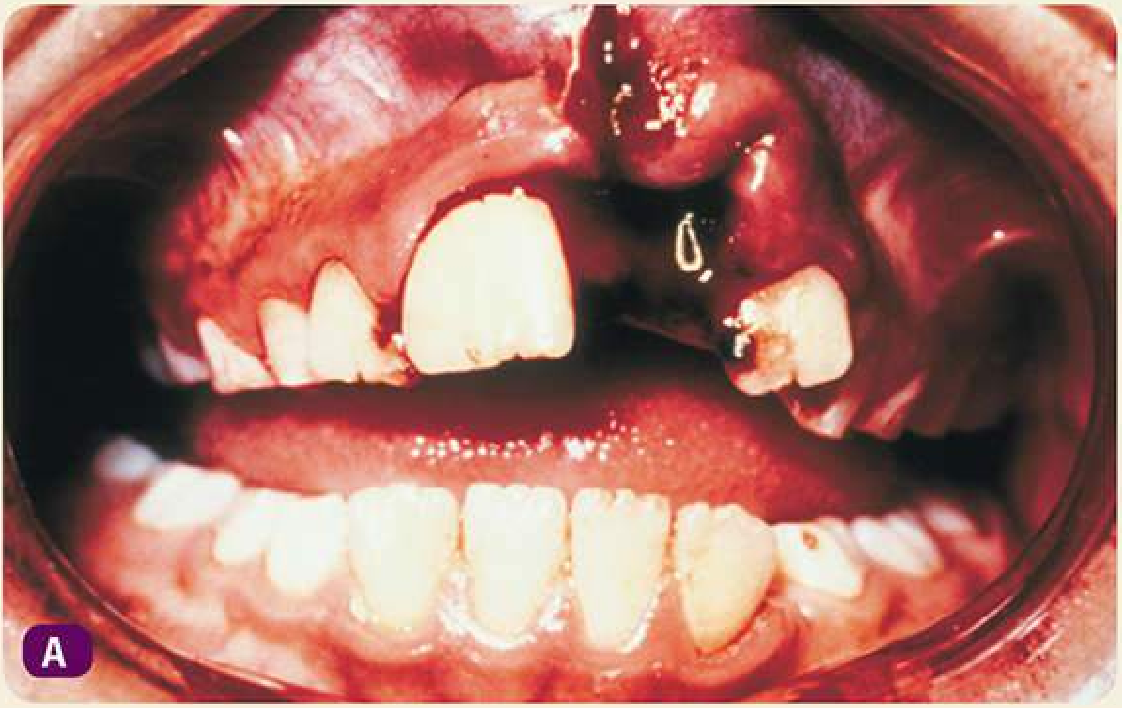
Facial fractures alone are not acute emergencies unless there is serious bleeding; however, they are an indication of significant blunt force trauma applied to that region of the body. Serious bleeding from a facial fracture can be life threatening. In addition to external hemorrhage, there is the danger of blood clots lodging in the upper airway and causing an obstruction Figure 27-32. Fractures around the face and mouth can also produce deformity and loose bone fragments. However, plastic surgeons can repair the damage if the injuries are treated within 7 to 10 days of the injury. Be sure to remove and save loose teeth or bone fragments from the mouth; it is often possible to reimplant them **Figure 27-33**. Remove any loose dentures or dental bridges to protect against airway obstruction. The removal of dentures will affect the shape of the patient's jaw.

Another source of potential airway obstruction is swelling, which can be extreme within the first 24 hours after injury. If you notice swelling during assessment or at any time while the patient is in your care, check for airway obstruction.

Dental Injuries

Dental injuries can be traumatic to a patient. Not only is the injury itself traumatic, but the patient's permanent teeth may also be lost—affecting everything from eating to smiling. Keep this in mind when providing care.

Bleeding will occur whenever a tooth is violently displaced out of its socket; therefore, apply direct pressure to stop the bleeding. To keep the airway patent, perform suctioning if needed. Also keep in mind that cracked or loose teeth are possible airway obstructions; therefore, suctioning may be necessary.



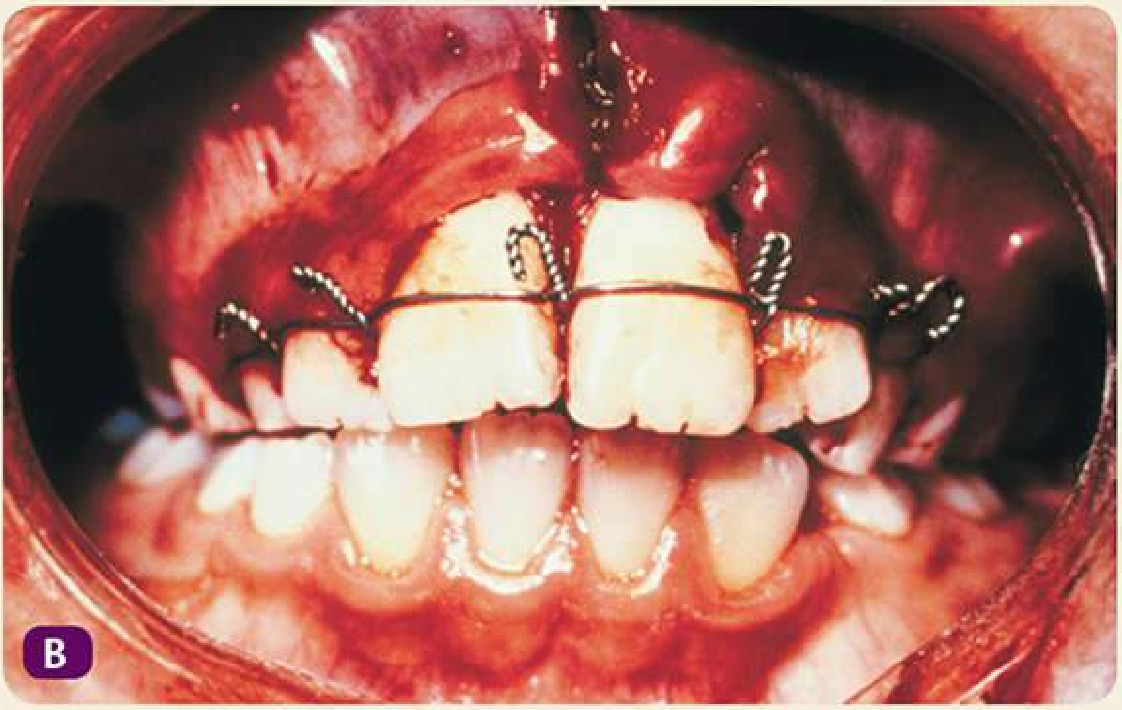


Figure 27-33 **A.** Save any lost teeth or bone fragments following an injury to the mouth. **B.** Even with traumatic loss of a tooth, the possibility of successful reimplantation is very good, especially if the tooth is stored in an appropriate tooth-storage solution, cold milk, or sterile saline.

When dealing with an avulsed tooth, handle it by its crown and not by the root. When transporting the patient, bring along the tooth, placing it in a special tooth storage solution if available in your supplies, or in cold milk or sterile saline. There are also commercially available kits that may be used by your agency. Be familiar with how the kit is used before you encounter a patient with dental trauma. Notify the receiving facility about the avulsed tooth because reimplantation is recommended within 20 minutes to 1 hour after the trauma.

Injuries of the Cheek

You may encounter an object that is impaled in the patient's cheek. If you are unable to control the bleeding and it is compromising the patient's airway, consider removing the impaled object if possible and provide direct pressure on the inside and outside of the cheek. The amount of bandaging should not be so overwhelming that it occludes the mouth and makes it difficult for the patient to breathe.

Injuries of the Neck

The neck contains many structures that are vulnerable to injury by blunt trauma, such as from a steering wheel in a car crash, or by penetrating injury, such as a stab or gunshot wound. These structures include the upper airway, the esophagus, the carotid arteries and jugular veins, the thyroid cartilage or Adam's apple, the cricoid cartilage, and the upper part of the trachea. Any injury to the neck is serious and should be considered life threatening until proven otherwise in the emergency department.

Blunt Injuries

Any crushing injury of the upper part of the neck is likely to involve the larynx or trachea. Examples include a collision with a steering wheel, an attempted suicide by hanging, and a clothesline injury sustained while riding a bicycle. Once the cartilages of the upper airway and larynx are fractured, they do not spring back to their normal position. This type of fracture can lead to loss of voice, difficulty swallowing, severe and sometimes fatal airway obstruction, and leakage of air into the soft tissues of the neck **Figure 27-34**. The presence of air in the soft tissues produces a characteristic crackling sensation called **subcutaneous emphysema**. If you feel this sensation when you palpate the neck, you should maintain the airway as best you can and provide immediate transport. Be aware that complete airway obstruction can develop very rapidly in these patients as a result of swelling or bleeding into the underlying tissues. It may be very difficult to manage the airway in patients with these injuries; therefore, ALS support either by air or during an intercept may be necessary. Some patients will require a surgical airway at the hospital. An incident involving an injury to the throat may also have caused a cervical spinal injury; therefore, spinal immobilization may be needed.

Penetrating Injuries

Penetrating injuries to the neck can cause profuse bleeding from laceration of the great vessels in the neck—the carotid arteries or the jugular veins **Figure 27-35**. Injuries to the carotid and jugular vessels in the neck can cause the body to bleed out, also known as exsanguination. Injuries to these large vessels may also allow air to enter the circulatory system. If a vein has been punctured, air may be sucked through it to the heart, a clinical situation called an **air embolism**. A large amount of air in the right atrium and right ventricle of the heart can lead to cardiac arrest. The airway, the esophagus, and even the spinal cord can be damaged by a penetrating injury.

Figure 27-34 Fractures of the larynx or trachea can cause air to leak from the airway into the subcutaneous tissues. The presence of air in the soft tissues produces a crackling sensation called subcutaneous emphysema.

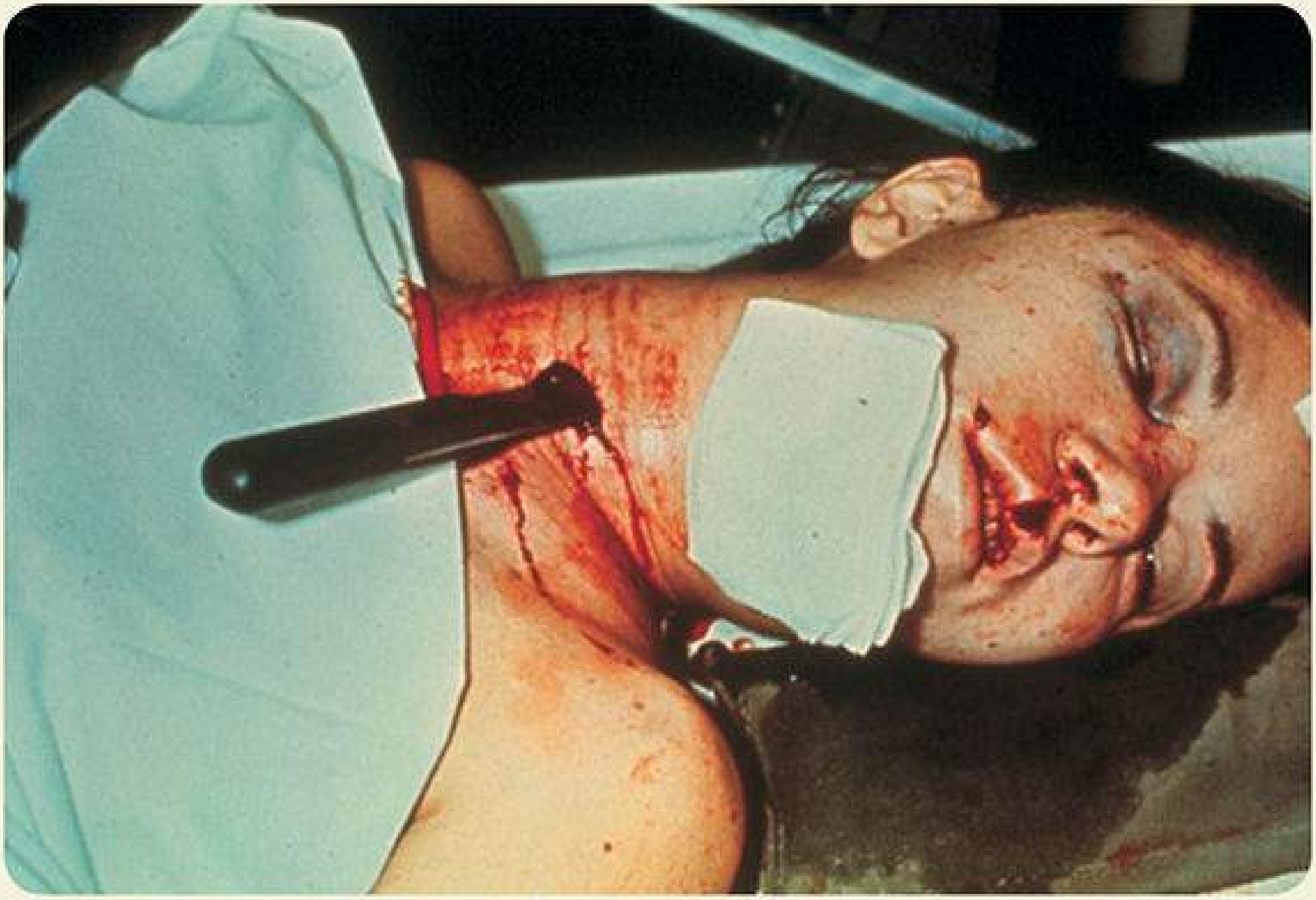


Figure 27-35 Penetrating injuries to the neck can result in profuse bleeding if a carotid artery or jugular vein is damaged.

Direct pressure over the bleeding site will control most neck bleeding. Follow the steps in Skill Drill 27-3:

1. Apply direct pressure to the bleeding site using a gloved fingertip if necessary to control bleeding Step 1.
2. Apply a sterile occlusive dressing to ensure that air does not enter a vein or artery Step 2.
3. Secure the dressing in place with roller gauze, adding more dressings if needed.
4. Wrap the gauze around and under the patient's shoulder. To avoid possible airway and circulation problems, do not wrap the gauze around the neck.

Despite the use of these measures, the tissues within the neck may still continue to bleed and compress the upper airway, so you should look for signs of airway obstruction.

You might find it necessary to apply pressure both above and below the penetrating wound to control life-threatening bleeding from the carotid artery (above) and the jugular vein (below). You may also need to treat the patient for shock.

If indicated, maintain cervical spine immobilization, and with the patient fully immobilized to a backboard, provide prompt transport. Ensure that the airway remains open en route, and apply high-flow oxygen.

Laryngeal Injuries

Blunt force trauma to the larynx can occur when an unrestrained driver strikes the steering wheel or when a snowmobile rider or off-road biker strikes a clothesline or a fixed wire strung across a property line. The larynx becomes crushed against the cervical spine, resulting in soft-tissue injury, fractures, and/or separation of the fascia that connects the thyroid and cricoid cartilages. These strangulation injuries can also be found in either intentional or unintentional hangings. Any time there is suspected injury to the larynx, you should suspect possible cervical spine injury.

Open injuries to the larynx can occur as a result of a stabbing or penetration by a similar object. Penetrating and impaled objects should not be removed unless they interfere with cardiopulmonary resuscitation. Stabilize all impaled objects if they are not obstructing the airway (see Chapter 26, *Soft-Tissue Injuries*).

Skill Drill 27-3 Controlling Bleeding From a Neck Injury

Step 1

Apply direct pressure to the bleeding site using a gloved fingertip if necessary to control bleeding.

Step 2

Apply a sterile occlusive dressing to ensure that air does not enter a vein or artery.

Significant injuries to the larynx pose an immediate risk of airway compromise because of disruption of the normal passage of air, soft-tissue swelling, or aspiration of blood. The signs and symptoms of larynx injuries include respiratory distress, hoarseness, pain, difficulty swallowing (dysphagia), cyanosis, pale skin, sputum in the wound, subcutaneous emphysema, bruising on the neck, hematoma, or bleeding.

To manage a laryngeal injury, provide oxygenation and ventilation. Apply a cervical collar, but avoid the use of rigid collars because they may cause further damage to the soft tissues.

YOU are the Provider — SUMMARY

1. What should be your most immediate concern after receiving this initial patient information?

The presence of severe facial trauma should immediately increase your index of suspicion for potential airway and ventilation compromise, including partial or complete upper airway obstruction. Direct trauma to the nose and mouth can be a source of significant bleeding. Severe swelling and bleeding can occur in the oropharynx. Crushing injuries to the larynx and trachea are associated with a high incidence of airway and ventilation compromise. The risk of upper airway obstruction is significantly higher if the patient has a decreased level of consciousness and is unable to expel blood from the mouth on his or her own. Also, if the patient swallows large amounts of blood, the risks of vomiting and subsequent aspiration are high.

Dislodged teeth can fall to the back of the throat and be aspirated into the lungs or complicate obstruction of the upper airway. Crushing injuries to the throat should increase your index of suspicion for a spinal injury. In addition, when trauma is severe enough to fracture facial bones, the possibility of an underlying closed head injury should be considered as well.

2. What should your initial actions consist of when you arrive at the scene?

First, conduct a scene size-up. Although law enforcement personnel have advised you that the scene is secure, you must still remain aware of your surroundings at all times. Your patient has been assaulted, which means that the perpetrator, if he or she is not in custody, could return to the scene. Ascertain the total number of patients and call for additional resources if you think you will need them.

As you are approaching the patient, form a general impression.

As you make physical contact with the patient, introduce yourself and manually stabilize his head. Next, assess the status of the patient's airway. If he can talk to you, he has no *immediate* airway problems, although this can quickly change. If there is any blood in his oropharynx, remove it with suction. If he is conscious and alert, consider allowing him to suction his own mouth. Follow standard precautions, including protective facial wear.

After ensuring a patent airway, assess the quality of the patient's breathing and intervene at once. If he is breathing adequately, administer high-flow oxygen via a nonrebreathing mask. If he has signs of inadequate breathing (eg, fast or slow rate, shallow breathing [reduced tidal volume]), assist his ventilations.

Complete your primary assessment by assessing the rate and quality of his radial and carotid pulses and looking for and immediately controlling any severe external bleeding. If signs of shock are present, begin immediate shock treatment.

3. Does this patient have a patent airway? How can you tell?

Since the patient is conscious, alert, and talking, he has a patent airway—at least, for the time being. Although he has blood in his mouth, he is able to keep his own airway clear by spitting it out. The patient's voice is hoarse; this should concern you because it could indicate upper airway swelling or a crushing injury to the structures of the anterior neck (ie, trachea, larynx).

At this point in the primary assessment, you have not yet determined if he has any injuries that could affect his level of consciousness, such as a closed head injury. Therefore, you must pay meticulous attention to his mental status and be prepared to suction the blood from his mouth. If he has a loss of consciousness, he will not be able to maintain his airway and you need to be prepared to intervene immediately. *Regardless of the situation, a patient's airway must remain patent at all times!*

4. What should be your initial treatment priorities for this patient?

The goal of the primary assessment is to *find and quickly treat* problems associated with the ABCs. Further assessment and treatment must focus on injuries or conditions that will kill your patient *first*.

Your patient has severe facial trauma and his voice is hoarse. Although he is able to maintain his own airway right now, do not assume that he will be able to continue to do this until you get him to a hospital. Closely monitor his airway and ventilation status!

Your partner is providing manual stabilization of the patient's head based on the assumption that trauma significant enough to cause massive facial trauma can just as easily fracture or dislocate a spinal vertebra.

Apply high-flow oxygen via a nonrebreathing mask, but closely monitor his airway for continued oral bleeding. It may be necessary to occasionally remove the oxygen mask, allow him to expel any blood from his mouth, and then reapply the mask. If he remains conscious and can easily follow commands, you can allow him to hold the rigid suction catheter and suction the blood from his mouth himself.

Carefully monitor the patient's level of consciousness and breathing adequacy, keep his airway clear of blood, and be prepared to assist his ventilations.

5. On the basis of the mechanism of injury, what type of injuries should you suspect and assess for?

On the basis of your assessment, the patient's injuries appear to be isolated to his face and anterior part of the neck. However, a more in-depth assessment by a physician is needed to rule out occult injuries. Facial swelling, which is common following blunt force facial trauma, can make assessment difficult.

On the basis of the mechanism of injury, you should be suspicious for facial bone fractures and injury to his trachea and/or larynx. Indicators of facial fractures include oropharyngeal bleeding, loose or absent teeth, difficulty talking or swallowing, and loose or obviously movable bone fragments. Your patient's report that it "doesn't feel right" when he tries to close his mouth signals an irregular bite (dental malocclusion) and is a sign of a mandibular fracture. This is a significant finding because it takes a lot of force to fracture the mandible!

Any crushing injury to the anterior part of the neck is likely to involve the larynx or trachea. During your assessment, you detected bruising and swelling of the throat, and the patient's voice is hoarse. These are red flag indicators of significant anterior neck trauma. Suspect fracture of the trachea if you detect subcutaneous emphysema, a crackling sensation that is felt when palpating the soft tissues of the neck.

Fractures of the zygomas (cheek bones) often present with a flattened appearance of the cheek bones; however, if the face is severely swollen, this may not be grossly apparent.

When caring for a patient with blunt facial trauma, assess the ability of the patient to move his or her eyes in all directions. Inability of the patient to look up (paralysis of upward gaze) suggests an orbital (blowout) fracture, in which case a bone fragment has entrapped one of the oculomotor nerves.

A closed head injury cannot be ruled out. During your assessment, you should look in and behind the ears. Bruising over the mastoid bone (Battle sign) indicates a basilar skull fracture. Blood that is draining from the ears may contain cerebrospinal fluid. This is also an indicator of a basilar skull fracture. Blood or fluid drainage from the nose is also a sign of an underlying skull fracture.

Sudden hyperextension of the head during trauma can cause fractures or dislocations of the vertebrae of the cervical spine. Provide full spinal immobilization when caring for a patient with significant blunt facial trauma.

6. What should you do if this patient begins to vomit?

If aspiration occurs, the risk of mortality increases significantly so you *must* have a plan of action to prevent aspiration while transporting a patient who is supine and immobilized on a backboard.

If the patient begins to vomit, *immediately* place him on his side to allow vomitus to drain from his mouth. It is imperative that you protect the patient's airway, but as you turn the entire backboard onto its side, you must also avoid aggravating any possible spinal injury by ensuring that the patient is properly immobilized.

While the patient is on his side, suction his mouth to remove any remaining vomitus that did not drain with gravity. Before returning the patient to a supine position, make sure that *all* vomitus and other secretions are removed from his mouth!

7. How should you treat a patient with active oral bleeding and inadequate ventilation?

Not only is the patient's airway in immediate jeopardy from obstruction from blood clots and aspiration, but inadequate ventilation will result in hypoxia and may lead to respiratory or cardiopulmonary arrest. Therefore, you must treat both problems simultaneously.

If blood has pooled in the patient's mouth, immediately place the patient onto his or her side to allow the blood to drain from the mouth. Suction the airway for up to 15 seconds. Then assist the patient's ventilations for 2 minutes.

Continue this alternating pattern of suctioning for 15 seconds and assisting ventilations for 2 minutes as needed, until the bleeding in the oropharynx is minimal or stops altogether. Regardless of the situation, the patient's airway must remain patent at all times and adequate ventilation must be ensured.

Patients with this type of airway and ventilation predicament would benefit from advanced airway management, especially if they are unconscious. Paramedics can intubate the patient, thus isolating the trachea and preventing aspiration, while manually ventilating the patient with a BVM attached to the endotracheal tube. Request an ALS ambulance, if possible, when caring for patients with this type of complex airway and breathing problem.

8. What is the most likely cause of your patient's labored breathing?

Reassessment reveals that his airway remains clear of blood. However, the anterior part of his neck is more swollen so you should suspect that his upper airway is swelling—most likely because of injury to his trachea or larynx, thus making it increasingly difficult for him to breathe. His oxygen saturation of 88%, even with high-flow oxygen, reflects significant hypoxemia, and perioral cyanosis (cyanosis around the mouth) is developing.

It is important to note that not all patients with significant injuries deteriorate at the scene. Many of them deteriorate en route to the hospital or shortly after you arrive at the hospital. Therefore, it is critical to *frequently reassess* any patient with injuries that could jeopardize airway patency and impair ventilation.

9. What adjustments, if any, should you make to your current treatment?

Your patient's ventilation status has clearly deteriorated. You should consider assisting his ventilations with a BVM and high-flow oxygen. Try to assist the patient's breathing, but do not be too aggressive. If he becomes combative and pushes the BVM away from his face, reapply the nonrebreathing mask and carefully monitor his breathing.

If he tolerates assisted ventilation, use extreme caution. Although you must maintain adequate minute volume, a tracheal or laryngeal injury can be exacerbated by aggressive positive-pressure ventilation. Squeeze the BVM just enough to improve the amount of tidal volume with each breath; observe for visible chest rise.

You should *not* use any type of mechanical ventilation device, such as a flow-restricted, oxygen-powered ventilation device, when ventilating a patient with tracheal or laryngeal trauma. These devices deliver oxygen under high pressure and can cause further injury to patients with fractures of the trachea or larynx.

EMS Patient Care Report (PCR)

Date: 12-3-16	**Incident No.:** 012509	**Nature of Call:** Assault		**Location:** 1505 Eagle Rock Dr.	
Dispatched: 1926	**En Route:** 1927	**At Scene:** 1930	**Transport:** 1941	**At Hospital:** 2001	**In Service:** 2021

Patient Information

Age: 30 **Sex:** M **Weight (in kg [lb]):** 80 kg (175 lb)	**Allergies:** Penicillin **Medications:** None **Past Medical History:** None **Chief Complaint:** Face and neck injury secondary to assault

Vital Signs

Time: 1935	**BP:** 132/68	**Pulse:** 118	**Respirations:** 22	**Spo_2:** 97%
Time: 1941	**BP:** 128/62	**Pulse:** 108	**Respirations:** 20	**Spo_2:** 98%
Time: 1946	**BP:** 122/58	**Pulse:** 124	**Respirations:** 26	**Spo_2:** 88%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Suctioning, spinal immobilization

Narrative

Ambulance 12 dispatched to the scene of an assault. The scene was secured by law enforcement prior to EMS arrival. On arrival at the scene, found the patient, a 30-year-old male, sitting on the ground; his face was covered with blood and his face was swollen. He was conscious but appeared anxious. He was spitting out small amounts of blood from his mouth, but was maintaining his own airway; his breathing was adequate. Manual c-spine stabilization was applied as patient was assessed further. He stated that he was struck across the face with a steel pipe, fell to the ground, and was kicked in the face and throat. He denies loss of consciousness. Applied high-flow oxygen via nonrebreathing mask and suctioned the patient's mouth as needed to remove blood. Secondary assessment revealed severe swelling of the entire face, and bruising and mild swelling of the anterior part of the neck. Patient states that it "doesn't feel right" when he tries to close his mouth. No gross evidence of head or c-spine injury was noted during secondary assessment. Recovered pt's teeth and placed them in a commercial tooth-saver container. Applied full spinal immobilization, placed patient onto stretcher, loaded him into the ambulance, and began transport to the hospital. Reassessment en route revealed that his airway was free of blood or other secretions and his vital signs were stable. After radio report was called to receiving facility, patient became more anxious and nauseated and began experiencing respiratory distress. Immediate reassessment revealed that his airway remained free of blood or other secretions, but the anterior part of his neck appeared more swollen than in previous assessments. Further reassessment revealed that he was developing perioral cyanosis, and his oxygen saturation decreased significantly. Began assisting the patient's ventilations with a BVM and high-flow oxygen; he was initially resistant, but became more compliant with coaching. Notified hospital of patient status change. Continued to assist patient's ventilations and monitor his airway status for the duration of the transport. Noted improvement in patient's oxygen saturation and skin condition with assisted ventilation. Delivered patient to the emergency department staff and gave verbal report to the attending physician. Ambulance 12 cleared the hospital and returned to service at 2021 hrs.**End of report**

Prep Kit

Ready for Review

- Soft-tissue injuries and fractures of the bones of the face and neck are common and vary in severity.
- In face and neck injuries, your priorities are to prevent further injury to the cervical spine, manage the airway and ventilation of the patient, and control bleeding.
- Airway compromise may be caused by heavy bleeding into the airway, swelling in and around the structures of the airway located in the face and neck, and injuries to the central nervous system that interfere with normal respiration.
- To control heavy bleeding from soft-tissue injuries to the face, use direct pressure with a dry, sterile dressing. If brain tissue is exposed, use a moist, sterile dressing.
- Always check for bleeding inside the mouth because this may produce airway obstruction.
- Open the airway using the jaw-thrust maneuver (when indicated), and clear the airway in all patients with facial injuries.
- Save avulsed pieces of skin and tissue, and transport them with the patient for possible reattachment at the hospital.
- Maintain a high index of suspicion for patients with unequal pupils—this sign may indicate an illness or an injury to the brain. Remember, some people are born with one pupil larger than the other. During your assessment, ask your patient whether he or she normally has unequal pupils.
- Foreign bodies on the surface of the eye should be irrigated gently with normal saline solution. Always flush from the region of the eye closest to the nose toward the outside, away from the midline.
- If a foreign body is on the underside of the eyelid, remove it gently with a cotton-tipped applicator. Never remove foreign bodies stuck to the cornea.
- Chemicals, heat, and light rays can all cause burn injury to the eyes, resulting in permanent damage.
- Be alert to clear fluid draining from the ears or nose. This may indicate a basilar skull fracture.
- Blunt and penetrating trauma to the neck can produce life-threatening injuries. Palpate the neck for signs of subcutaneous emphysema. In patients with this sign, complete airway obstruction may develop in minutes.
- If bleeding is present from a penetrating injury, direct pressure over the site will usually control most forms of bleeding.
- Be alert to the possibility of an air embolism from an open neck injury. Place an occlusive dressing over the site, and provide direct pressure.

Vital Vocabulary

air embolism The presence of air in the veins, which can lead to cardiac arrest if it enters the heart.

anisocoria Naturally occurring uneven pupil size.

blow-out fracture A fracture of the orbit or of the bones that support the floor of the orbit.

conjunctiva The delicate membrane that lines the eyelids and covers the exposed surface of the eye.

conjunctivitis Inflammation of the conjunctiva.

cornea The transparent tissue layer in front of the pupil and iris of the eye.

eustachian tube A branch of the internal auditory canal that connects the middle ear to the oropharynx.

external auditory canal The ear canal; leads to the tympanic membrane.

globe The eyeball.

iris The muscle and surrounding tissue behind the cornea that dilate and constrict the pupil, regulating the amount of light that enters the eye; pigment in this tissue gives the eye its color.

lacrimal glands The glands that produce fluids to keep the eye moist; also called tear glands.

lens The transparent part of the eye through which images are focused on the retina.

mastoid process The prominent bony mass at the base of the skull about 1 inch posterior to the external opening of the ear.

optic nerve A cranial nerve that transmits visual information to the brain.

pinna The external, visible part of the ear.

pupil The circular opening in the middle of the iris that admits light to the back of the eye.

retina The light-sensitive area of the eye where images are projected; a layer of cells at the back of the eye that changes the light image into electric impulses, which are carried by the optic nerve to the brain.

retinal detachment Separation of the retina from its attachments at the back of the eye.

sclera The tough, fibrous, white portion of the eye that protects the more delicate inner structures.

sternocleidomastoid muscles The muscles on either side of the neck that allow movement of the head.

subcutaneous emphysema A characteristic crackling sensation felt on palpation of the skin, caused by the presence of air in soft tissues.

temporomandibular joint The joint formed where the mandible and cranium meet, just in front of the ear.

tragus The small, rounded, fleshy bulge that lies immediately anterior to the ear canal.

turbinates Layers of bone within the nasal cavity.

tympanic membrane The eardrum, which lies between the external and middle ear.

Assessment *in Action*

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You are dispatched to a motor vehicle crash on a rural road where a single vehicle is up on an embankment. The vehicle has front-end damage and a starred windshield. The unrestrained driver is lying supine in the road; the police report that they found the patient outside of the vehicle. He is unconscious and has obvious facial bleeding. Examination reveals a hematoma and depression of the left temporal area, both eyes are black and blue, and one pupil is dilated, whereas the other is normal. The patient has blood coming from the nose and mouth, and palpation reveals subcutaneous emphysema around the clavicles and chest area. The patient's breathing is labored, and the pulse is rapid and thready.

1. What is the priority for this patient?

   A. Perform spinal immobilization.
   B. Assess the vital signs.
   C. Provide rapid transport.
   D. Assess the airway, breathing, and circulation.

2. How should you manage this patient's airway?

   A. Give oxygen via a nasal cannula at 4 L/ min.
   B. Give oxygen via a nonrebreathing mask at 15 L/min.
   C. Suction the airway and assist with ventilations with a BVM.
   D. Suction the airway and give 100% oxygen via a nonrebreathing mask.

3. The unequal pupils most likely indicate what type of injury?

   A. Brain
   B. Skull
   C. Chest
   D. Spinal

4. What type of airway adjunct should be used to maintain a patent airway in this patient?

   A. Nasopharyngeal airway
   B. Gastric airway
   C. Oropharyngeal airway
   D. Endotracheal airway

5. When subcutaneous emphysema is found, what substance has accumulated under the skin?

   A. Blood
   B. Air
   C. Both blood and air
   D. Cerebrospinal fluid

6. Which of the following best describes hyphema?

   A. Bleeding in the interior chamber of the brain
   B. Bleeding in the oropharynx
   C. Bleeding in the posterior thorax
   D. Bleeding in the anterior chamber of the eye

7. Which of the following fractures is associated with bruising around the ears and blood coming from the nose?

   A. Basilar skull fracture
   B. Orbit fracture
   C. Mandibular fracture
   D. Maxilla fracture

8. A hematoma is:

   A. a form of cancer affecting red blood cells.
   B. an entrapment of air and blood in the airway.
   C. a collection of blood within the tissues.
   D. a rupture of the eye.

9. Why does this patient need rapid transport?

10. In patients with head injuries, cerebrospinal fluid (CSF) may escape from the skull. What test can you use to determine

if there is leakage of CSF?

CHAPTER
28

Head and Spine Injuries

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National EMS Education Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Head, Facial, Neck, and Spine Trauma

Recognition and management of

› Life threats (pp 993–995)
› Spine trauma (pp 991–1001, 1003–1018)

Pathophysiology, assessment, and management of

› Penetrating neck trauma (Chapter 27, *Face and Neck Injuries*)
› Laryngotracheal injuries (Chapter 27, *Face and Neck Injuries*)
› Spine trauma (pp 991–1001, 1003–1018)
› Facial fractures (Chapter 27, *Face and Neck Injuries*)
› Skull fractures (pp 986–988, 992–1002)
› Foreign bodies in the eyes (Chapter 27, *Face and Neck Injuries*)
› Dental trauma (Chapter 27, *Face and Neck Injuries*)

Nervous System Trauma

Pathophysiology, assessment, and management of

› Traumatic brain injury (pp 988–989, 992–1002)
› Spinal cord injury (pp 991–1001, 1003–1018)

Knowledge Objectives

1. Describe the anatomy and physiology of the nervous system, including its divisions into the central nervous system (CNS) and peripheral nervous system (PNS) and the structures and functions of each. (pp 981–984)
2. Explain the functions of the somatic and autonomic nervous systems. (p 984)
3. List the major bones of the skull and spinal column and their related structures; include their functions as they relate to the nervous system. (pp 984–986)
4. Explain the different types of head injuries, their potential mechanism of injury (MOI), and general signs and symptoms of a head injury that EMTs should consider when performing a patient assessment. (pp 986–991)
5. Define traumatic brain injury (TBI). (p 988)
6. Explain the difference between a primary (direct) injury and a secondary (indirect) injury; include examples of possible MOIs that may cause each one. (p 988)
7. Describe the different types of brain injuries and their corresponding signs and symptoms, including increased intracranial pressure (ICP), concussion, contusion, and injuries caused by medical conditions. (pp 988–991)
8. Describe the different types of injuries that may damage the cervical, thoracic, or lumbar spine; include examples of possible MOIs that may cause each one. (p 991)
9. Explain the steps in the patient assessment process for a person who has a suspected head or spine injury; include specific variations that may be required as related to the type of injury. (pp 991–1001)
10. List the mechanisms of injury that cause a high index of suspicion for the possibility of a head or spinal injury. (p 992)
11. Explain emergency medical care of a patient with a head injury; include the three general principles designed to protect and maintain the critical functions of the CNS and ways to determine if the patient has a traumatic brain injury. ((pp 1001–1003)
12. Explain emergency medical care of a patient with a spinal injury; include the implications of not properly caring for patients with injuries of this nature, the steps for performing manual in-line stabilization, implications for sizing and using a cervical spine immobilization device, and key symptoms that contraindicate in-line stabilization. (pp 1003–1007)
13. Explain the process of preparing patients who have suspected head or spinal injuries for transport; include the use and functions of a long backboard, vacuum mattress, short backboard, and other short spinal extrication devices to immobilize the patient’s cervical and thoracic spine. (pp 1007–1018)
14. Explain the different circumstances in which a helmet should be left on or taken off a patient with a possible head or spinal injury. (p 1018)
15. List the steps EMTs must follow to remove a helmet, including the alternate method for removing a football helmet. (pp 1018–1022)
16. Discuss age-related variations that are required when providing emergency care to a pediatric patient who has a suspected head or spine injury. (p 1021)

Skills Objectives

1. Demonstrate how to perform a jaw-thrust maneuver on a patient with a suspected spinal injury. (p 1003)
2. Demonstrate how to perform manual in-line stabilization on a patient with a suspected spinal injury. (pp 1003–1004, Skill Drill 28-1)
3. Demonstrate how to apply a cervical collar to a patient with a suspected spinal injury. (pp 1005–1006, Skill Drill 28-2)
4. Demonstrate how to secure a patient with a suspected spinal injury to a long backboard. (pp 1007–1009, Skill Drill 28-3)
5. Demonstrate how to secure a patient with a suspected spinal injury using a vacuum mattress. (pp 1008, 1010–1013, Skill Drill 28-4
6. Demonstrate how to secure a patient with a suspected spinal injury who was found in a sitting position. (pp 1013–1016, Skill Drill 28-5)
7. Demonstrate how to remove a helmet from a patient with a suspected head or spinal injury. (pp 1019–1020, Skill Dril 28-6)
8. Demonstrate the alternate method for removal of a football helmet from a patient with a suspected head or spinal injury. (pp 1021–1022)

Introduction

The nervous system is a complex network of nerve cells that enables all parts of the body to function. It includes the brain, the spinal cord, and several billion nerve fibers that carry information to and from all parts of the body. Because the nervous system is so vital, it is well protected. The brain lies within the skull, and the spinal cord is inside the bony spinal canal.

Despite this protection, serious injuries can damage the nervous system.

This chapter briefly reviews the anatomy and function of the central and peripheral nervous systems and of the skeletal system. Discussion of specific head, brain, and spinal injuries follows, including signs, symptoms, assessment, and treatment. Extrication of patients with possible spinal injuries and removal of helmets are also described.

Anatomy and Physiology

Nervous System

The nervous system is divided into two anatomic parts: the central nervous system and the peripheral nervous system **Figure 28-1**. The central nervous system (CNS) includes the brain and the spinal cord, including the nuclei and cell bodies of most nerve cells. Long nerve fibers link these cells to the body's various organs through openings in the spinal column. These cables of nerve fibers make up the peripheral nervous system.

Central Nervous System

The CNS is composed of the brain and spinal cord. The brain is the organ that controls the body; it is also the center of consciousness. It is divided into three major areas: the cerebrum, the cerebellum, and the brainstem **Figure 28-2**.

The cerebrum, which contains about 75% of the brain's total volume, controls a wide variety of activities, including most voluntary motor function and conscious thought. It is the main part of the brain and is divided into two hemispheres with four lobes. Underneath the cerebrum lies the cerebellum, which coordinates balance and body movements. The most primitive part of the CNS, the brainstem, controls virtually all the functions that are necessary for life, including the cardiac and respiratory systems and nerve function transmissions. Deep within the cranium, the brainstem is the best-protected part of the CNS.

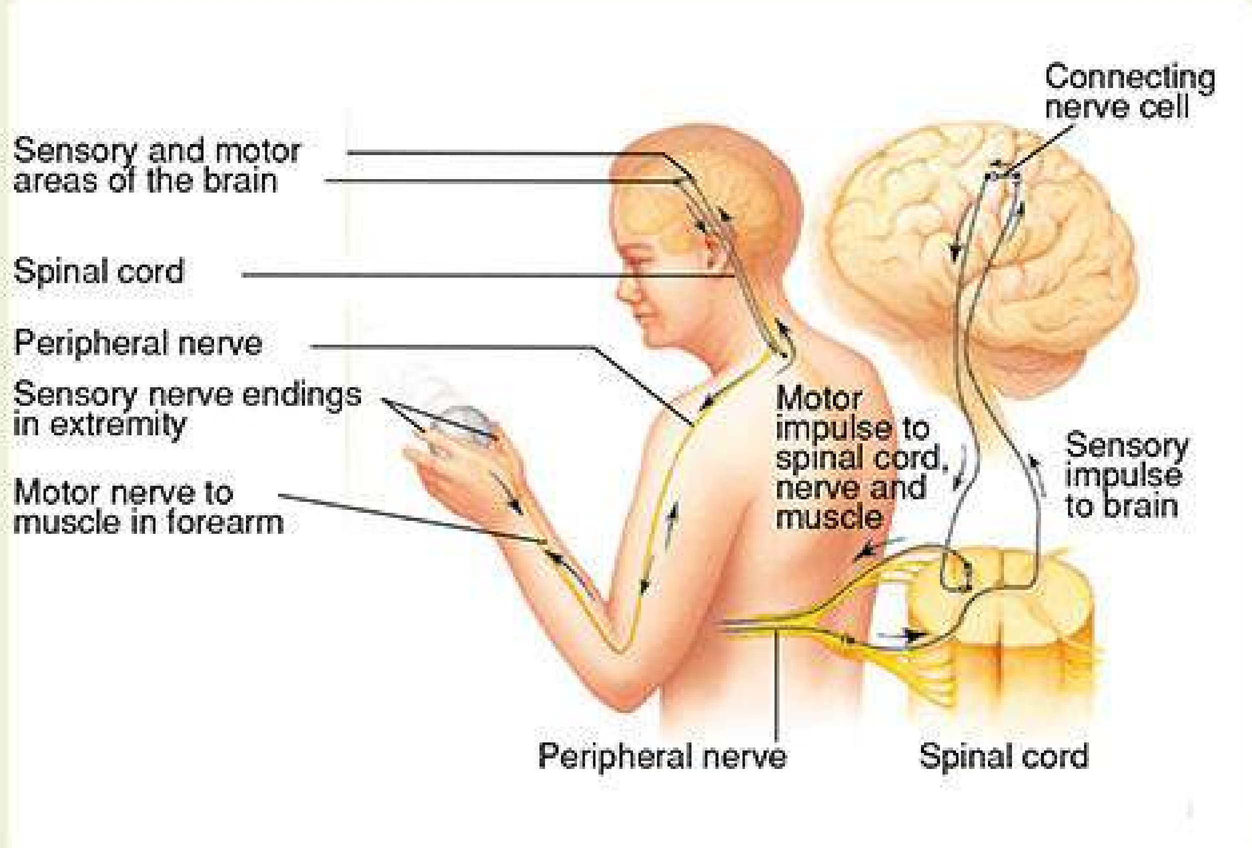

Figure 28-1 The nervous system has two anatomic components: the central nervous system and the peripheral nervous system. The central nervous system is composed of the brain and the spinal cord. The peripheral nervous system conducts sensory and motor impulses from the skin and other organs to the spinal cord.

The spinal cord, the other major portion of the CNS, is mostly made up of fibers that extend from the brain's nerve cells. The spinal cord carries messages between the brain and the body via the gray and white matter of the spinal cord. Gray matter is composed of neural cell bodies and synapses, which are connections between nerve cells. White matter consists of fiber pathways.

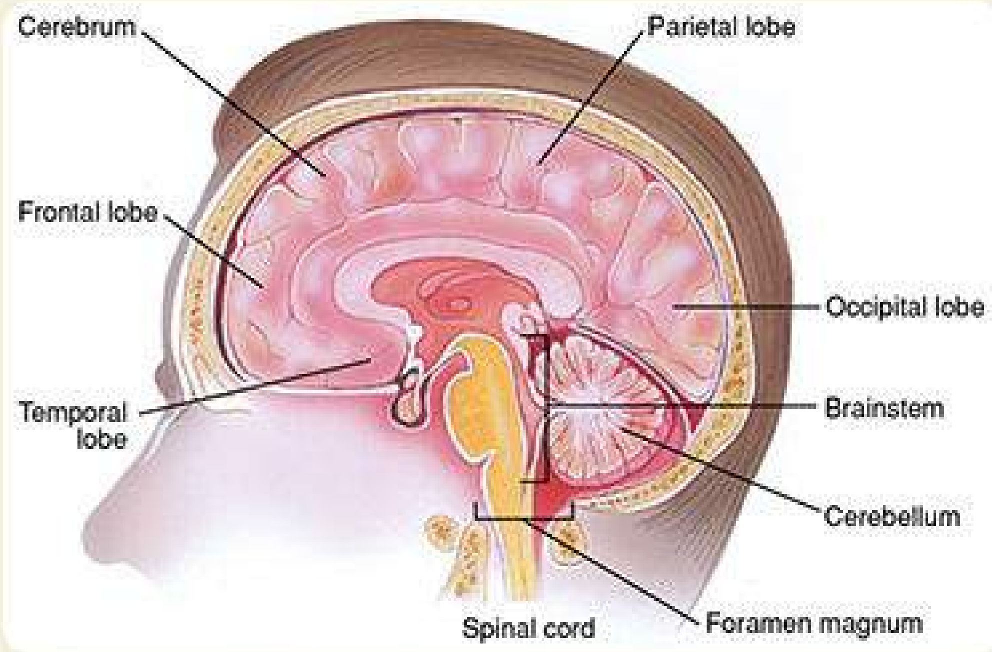

Figure 28-2 The brain is part of the central nervous system and is the organ that controls the body. It is divided into three major areas: the cerebrum, the cerebellum, and the brainstem.

Protective Coverings. The cells of the brain and spinal cord are soft and easily injured. Once damaged, they cannot be regenerated or reproduced. Therefore, the entire CNS is contained within a protective framework.

The thick, bony structures of the skull and spinal canal withstand injury very well. The skull is covered by layers of muscle, superficial fascia, and thick skin, which usually bears hair. Superficial fascia connects the muscle to the skin and contains white blood cells that are used to destroy pathogens when there is an open wound. The spinal canal is also surrounded by a thick layer of skin and muscles.

The CNS is further protected by the **meninges**, three distinct layers of tissue that suspend the brain and the spinal cord within the skull and the spinal canal **Figure 28-3**. The outer layer, the dura mater, is a tough, fibrous layer that closely resembles leather.

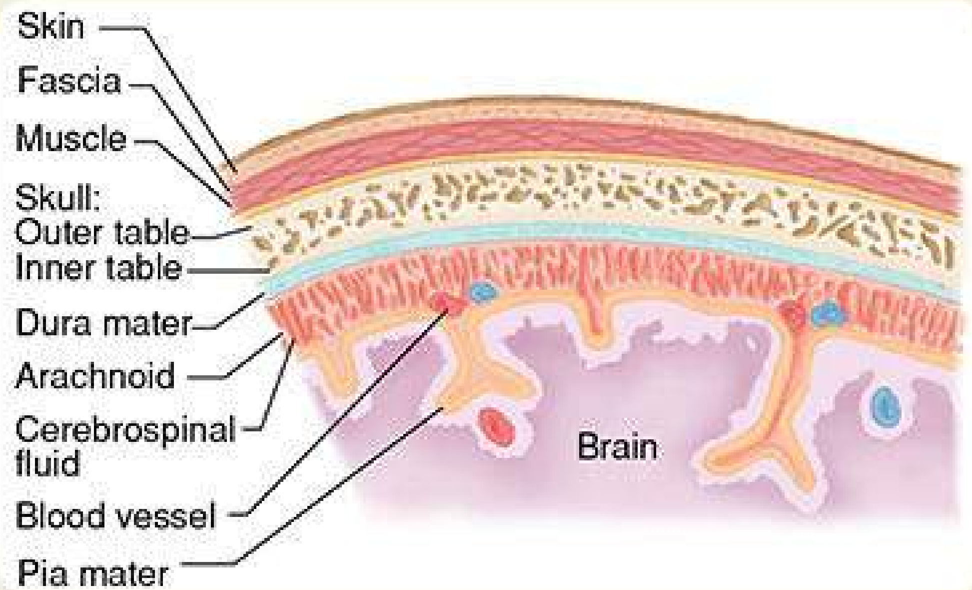

Figure 28-3 The central nervous system has several layers of protective coverings: the skin, muscles and their fascia, bone, and the meninges. The three layers of the meninges are the dura mater, the arachnoid, and the pia mater.

YOU are the Provider — PART 1

At 0220 hours, you receive a call for a man who was allegedly assaulted outside a nightclub. Law enforcement personnel are present and have secured the scene. While you are en route, one of the police officers radios you and informs you the patient was struck in the side of the head with a baseball bat and is unconscious. Your response time to the scene is less than 5 minutes.

1. Why is the structure of the cranium considered to be a mixed blessing in terms of blood flow, oxygen levels, and swelling?
2. What is the difference between a primary and a secondary brain injury?

This layer forms a sac to contain the CNS, with small openings through which the peripheral nerves exit.

The inner two layers of the meninges, called the arachnoid and the pia mater, are much thinner than the dura mater. They contain the blood vessels that nourish the brain and spinal cord. Cerebral spinal fluid (CSF) is produced in a chamber inside the brain, called the third ventricle. CSF is located in the subarachnoid space below the arachnoid, which is a web-like structure. There is approximately 125 to 150 mL of CSF in the brain at any one time. CSF primarily acts as a shock absorber. The brain and spinal cord essentially float in this fluid, buffered from injury. The brain depends on a rich supply of oxygenated blood to function properly. When this supply is interrupted, even for short periods of time, serious damage to the brain tissue may occur.

When an injury does penetrate all of these protective layers, clear, watery CSF may leak from the nose, the ears, or an open skull fracture. Therefore, if a patient with a head injury has what looks like a runny nose or reports a salty taste at the back of the throat, you should assume that the fluid is CSF.

Ironically, the closed bony structure of the skull (which is similar to a vault) and the meninges, the very layers of tissue that isolate and protect the CNS, may lead to serious problems in closed head injuries. Severe injury may cause bleeding within the skull, referred to as intracranial hemorrhage. Such bleeding causes increased pressure inside the skull and compresses softer brain tissue. In many cases, only prompt surgery can prevent permanent brain damage.

Peripheral Nervous System

The peripheral nervous system has two anatomic parts: 31 pairs of spinal nerves and 12 pairs of cranial nerves **Figure 28-4**.

The 31 pairs of spinal nerves conduct sensory impulses from the skin and other organs to the spinal cord. They also conduct motor impulses from the spinal cord to the muscles. Because the arms and legs have so many muscles, the spinal nerves serving the extremities are arranged in complex networks. The brachial plexus controls the arms, and the lumbosacral plexus controls the legs.

Cranial nerves are the 12 pairs of nerves that emerge from the brainstem and transmit information directly to or from the brain. For the most part, they perform special functions in the head and face, including sight, smell, taste, hearing, and facial expressions.

There are two major types of peripheral nerves. The sensory nerves, with endings that perceive only one type of information, carry that information from the body to the brain via the spinal cord. The motor nerves, one for each muscle, carry information from the CNS to the muscles. The connecting nerves, found only in the brain and spinal cord, connect the sensory and motor nerves with short fibers, which allow the cells on either end to exchange simple messages.

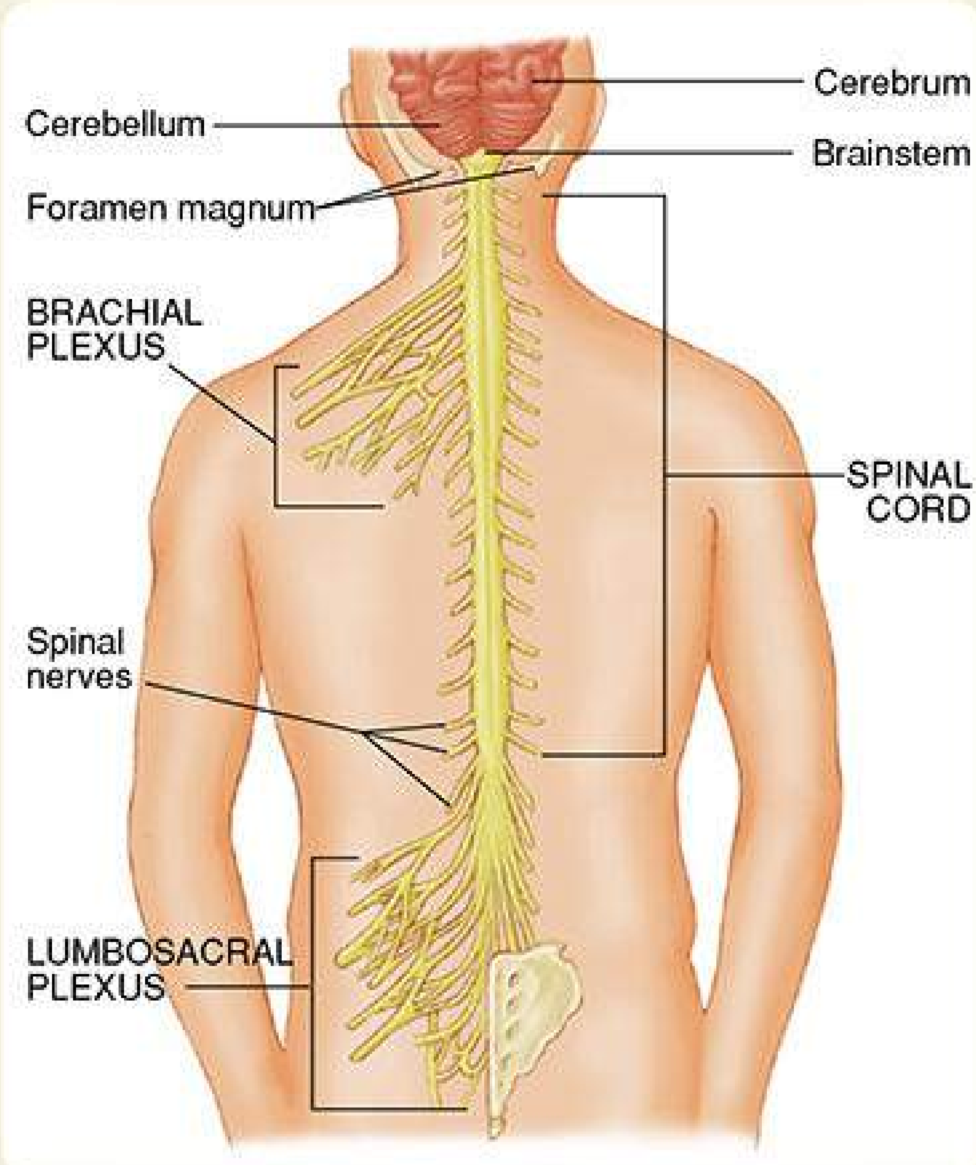

Figure 28-4 The peripheral nervous system is a complex network of motor and sensory nerves. The brachial plexus controls the arms, and the lumbosacral plexus controls the legs.

How the Nervous System Works

The nervous system controls virtually all of the body's activities, including reflex, voluntary, and involuntary activities.

In connecting the sensory and motor nerves of the limbs, the connecting nerves in the spinal cord form a reflex arc. If a sensory nerve in this arc detects an irritating stimulus, such as heat, it will bypass the brain and send a message directly to a motor nerve, causing a response such as pulling away from the heat **Figure 28-5**.

Voluntary activities are the actions that we consciously perform, in which sensory input determines the specific muscular activity—for example, reaching across the table for a salt shaker or to pass a dish. **Involuntary activities** are the actions that are not under our conscious control, such as breathing; in most instances, we inhale and exhale without consciously thinking about it. Many of our body's functions occur independently of thought, or involuntarily.

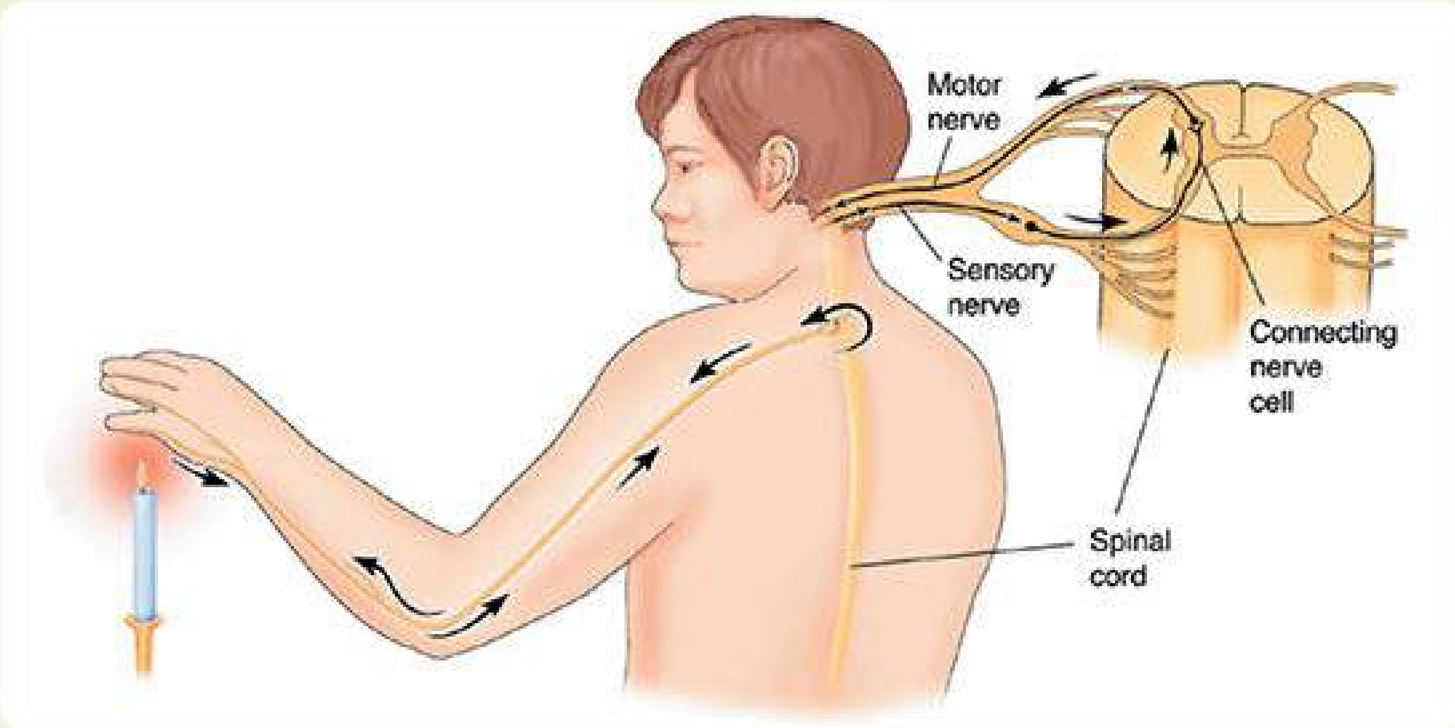

Figure 28-5 The connecting nerves in the spinal cord form a reflex arc. If a sensory nerve in this arc detects an irritating stimulus, it will bypass the brain and send a direct message to a motor nerve.

Words of Wisdom

Central nervous system structures, whose bony enclosures protect them quite well, are also very fragile. Protecting them from further damage is vital to the patient's future ability to live a normal life. Lean toward caution and overprotection in assessing and treating possible brain and spinal cord injuries.

The part of the nervous system that regulates or controls our voluntary activities, including almost all coordinated muscular activities, is called the somatic (voluntary) nervous system. The mechanism of the somatic nervous system is simple. The brain interprets the sensory information that it receives from the peripheral and cranial nerves and responds by sending signals to the voluntary muscles.

The body functions that occur without conscious effort are regulated by the much more primitive autonomic (involuntary) nervous system. The autonomic nervous system controls the functions of many of the body's vital organs, over which the brain has no voluntary control.

The autonomic nervous system is divided into two sections: the sympathetic nervous system and the parasympathetic nervous system. When confronted with a threatening situation, the sympathetic nervous system reacts to the stress with the fight-or-flight response. This response causes the pupils to dilate, smooth muscle in the lungs to dilate, heart rate to increase, and blood pressure to rise. This response also causes the body to shunt blood to vital organs and to skeletal muscle. During this time of stress, a hormone called epinephrine (also known as adrenaline) is released, which is responsible for much of these activities inside the body. The parasympathetic nervous system has the opposite effect on the body, causing blood vessels to dilate, slowing the heart rate, and relaxing the muscle sphincters. When this portion of the autonomic nervous system is activated, the body shunts blood to the organs of digestion. As the body attempts to maintain homeostasis (balance), these two divisions of the autonomic nervous system tend to balance each other so that basic body functions remain stable and effective.

Skeletal System

Skull

The skull is composed of two groups of bones: the cranium, which protects the brain, and the facial bones **Figure 28-6**. The cranium is composed of a number of thick bones that fuse together to form a shell above the eyes and ears that holds and protects the brain. It is occupied by 80% brain tissue, 10% blood supply, and 10% CSF. The brain connects to the spinal cord through a large opening at the base of the skull called the foramen magnum.

> **Special Populations**
>
> The spinal canal is closed by birth and must grow and expand as the child grows. Neural tube deformities are common and can result in serious birth defects. The most discussed neural tube deformity is spina bifida, in which the lower portion of the spine does not close prior to birth. As an EMT, you may be called on to treat or transport a child with one of these birth defects. Chapter 36, *Patients With Special Challenges,* covers spina bifida in detail.

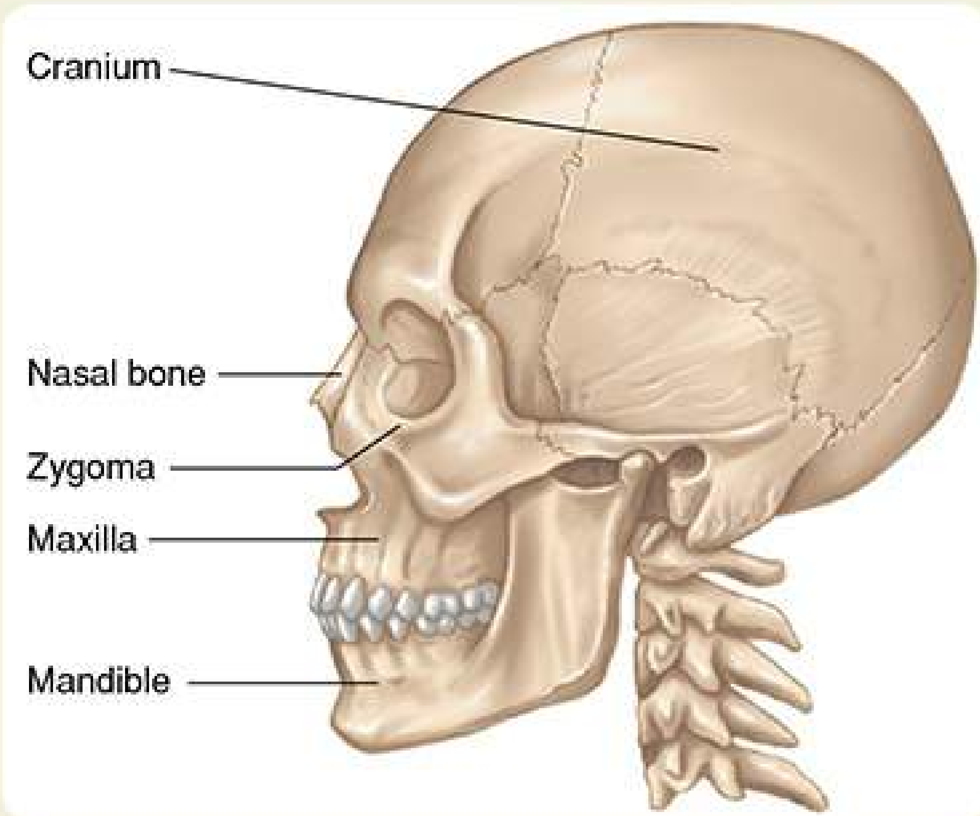

Figure 28-6 The skull includes two large structures: the cranium and the face.

Four major bones make up the cranium. The most posterior portion of the cranium is called the occiput. On each side of the cranium, the lateral portions are called the temples or temporal regions. Between the temporal regions and the occiput lie the parietal regions. The forehead is called the frontal region.

The face is composed of 14 bones. The upper, non-moveable jawbones are called the maxillae, the cheek bones are called the zygomas, and the mandible is the lower, moveable portion of the jaw.

The orbit (eye socket) is made up of two facial bones: the maxilla and the zygoma. The orbit also includes the frontal bone of the cranium. Together, these bones form a solid bony rim that protrudes around the eye to protect it. The nose mostly consists of flexible cartilage; in fact, only the proximal one-third of the nose is formed by bone with very short bones forming the bridge of the nose.

Spinal Column

The spinal column is the body's central supporting structure. It has 33 bones, called vertebrae, and is divided into five sections: cervical, thoracic, lumbar, sacral, and coccygeal **Figure 28-7**. Injury to the vertebrae, depending on the level at which the injury occurs, may result in paralysis if the underlying spinal cord or nervous structures are also damaged.

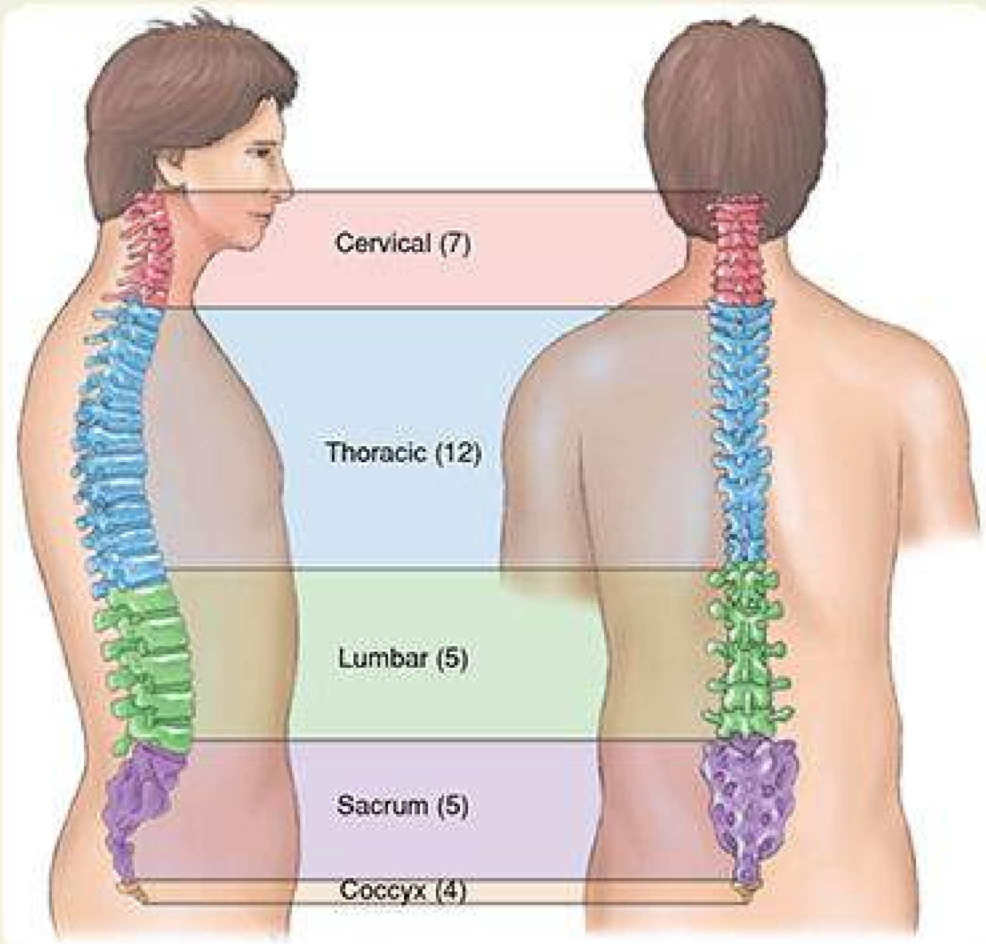

Figure 28-7 The spinal column is the body's central supporting system and consists of 33 bones divided into five sections. Injury to the vertebrae may cause paralysis.

The front part of each vertebra consists of a round, solid block of bone called the vertebral body; the back part forms a bony arch. From one vertebra to the next, the series of arches form a tunnel running the length of the spinal column. This tunnel is the spinal canal, which encases and protects the spinal cord **Figure 28-8**.

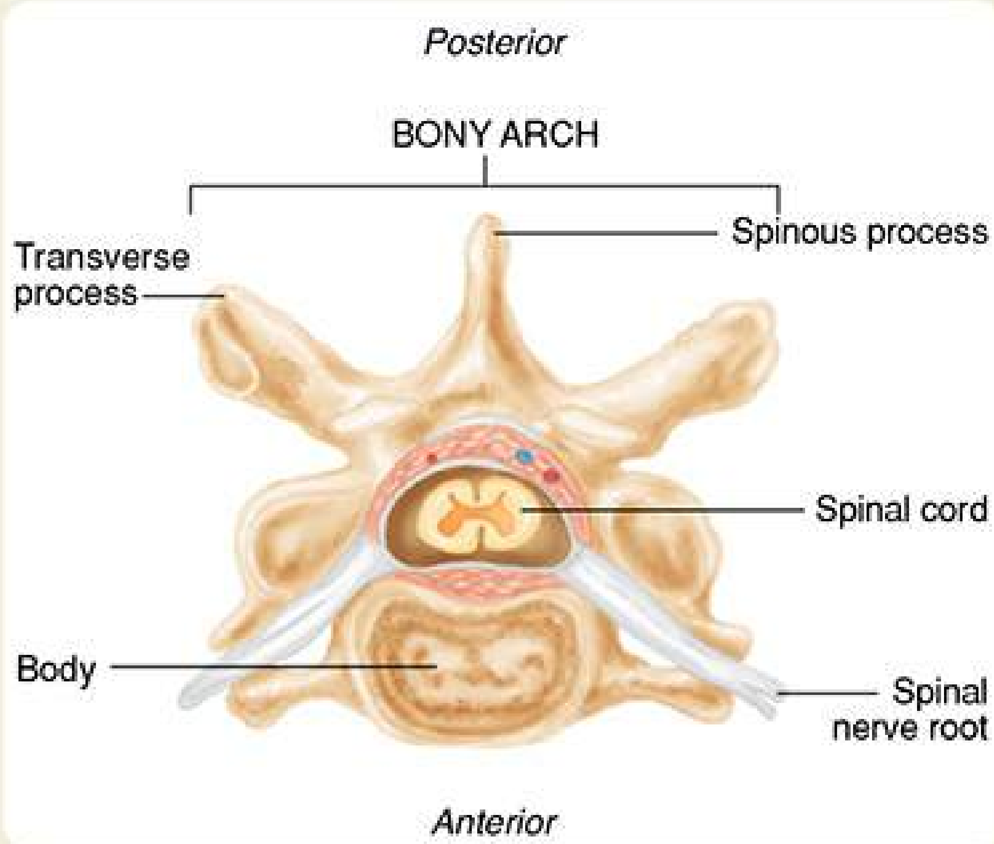

Figure 28-8 The spinal canal is formed by the vertebral body in the front (or anteriorly) and the bony arch in the back (or posteriorly).

The vertebrae are connected by ligaments and separated by cushions, called **intervertebral disks**. These ligaments and disks allow the trunk to bend forward and back, but they also limit motion so that the spinal cord is not injured. When the spine is injured or fractured, the spinal cord and its nerves are left unprotected. Therefore, until the spine is immobilized, you must keep it aligned as best you can to prevent further injury to the spinal cord.

The spinal column itself is almost entirely surrounded by muscles. However, you can usually palpate the posterior spinous process of each vertebra, which lies just under the skin in the midline of the back. The most prominent and most easily palpable spinous process is at the seventh cervical vertebra at the base of the neck.

Head Injuries

A head injury is a traumatic insult to the head that may result in injury to soft tissue, bony structures, or the brain. Approximately 4 million people experience head injuries of varying severity in the United States each year. According to the Brain Trauma Foundation, 52,000 deaths occur annually as the result of severe head injury. More than 50% of all traumatic deaths result from a head injury. When head injuries are fatal, the cause is invariably associated injury to the brain. In addition to the head injury, and dependent on the mechanism of injury (MOI), you should be alert to the fact that the patient may have sustained additional trauma such as cervical spine injuries, pelvic injuries, and chest injuries.

There are two general types of head injuries. **Closed head injuries** are those in which the brain has been injured but there is no opening into the brain. For example, a severe blow that fractures the skull but does not create an open wound would be considered a closed head injury. An **open head injury** is one in which an opening from the brain to the outside world exists. Obvious skull deformity with a break in the skin is a sign of an open head injury, which is often caused by penetrating trauma. There may be bleeding and exposed brain tissue.

Motor vehicle crashes are the most common MOI, with more than two-thirds of people involved in motor vehicle crashes experiencing a head injury. Head injuries also occur commonly in victims of assault, when older adults fall, during sports-related incidents, and in a variety of incidents involving children.

Any head injury is potentially serious. If not properly treated, those that at first seem minor may end up becoming a life-threatening brain injury **Table 28-1**. Conversely, severe lacerations of the scalp or fractures of the skull may occur with little or no brain injury and may lead to minimal or no long-term consequences.

Table 28-1 General Signs and Symptoms of a Head Injury

Following a head injury, any patient who exhibits one or more of these signs or symptoms has potentially sustained a very serious underlying brain injury:

- Lacerations, contusions, or hematomas to the scalp
- Soft area or skull depression on palpation
- Visible fractures or deformities of the skull
- Decreased mentation, confusion
- Irregular breathing pattern
- Widening pulse pressure
- Slow heart rate
- Ecchymosis about the eyes or behind the ear over the mastoid process
- Clear or pink CSF leakage from a scalp wound, the nose, or the ear
- Failure of the pupils to react to light
- Unequal pupil size
- Loss of sensation and/or motor function
- A period of unconsciousness
- Amnesia
- Seizures
- Numbness or tingling in the extremities
- Irregular respirations
- Dizziness
- Visual complaints
- Combative or other abnormal behavior
- Nausea or vomiting
- Posturing (decorticate or decerebrate)

Scalp Lacerations

Scalp lacerations can be minor or very serious. Because both the face and the scalp have unusually rich blood supplies, even small lacerations can quickly lead to significant blood loss **Figure 28-9**. Occasionally, this blood loss may be severe enough to cause hypovolemic shock, particularly in children. In any patient with multiple injuries, bleeding from scalp or facial lacerations may contribute to hypovolemia. In addition, because scalp lacerations are usually the result of direct blows to the head, they are often an indicator of deeper, more serious injuries.

Skull Fracture

Significant force applied to the head may cause a skull fracture. As with any fracture, a skull fracture may be open or closed, depending on whether there is an overlying laceration of the scalp. Injuries from bullets or other penetrating weapons frequently result in fracture of the skull. The diagnosis of a skull fracture is usually made in the hospital with a computed tomography (CT) scan, but maintain a high index of suspicion that a fracture is present if the patient's head appears deformed or if there is a visible crack in the skull within a scalp laceration. Additional signs of skull fracture that you may see include ecchymosis (bruising) that develops under the eyes (**raccoon eyes**) **Figure 28-10A** or behind one ear over the mastoid process (**Battle sign**) **Figure 28-10B**.

Figure 28-9 The scalp has an unusually rich blood supply; therefore, even small lacerations can result in significant blood loss.

© Marco Ugarte/AP Photo.

Linear Skull Fractures

Linear skull fractures (nondisplaced skull fractures) account for approximately 80% of all fractures to the skull **Figure 28-11A**. Radiographs are required to diagnose a linear skull fracture because there are often no physical signs such as deformity. If the brain is uninjured and there are no scalp lacerations, then linear fractures are not life threatening. However, if there is a scalp laceration with the linear fracture—making it an open fracture—there is a risk of infection and bleeding inside the brain.

Depressed Skull Fractures

Depressed skull fractures result from high-energy direct trauma to the head with a blunt object (such as a baseball bat to the head) **Figure 28-11B**. The frontal and parietal bones of the skull are most susceptible to these types of fractures because the bones in these areas are relatively thin. As a consequence, bony fragments may be driven into the brain, resulting in injury. The scalp may or may not be lacerated. Patients with depressed skull fractures often present with neurologic signs (such as loss of consciousness).

Figure 28-10

Signs of skull fracture include **A.** ecchymosis under the eyes (raccoon eyes) or **B.** behind one ear over the mastoid process (Battle sign).

Basilar Skull Fractures

Basilar skull fractures are also associated with high-energy trauma, but they usually occur following diffuse impact to the head (eg, falls, motor vehicle crashes). These injuries generally result from extension of a linear fracture to the base of the skull and are usually diagnosed with a CT scan of the head **Figure 28-11C**.

Signs of a basilar skull fracture include CSF drainage from the ears, which indicates rupture of the tympanic membrane in the ear, and freely flowing CSF through the ear. Patients with leaking CSF are at risk for bacterial meningitis.

Other signs of a basilar skull fracture include raccoon eyes or Battle sign. Depending on the extent of the damage, raccoon eyes and Battle sign may appear relatively quickly, but in many patients, they may not appear until up to 24 hours following the injury, so their absence in the field does not rule out a basilar skull fracture.

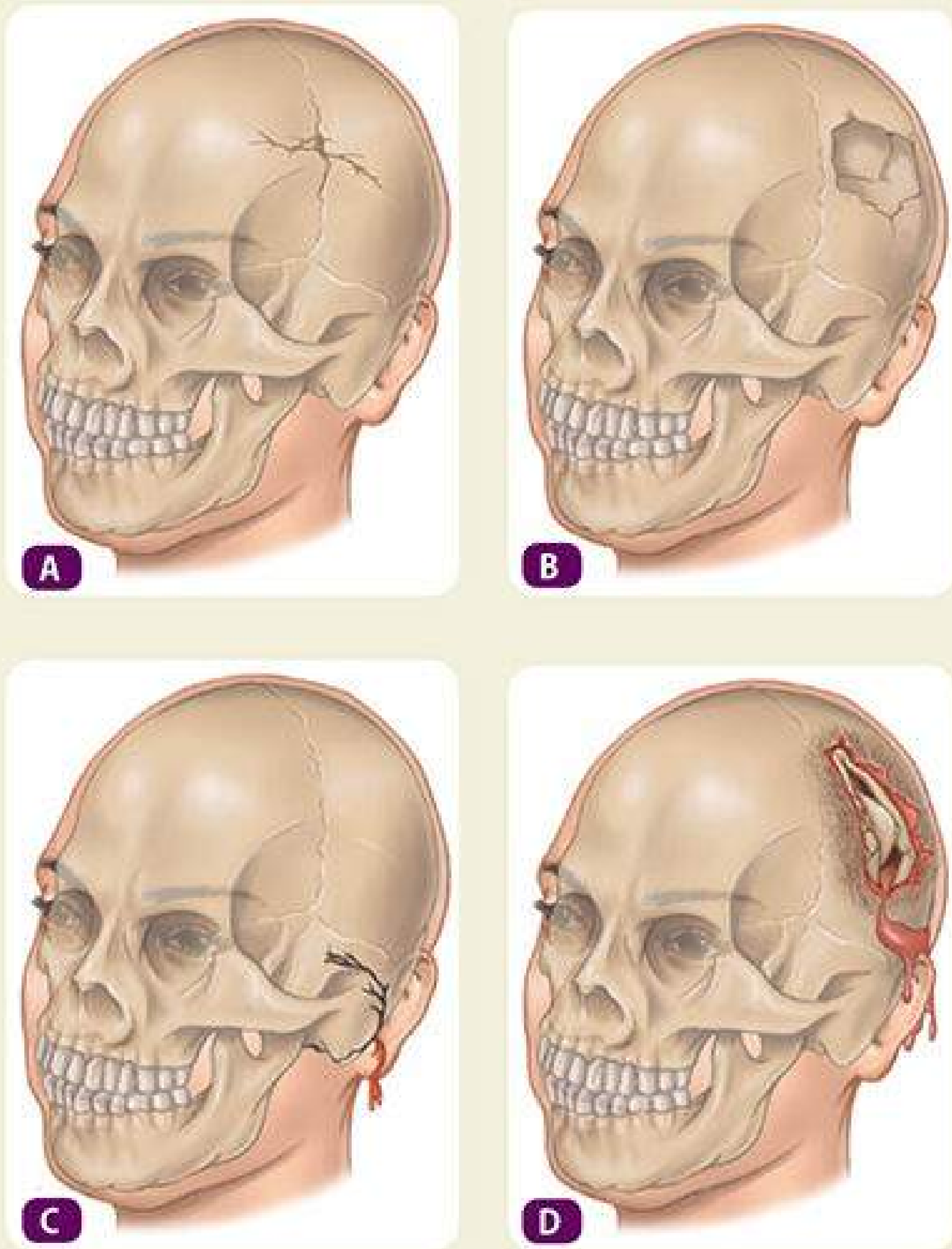

Figure 28-11 Types of skull fractures. **A.** Linear. **B.** Depressed. **C.** Basilar. **D.** Open.

Open Skull Fractures

Open fractures of the cranial vault result when severe forces are applied to the head and are often associated with trauma to multiple body systems Figure 28-11D. Brain tissue may be exposed to the environment, which significantly increases the risk of a bacterial infection (such as bacterial meningitis). Open cranial vault fractures have a high mortality rate.

Traumatic Brain Injuries

The National Head Injury Foundation defines a **traumatic brain injury (TBI)** as "a traumatic insult to the brain capable of producing physical, intellectual, emotional, social, and vocational changes." Traumatic brain injuries are the most serious of all head injuries. Traumatic brain injuries are classified into two broad categories: **primary (direct) injury** and **secondary (indirect) injury**. Primary brain injury is injury to the brain and its associated structures that results instantaneously from impact to the head. Secondary brain injury refers to a multitude of processes that increase the severity of a primary brain injury and, therefore, negatively impact the outcome. Secondary injuries may be caused by cerebral edema, intracranial hemorrhage, increased intracranial pressure, cerebral ischemia, and infection; however, hypoxia and hypotension are the two most common causes. According to the Brain Trauma Foundation, hypoxia or hypotension will increase death and disability significantly in a patient with a head injury. It is important to monitor and address hypoxia and hypotension when identified. Secondary brain injury may occur anywhere from a few minutes to several days following the initial head injury.

The brain can be injured directly by a penetrating object, such as a bullet, knife, or other sharp object. More commonly, brain injuries occur indirectly, as a result of external forces exerted on the skull. Consider the most common cause of brain injury, the motor vehicle crash. When the passenger's head hits the windshield on impact with a fixed object, the brain continues to move forward until it comes to an abrupt stop by striking the inside of the skull. This rapid deceleration results in compression injury (or bruising) to the anterior portion of the brain along with stretching or tearing of the posterior portion of the brain Figure 28-12. As the brain strikes the front of the skull, the body begins its path of moving backward. The head falls back against the headrest and/or seat, and the brain slams into the rear of the skull. This type of front-and-rear injury is known as a **coup-contrecoup injury**. The same type of injury may occur on opposite sides of the brain in a lateral collision.

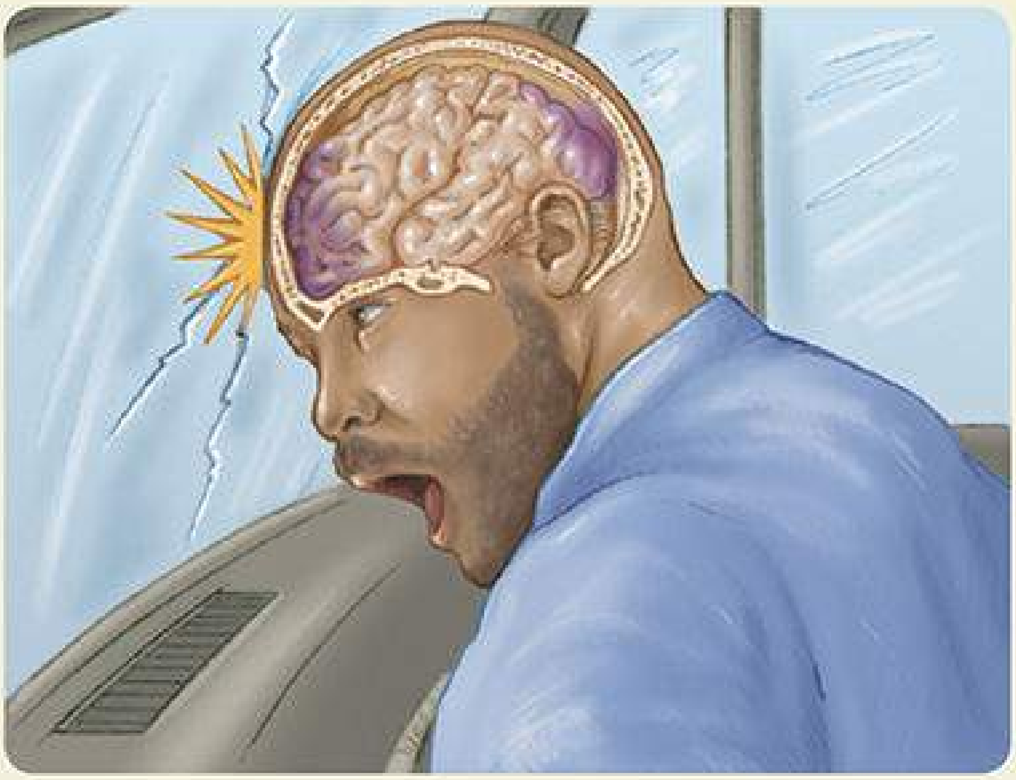

Figure 28-12 For the unrestrained driver or passenger in a motor vehicle crash, the brain continues its forward motion and strikes the inside of the skull, resulting in compression injury to the anterior portion of the brain and stretching of the posterior portion.

The injured brain starts to swell, initially because of cerebral vasodilation. An increase in cerebral water (cerebral edema) then contributes to further brain swelling. **Cerebral edema** (swelling of the brain) may not develop until several hours following the initial injury, however.

Low oxygen levels in the blood aggravate cerebral edema. Therefore, cerebral edema can be minimized by maintaining high oxygen saturations. In fact, the brain consumes more oxygen than any other organ in the body. For this reason, you must make sure that the airway is open and that adequate ventilations and high-flow oxygen (if indicated) are given to any patient with a head injury. This is especially true if the patient is unconscious. Do not wait for cyanosis or other obvious signs of hypoxia to develop.

It is not uncommon for the patient with a head injury to have a convulsion, or seizure. This is the result of excessive excitability of the brain, caused by direct injury or the accumulation of fluid within the brain (edema). Be prepared to manage seizures in all patients who have had a head injury because the brain may have sustained an injury as well.

Intracranial Pressure

For adults, the skull is a rigid, unyielding globe that allows little, if any, expansion of the intracranial contents. It also provides a hard and somewhat irregular surface against which brain tissue and its blood vessels can be injured when the head sustains trauma.

Accumulations of blood within the skull or swelling of the brain can rapidly lead to an increase in **intracranial pressure (ICP)**, the pressure within the cranial vault. Increased ICP squeezes the brain against bony prominences within the cranium. Cheyne-Stokes respirations (respirations that are fast and then become slow, with intervening periods of apnea) or ataxic (Biot) respirations (characterized by irregular rate, pattern, and volume of breathing with intermittent periods of apnea) are signs of increased intracranial pressure. Other signs and symptoms include decreased pulse rate, headache, nausea, vomiting, decreased alertness, bradycardia, sluggish or nonreactive pupils, decerebrate posturing, and increased or widened blood pressure. Signs and symptoms will increase and become more severe as the level of pressure increases.

The triad of increased systolic blood pressure, decreased pulse rate, and irregular respirations is called Cushing reflex, and signifies increased ICP.

Intracranial Hemorrhage

The closed compartment of the skull has no extra room for an accumulation of blood, so bleeding inside the skull also increases the ICP. Bleeding can occur between the skull and dura mater, beneath the dura mater but outside the brain, or within the tissue of the brain itself.

Epidural Hematoma

An **epidural hematoma** is an accumulation of blood between the skull and dura mater **Figure 28-13**. An epidural hematoma is nearly always the result of a blow to the head that produces a linear fracture of the thin temporal bone. The middle meningeal artery runs along a groove in that bone; therefore, it is vulnerable when the temporal bone is fractured. Arterial bleeding into the epidural space will result in rapidly progressing symptoms.

Often, the patient has an immediate loss of consciousness following the injury; this is often followed by a brief period of consciousness (lucid interval), after which the patient lapses back into unconsciousness. Meanwhile, as the ICP increases, the pupil on the side of the hematoma becomes fixed and dilated. Death will follow very rapidly without surgery to evacuate the hematoma.

Subdural Hematoma

A **subdural hematoma** is an accumulation of blood beneath the dura mater but outside the brain **Figure 28-14**. It usually occurs after falls or injuries involving strong deceleration forces. Subdural hematomas are more common than epidural hematomas and may or may not be associated with a skull fracture. Bleeding within the subdural space typically results from rupture of the veins that bridge the cerebral cortex and dura.

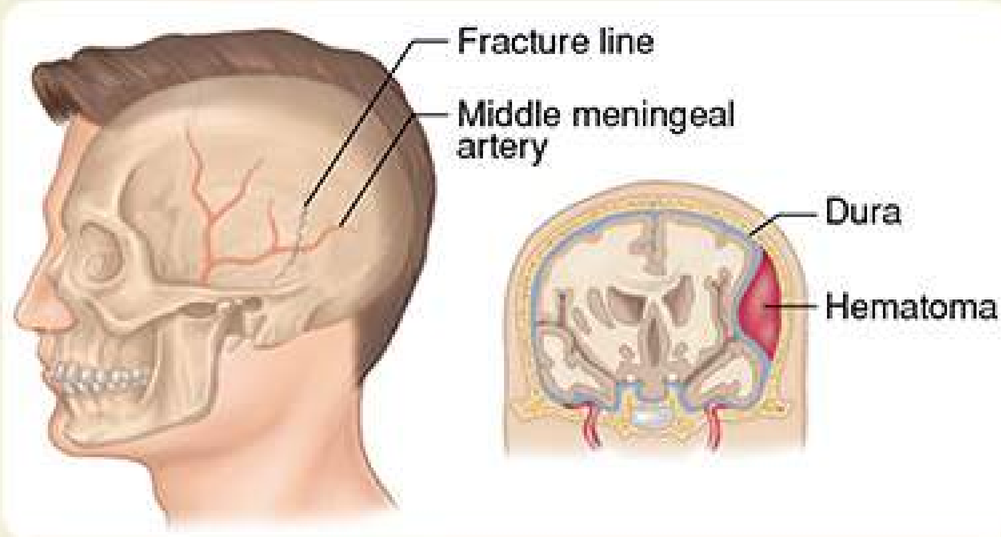

Figure 28-13 An epidural hematoma is usually the result of a blow to the head that produces a linear fracture of the temporal bone and damages the middle meningeal artery. Blood accumulates between the dura mater and the skull.

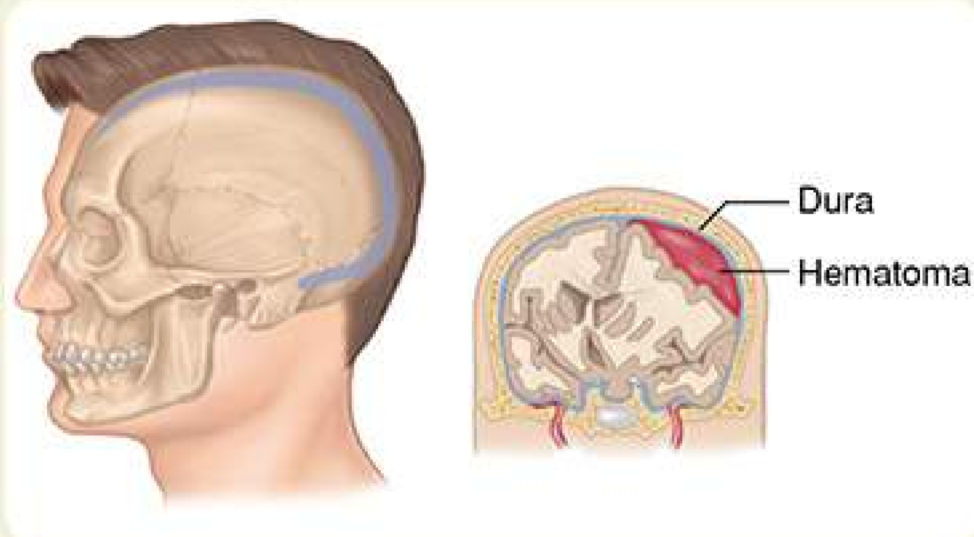

Figure 28-14 In a subdural hematoma, venous bleeding occurs beneath the dura mater but outside the brain.

Special Populations

Older people, people taking blood thinning medications, and those with a history of alcohol use are at higher risk for a subdural hematoma developing. This is caused by atrophy of the brain tissue that increases stretching of the bridging veins. Signs and symptoms of the condition may not occur for several hours, days, or weeks. Be sure to get a thorough history of any previous trauma.

A subdural hematoma is associated with venous bleeding, so this type of hematoma and the signs of increased ICP typically develop more gradually than with an epidural hematoma. The patient with a subdural hematoma often experiences a fluctuating level of consciousness or slurred speech. Any patient who you suspect has a subdural hematoma needs to be evaluated by a physician.

Intracerebral Hematoma

An **intracerebral hematoma** involves bleeding within the brain tissue itself **Figure 28-15**. This type of injury may occur following a penetrating injury to the head or because of rapid deceleration forces.

Many small, deep intracerebral hemorrhages are associated with other brain injuries. The progression of increased ICP depends on several factors, including the presence of other brain injuries, the region of the brain involved (frontal and temporal lobes are the most common locations), and the size of the hemorrhage. Once symptoms appear, the patient's condition often deteriorates quickly. Intracerebral hematomas have a high mortality rate, even if the hematoma is surgically evacuated.

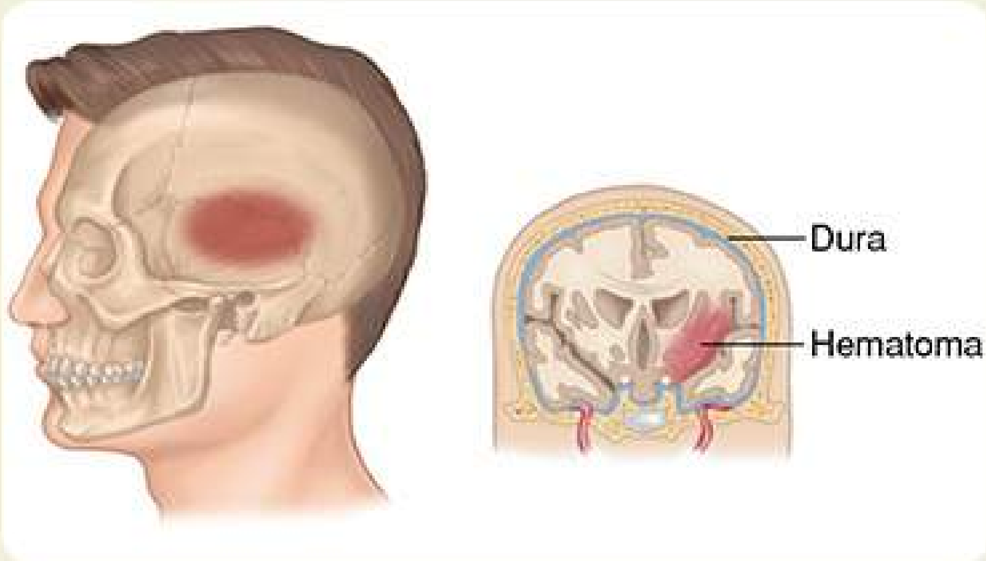

Figure 28-15 An intracerebral hematoma involves bleeding within the brain tissue itself.

Subarachnoid Hemorrhage

In a **subarachnoid hemorrhage**, bleeding occurs into the subarachnoid space, where the CSF circulates. It results in bloody CSF and signs of meningeal irritation (such as neck rigidity, headache). Common causes of a subarachnoid hemorrhage include trauma or rupture of an aneurysm.

The patient with a subarachnoid hemorrhage reports a sudden, severe headache. As bleeding into the subarachnoid space increases, the patient experiences the signs and symptoms of increased ICP: decreased level of consciousness, changes in the pupils, vomiting, and seizures.

A sudden, severe subarachnoid hemorrhage usually results in death. People who survive often have permanent neurologic impairment.

Concussion

A blow to the head or face may cause **concussion** of the brain. Concussions are also known as mild traumatic brain injuries. There is no universal agreement on the exact definition of a concussion, but in general, it is a closed injury with a temporary loss or alteration of part or all of the brain's abilities to function without demonstrable physical damage to the brain. For example, a person who "sees stars" after being struck in the head has sustained a concussion that affects the occipital portion of the brain. A concussion may result in unconsciousness and even the inability to breathe for short periods of time; however, approximately 90% of patients who sustain a concussion do not experience a loss of consciousness.

A patient with a concussion may be confused or have amnesia (loss of memory). Occasionally, the patient can remember everything but the events leading up to the injury; this is called **retrograde amnesia**. Inability to remember events after the injury is called **anterograde (posttraumatic) amnesia**.

Usually, a concussion lasts only a short time. In fact, it has often resolved by the time you arrive. Nevertheless, you should ask about symptoms of concussion in any patient who has sustained an injury to the head; these symptoms include dizziness, weakness, or visual changes. Additional signs and symptoms you may encounter with a patient who has sustained a concussion may include nausea or vomiting, and the patient may report ringing in the ears. Slurred speech and the inability to focus may also be present. Dependent on the severity of the concussion, you may also notice that the patient has a lack of coordination, a delay of motor functions, or displays inappropriate emotional responses. Patients may also report a temporary headache and may appear to be disoriented at times.

Patients with symptoms consistent with concussion may also have more serious underlying brain injury. A CT scan is necessary to differentiate between these conditions. Always assume that a patient with signs or symptoms of concussion has a more serious injury until proven otherwise. All patients with signs or symptoms of a concussion should be evaluated by a physician or other qualified healthcare provider.

Words of Wisdom

Be aware that all athletes who sustain a concussion should be evaluated by a qualified healthcare provider prior to being allowed to return to play. Some of the tools these healthcare providers use are specific, commercially-available computerized tests to assess concussion and recovery from it. Often the results of the test are compared to baseline evaluations conducted prior to injury. EMTs are not qualified to conduct these types of assessments.

Contusion

Like any other soft tissue in the body, the brain can sustain a contusion, or bruise, when the skull is struck. A contusion is far more serious than a concussion because it involves physical injury to the brain tissue, which may sustain long-lasting and even permanent damage. As with contusions that occur elsewhere in the body, there is associated bleeding and swelling from injured blood vessels. Injury of brain tissue or bleeding inside the skull causes an increase of pressure within the skull. A patient who has sustained a brain contusion may exhibit any or all of the signs of brain injury.

Other Brain Injuries

Brain injuries are not always a result of trauma. Certain medical conditions, such as blood clots or hemorrhages, can also cause brain injuries that produce significant bleeding or swelling. Problems with the blood vessels themselves, high blood pressure, or any number of other problems may cause spontaneous bleeding into the brain, affecting the patient's level of consciousness. This is known as altered mental status. The signs and symptoms of nontraumatic injuries are often the same as those of traumatic brain injuries, except that there is no obvious history of MOI or any external evidence of trauma. Altered mental status is discussed in Chapter 17, *Neurologic Emergencies*.

Spine Injuries

The cervical, thoracic, and lumbar portions of the spine can be injured in a variety of ways. Compression injuries can occur as a result of a fall, regardless of whether the patient landed on his or her feet or experienced a direct blow to the crown of the skull, coccyx, or top of the head. The forces that compress the patient's vertebral body can cause the herniation of disks, subsequent compression on the spinal cord and nerve roots, and fragmentation into the spinal canal. Motor vehicle crashes or other types of trauma can overextend or hyperflex the cervical spine and damage the ligaments and joints. Rotation-flexion injuries of the spine result from rapid acceleration forces. This is more likely to happen at C1 and C2. Injuries to this area of the spine are considered to be unstable due to the location on the spine and the lack of bony and soft-tissue support. Any one of these unnatural motions, as well as excessive lateral bending, can result in fractures or neurologic deficit.

When the spine is pulled along its length (hyperextension), it can cause fractures in the spine as well as ligament and muscle injuries. For example, hangings often result in fracture of the vertebrae in the upper portion of the cervical spine.

When the bones of the spine are altered from traumatic forces, they can fracture or move out of place. When these injuries pinch, pull, or penetrate the spinal cord, permanent damage may occur. Common findings include pain and tenderness on palpation of the region. Less commonly you may feel or observe a deformity of the spine, sometimes referred to as a "step-off" where the spinous process may be palpable on physical examination. If you suspect these types of injuries, take extra precautions when immobilizing the spine, both manually and with adjuncts.

Words of Wisdom

When assessing the spine, be aware of the possibility of open wounds from the associated trauma. These open wounds can be penetrating injuries or lacerations. If you follow the mnemonic DCAP-BTLS, you will discover any open wounds prior to securing the patient to a backboard.

Patient Assessment

You should suspect a possible head or spinal injury any time you encounter one of the following mechanisms of injury:

- Motor vehicle crashes (including motorcycles, snowmobiles, and all-terrain vehicles)

- Pedestrian–motor vehicle crashes
- Fall >20 feet (adult)
- Fall >10 feet (pediatric)
- Blunt trauma
- Penetrating trauma to the head, neck, back, or torso
- Rapid deceleration injuries
- Hangings
- **Axial loading injuries** (injuries where load is applied along the vertical or longitudinal axis of the spine; for example, falling from a height and landing on the feet in an upright position)
- Diving accidents

Motor vehicle crashes, direct blows, falls from heights, assault, and sports injuries are common causes of head and spinal injury. A deformed wind-shield or dented helmet may indicate a major blow to the head, which is likely to have caused traumatic brain injury **Figure 28-16**. It is especially important to evaluate and monitor the level of consciousness in patients with suspected head injuries, paying particular attention to any changes that may occur.

Figure 28-16 The classic "star" on the windshield after an automobile crash is a significant indicator of head injury. Be alert for the signs and symptoms of head injury.

YOU are the Provider — PART 2

When you arrive at the scene you find a 22-year-old man lying supine on the ground; he is motionless and his head is lying in a large pool of blood. Your partner manually stabilizes his head in a neutral position and opens his airway with the jaw-thrust maneuver as you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Motionless; large pool of blood under his head

Level of consciousness	Responsive only to deep painful stimuli
Airway	Open; clear of secretions or foreign bodies
Breathing	Slow and irregular
Circulation	Radial pulses; slow and bounding; skin, warm and dry; bleeding from a large laceration to the right side of his head

3. What are your most immediate treatment priorities for this patient?
4. Where should you focus your secondary assessment of this patient?

Scene Size-up

Evaluate every scene for hazards to your health and the health of your team or bystanders. Motor vehicle crashes are a common cause of head and spinal injuries. These situations have the potential to cause injury to rescuers and bystanders as well. Be prepared with appropriate standard precautions before you approach the patient. You will be spending a great deal of time at the head of the patient. Gloves, a mask, and eye protection should be the minimum standard precautions that you use. Because these patients can have very complicated injuries, call for ALS as soon as possible when a serious MOI or complicated presentation is evident. Law enforcement may be needed to control traffic or unruly people.

Words of Wisdom

Many mechanisms of injury that cause head and spine injuries may also pose a risk to EMTs. Before you approach the patient, get the "big picture" of scene safety and take any actions necessary to ensure your own well-being. Do not rely entirely on assistance from fire or police personnel; maintain your own awareness of the scene.

Words of Wisdom

Proper care of a patient with a possible spinal injury requires assessment of motor and sensory functions both before and after stabilizing the patient. Likewise, careful observation of level of consciousness at different stages of your care for a head-injured patient can provide crucial information. Document your detailed findings of these repeated neurologic examinations to make the information available to hospital personnel and to help establish that your care has been thorough and appropriate.

As you observe the scene, look for indicators of the MOI. This helps you develop an early index of suspicion for underlying injuries in the patient who has sustained a significant MOI. As you put together information from dispatch and your observations of the scene, consider how the MOI produced the injuries expected. For example, if you respond to a baseball field for a patient who was knocked unconscious by a foul ball, you may begin to suspect that the patient may have a depressed skull fracture and perform a neurologic assessment during the physical examination. Continue to consider the MOI while assessing a patient.

Primary Assessment

The primary assessment should focus on identifying and managing life-threatening concerns. Threats to circulation, airway, or breathing are considered life threatening and must be treated immediately to prevent mortality. Life-threatening external hemorrhage must be addressed before airway and breathing concerns.

Most head injuries are considered mild and result in no or limited permanent disability. A smaller percentage of head injuries are considered moderate, and the patient is left with some permanent disabilities. A still smaller percentage of head injuries are considered severe, and many patients with a severe head injury die before ever reaching the hospital or are left in a comatose state despite hospital intervention. There will be a number of patients with head or spine injuries that will not require much intervention other than a thorough assessment and continued observation while being transported to the hospital. In these patients you may choose to take some time at the scene to provide careful spine immobilization before transport. In patients who have problems with ABCs or have other conditions for which you decide a rapid transport to the closest appropriate hospital is needed, rapid immobilization of the spine and quick loading into the ambulance may be indicated. Reduction of on-scene time and recognition of a critical patient increase the patient's chances for survival or a reduction in the amount of irreversible damage.

Spinal Immobilization Considerations

When assessing a patient with suspected head and/or spine injuries, be aware that any unnecessary movement of the patient can cause additional injury. Assess the patient in the position found. After determining and correcting any life-threatening injuries, determine whether or not a cervical collar needs to be applied. Begin by assessing the scene to determine the risk of injury, then form a general impression of your patient based on his or her level of consciousness and the chief complaint.

Mechanism of injury alone is not a reason to place a person in full spinal immobilization. If the patient is absolutely clear in his or her thinking and does not have any neurologic deficits, spinal pain or tenderness, evidence of intoxication, or other illnesses or injuries that may mask a spinal injury, you may consider not placing the patient in spinal immobilization, if this is allowed per your local protocols.

Physicians have been considered to be the appropriate people to assess and clear patients with potential spinal injuries (c-spine clearance refers to assessing and determining whether or not a spinal injury is actually present). Many jurisdictions allow their EMTs to screen patients and to refrain from providing spinal immobilization on the basis of specific criteria.

The backboard is rigid and often places the patient in an anatomically incorrect position for a long period of time. During that time the back is pressed against the board, causing circulation to areas of skin to become compromised. The patient may report pain, there may be ischemia to the skin, and if left long enough, necrosis, which leads to decubitus ulcers. Some patients, especially patients who are obese, could experience respiratory compromise while lying flat. Consider placing padding under the patient to help minimize the risk of injury, and try to minimize the amount of time a patient is on a long backboard. Always follow your local protocols.

Apply a cervical collar as soon as you have assessed the airway and breathing and provided necessary treatments. A cervical collar may help maintain spinal immobilization as you treat the airway and breathing. The best time to apply the cervical collar depends on the patient's injuries and the seriousness of his or her condition. For some patients, you may have to apply the collar early on, while managing the ABCs. In other patients, manual stabilization may be adequate until you complete your assessment and determine if you need to place the patient on a backboard or other spinal immobilization device. The key to managing spinal injuries and airway and breathing problems is to move the patient as little as possible and as carefully as possible, maintaining spinal alignment throughout. Place an appropriately sized cervical collar on the patient when indicated. Once the cervical collar is on, do not remove it unless it causes a problem with maintaining the airway. If you must remove the cervical collar, you will have to maintain manual stabilization of the cervical spine until it can be replaced and the patient has been once again secured to the cervical collar.

Assessing for Signs and Symptoms of a Head or Spine Injury

Patients with head injuries frequently have spinal injuries and vice versa. When assessing a patient for possible head or spinal injury, begin by asking the responsive patient the following questions to determine his or her chief complaint:

- What happened?
- Where does it hurt?
- Does your neck or back hurt?
- Can you move your hands and feet?
- Did you hit your head?

Confused or slurred speech, repetitive questioning, or amnesia in responsive patients is an indication of a head injury. Whereas other problems may cause similar symptoms, in the setting of trauma, assume your patient has a head injury until your assessment proves otherwise. A decreased blood glucose level can mimic these same symptoms.

If the patient is found unresponsive, emergency responders, family members, or bystanders may have helpful information, including when the patient lost consciousness or what was his or her previous level of consciousness. Unresponsive patients with any trauma should be assumed to have a spinal injury. Patients with a decreased level of responsiveness on the AVPU scale (responds to verbal stimulus or responds to painful stimulus) should also be considered to have a spinal injury based on their chief complaint.

Airway, Breathing, and Circulation Considerations

In patients with head and spinal injuries, airway and breathing problems are common and may result in death if not recognized and treated immediately. When a spinal injury is suspected, how you open and assess the airway is important. Begin by manually holding the patient's head still while you assess the airway. Use a jaw-thrust maneuver to open the airway. When performed correctly, this will prevent movement of the cervical spine. If, however, you are unable to provide a patent and open airway using the jaw-thrust maneuver, it is acceptable to use the head tilt–chin lift maneuver. The patient cannot survive if the airway is not functioning, and even though this maneuver may cause further injury to the spine, it is considered the last resort to provide an airway for your patient. An oropharyngeal or nasopharyngeal airway may assist in maintaining an airway; proper BLS maneuvers have been shown to adequately protect the patient's airway. When it becomes difficult to maintain the airway with BLS techniques, advanced airway techniques, usually used by AEMTs and paramedics, can be used. The decision to use an oropharyngeal or nasopharyngeal airway is based on the patient's ability to maintain his or her own airway, the presence of a gag reflex, and the extent of facial injuries. Review the indications and contraindications for these airway adjuncts in Chapter 10*, Airway Management*, and the use of advanced airway techniques in Chapter 41*, A Team Approach to Health Care*.

Vomiting may occur in the patient with a head injury. With large amounts of emesis, the patient may need to be log rolled to the side and the mouth swept of secretions. When it is necessary to log roll the patient to clear the airway, roll the patient keeping the body in as straight a line as possible to minimize spinal injuries. Suctioning should be performed immediately to remove smaller amounts of secretions.

Irregular breathing, such as Cheyne-Stokes respirations, may result from increased pressure on the brain because of bleeding or swelling in the cranium. If the ICP increases, there will be more periods of apnea. In either situation, determine whether breathing is present and adequate and continue to monitor the patient's respiratory rate and depth. Prehospital administration of high-flow oxygen is indicated for patients with head and spinal injuries. A single episode of hypoxia in a patient with a head injury significantly increases the risk of death or permanent disability. Pulse oximeter values should not fall below 90% and, ideally, should be 95% or higher. Positive-pressure ventilations are not always necessary; however, if the patient's breathing rate is too slow or too fast and shallow, provide positive-pressure ventilations using a bag-valve mask (BVM) or a manually triggered ventilation device (see Chapter 10, *Airway Management*). The rate of ventilations should be based on the age of the patient and established BLS guidelines.

Do not panic and hyperventilate the patient because his or her condition appears severe. Hyperventilation (ventilating too fast or with too much force) should be reserved for specific conditions and performed under specific guidelines. Hyperventilation is controversial because it can increase the severity of head injuries; therefore, it should be avoided except in cases where signs of brainstem herniation have been identified. Even when used, hyperventilation should be used with caution and only when capnography is available to ensure an end-tidal carbon dioxide ($ETCO_2$) level between 30 and 35 mm Hg. Be sure to know your local protocols on this subject.

When approaching a patient who is unconscious, the obvious question is, "Is this person alive?" Whereas checking immediately to determine whether a pulse is present is tempting, it is more important for you to remember the ABCs. Always assess airway and breathing prior to moving on to assessment of circulation. Patients who are responsive and moving obviously have a pulse; however, you should still check to see if the pulse is weak or strong and if it is generally too fast or too slow. A pulse that is too slow in the setting of a head injury can indicate a serious condition in your patient. If the pulse is present and adequate, continue your evaluation of the patient.

A single episode of hypoperfusion in a patient with a head injury can lead to significant brain damage and even death. Assess for signs and symptoms of shock and treat appropriately. Neurogenic (spinal) shock is discussed in Chapter 12, *Shock*.

Bleeding may also be present from the same injury that caused the spine and/or head injury. That injury may involve blunt or penetrating forces. Consider again the MOI and the effects it has had on your patient. Control bleeding as previously discussed. When bandaging the head, be careful that you do not move the neck if spinal injuries are suspected and do not apply pressure if a skull fracture is suspected. Remember that head and spine injuries often occur together.

Manner of Transport

Several transport considerations should be kept in mind for patients with head trauma. Patients with impaired airways, open head wounds, abnormal vital signs, or those patients who do not respond to painful stimuli may need to be rapidly extracted from a motor vehicle and transported. During transport, providing the patient with a patent airway and high-flow oxygen is paramount. Because of the potential for increasing ICP, there is an increased risk of vomiting and seizures, so suction should be readily available. A patient with head trauma may deteriorate rapidly, thus requiring aeromedical transport depending on your local protocols. In supine patients, the head should be elevated 30 degrees, if possible, to help reduce ICP. Remember to maintain immobilization of the spine.

Words of Wisdom

A blanket or one or two towels placed under the long backboard will elevate the head.

Studies have shown that the use of lights and siren for transportation of patients does not significantly reduce transport time. In fact, the use of lights and siren may increase the patient's level of distress. Patients who are conscious and aware of the inability to move their limbs need to be offered emotional support. Remember that it can be very traumatizing for a patient to realize that he or she may now have a debilitating and life-altering injury; therefore, you need to be careful in your choice of words. A patient may ask you difficult questions, "Will I be able to walk?" It is best to tell the patient that you are providing immediate care and you cannot predict the outcome.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint. Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives such as no pain or no loss of sensation.

Using OPQRST may provide some background on isolated extremity injuries. Does the patient have any recall of the incident? Inability to recall events is an important finding in patients with head injuries. You have the opportunity to interview the patient well in advance of the emergency physician. Any information you receive will be very valuable if the patient has a loss of consciousness.

If the patient is not responsive, attempt to obtain the history from other sources, such as friends or family members. Medical identification jewelry and cards in wallets may also provide information about the patient's medical history (follow local protocols regarding the removal of items from a patient's wallet.). Does the patient have a recent or previous history of unresponsiveness? These key indicators may lead you to suspect a developing traumatic brain injury.

Make every attempt to obtain a SAMPLE history from your patient. History may be difficult to obtain when a person is confused from a head injury or frightened from a spinal injury. Whereas the prehospital environment is an excellent place to obtain important history, do not delay rapid transport for patients who need hospital intervention. Gather as much SAMPLE history as you can while preparing for transport. In less urgent situations, you should have enough time to gather a complete SAMPLE history without compromising patient care.

Secondary Assessment

Remember that the ability to walk, move the extremities, or feel sensation does not necessarily rule out a spinal cord injury. Similarly, the absence of pain does not always indicate that a spinal injury has not occurred. Do not ask patients with possible spinal injuries to move their necks as a test for pain. Instead, instruct the patient to keep still and not to move the head or neck.

The physical examination may be a systematic full-body scan or a systematic assessment that focuses on a certain area or region of the body, often determined through the chief complaint.

Patients with moderate or severe head injuries associated with a significant MOI should receive life-saving medical or surgical intervention at the closest appropriate trauma hospital without delay. If time allows, perform a secondary assessment to identify and treat injuries that may have been missed during the primary assessment en route to the emergency department (ED). Extremities can be stabilized using the backboard and splinted individually while in the back of the ambulance as time and conditions permit.

Obtaining a complete set of baseline vital signs is essential in patients with head and spine injuries. Significant head injuries may cause the pulse to slow and the blood pressure to rise. With neurogenic shock, the blood pressure may drop and the heart rate may increase to compensate. Respirations will become erratic with complications from both head and spine injuries. Hypotension may be present with cervical or high thoracic spine injuries. The heart rate may become slow or fail to increase in response to hypotension.

In addition to hands-on assessment, you should use monitoring devices to quantify your patient's oxygenation and circulatory status. Pulse oximetry and $ETCO_2$ monitoring should be utilized, if available, on all patients suspected of having a head injury to ensure the patient is not hypoventilating or hyperventilating. Maintain $ETCO_2$ between 35 and 40 mm Hg. You may also use noninvasive methods to monitor the blood pressure. It is recommended that you always assess the patient's first blood pressure manually with a sphygmomanometer (blood pressure cuff) and stethoscope.

Physical Examination Considerations

Examine the entire body using DCAP-BTLS and examine the head, chest, abdomen, extremities, and back. Check perfusion, motor function, and sensation in all extremities prior to moving the patient. Make sure that you do not move any body parts excessively. Determine whether the strength in each extremity is equal by asking the patient to squeeze your hands and to gently push each foot against your hands **Figure 28-17**.

A decreased or altered level of consciousness is the most reliable sign of a head injury. Monitor the patient for changes in level of consciousness, including signs of confusion, disorientation, or deteriorating mental status. Is the patient unresponsive or repeating questions? Experiencing seizures? Nauseous or vomiting?

Figure 28-17 **A.** Assess the equality of strength in each extremity by asking the patient to squeeze your hands. **B.** Next, ask the patient to gently push each foot against your hands.

Determine whether there is decreased movement and/or numbness and tingling in the extremities. Is there any spinal cord posturing? Is the patient able to perform motor function such as squeezing your hands appropriately and equally? Can the patient smile? An inability to smile is a sign that the cervical vertebrae may be injured. Part the patient's hair and inspect the scalp for bruising. Look for blood or CSF leaking from the ears, nose, or mouth and for bruising around the eyes and behind the ears.

Assess pupil size and reaction to light. Unequal pupil size after a head injury in an unconscious patient often signals a serious problem. The brain controls the diameter of pupils and how quickly they react. If an injury has occurred on one side of the brain, just one pupil will dilate. Developing blood clots may be compressing the brain, causing one pupil to dilate and indicating that the brain is at extreme risk of sustaining catastrophic damage **Figure 28-18**. The pupils are windows to the brain and should be assessed as soon as possible to establish a baseline from which to monitor changes.

Figure 28-18 Assess pupil size and reaction to light in all patients at least once.

As soon as you have assessed the patient's level of consciousness, determine the reaction of each pupil to light. Sketch the size of both pupils on the ambulance report to indicate any difference between the two eyes. Continue to monitor the pupils. Any change in their reactions over time may indicate progressive brain injury.

Do not probe open scalp lacerations with your gloved finger because this may push bone fragments into the brain. Do not remove an impaled object from an open head injury.

Neurologic Examination

For a patient with a head injury, perform a neurologic examination. Perform a baseline assessment using the Glasgow Coma Scale (GCS) and record the time **Table 28-2**. The GCS helps you to identify the patient's speech and ability to follow commands. Always use simple, easily understood terms when reporting the level of consciousness, such as "does not remember events immediately before the injury" or "confused about date and time." Terms such as "obtunded" or "dazed" have different meanings to different people and should not be used in either written or verbal reports.

If your jurisdiction uses the Revised Trauma Score (RTS), then the findings from the GCS will be used to determine the RTS value. See Chapter 24, *Trauma Overview*, for a discussion of this scoring system.

Frequently, the level of consciousness will fluctuate—improving, deteriorating, and improving again over time. On other occasions, there may be a gradual, progressive deterioration in the patient's response to stimuli; this usually indicates serious brain injury that may need aggressive medical and/or surgical treatment. The physicians who treat the patient will need to know when a loss of consciousness occurred.

Table 28-2 Glasgow Coma Scale

Eye Opening		Best Verbal Response		Best Motor Response	
Spontaneous	4	Oriented conversation	5	Obeys commands	6
In response to speech	3	Confused conversation	4	Localizes pain	5
In response to pain	2	Inappropriate words	3	Withdraws to pain	4
None	1	Incomprehensible sounds	2	Abnormal flexion	3
		None	1	Abnormal extension	2
				None	1
Score: 13–15 may indicate mild dysfunction, although 15 is the score a person with no neurologic disabilities would receive.					
Score: 9–12 may indicate moderate dysfunction.					
Score: 8 or less is indicative of severe dysfunction.					

YOU are the Provider PART 3

Your secondary assessment reveals an area of depression to the right side of the patient's head over the temporal bone and dilated and sluggishly reactive pupils. The rest of his body is unremarkable for gross injury. He opens his eyes in response to pain, is making unrecognizable sounds, and his arms are flexed and drawn in toward his body. An engine company arrives at the scene to provide assistance. You ask them to prepare the backboard and straps while you quickly assess the patient's vital signs.

Recording Time: 5 Minutes	
Respirations	6 breaths/min and irregular (baseline); ventilations are being assisted
Pulse	60 beats/min; regular and bounding
Skin	Pink, warm, and dry
Blood pressure	190/104 mm Hg
Oxygen saturation (Spo_2)	94% (on oxygen)

There are numerous bystanders present; however, no one knows the patient. During your physical assessment, you did not find any medical alert bracelets or any other evidence of a past medical history.

5. What is this patient's Glasgow Coma Scale score?
6. What is the likely explanation for the patient's vital signs?

Special Populations

A modified Glasgow Coma Scale (GCS) for pediatric and nonverbal patients assesses eye opening, verbal response, and motor response. The scoring indicators are the same as the GCS but the modified scale takes into consideration responses of coos and babbling, scoring these responses as oriented and appropriate.

Words of Wisdom

A change in the level of consciousness is the single most important observation that you can make in assessing the severity of brain injury. Level of consciousness usually corresponds to the extent of loss of brain function.

They will want to compare their neurologic evaluation with the one you performed in the field.

As you proceed with your assessment, ask yourself these questions: Is the patient's speech clear and appropriate? Does the patient answer in a logical manner, and is the patient able to make decisions? Is the patient aware of his or her current location? Is the patient alert to person, place, time, and why you are at the scene? Can the patient recall the events leading up to the incident, or is there a period of memory lapse? Can the patient recall major current events?

Any person with a head injury that has resulted in a change in level of consciousness, progressive development of signs or symptoms of a concussion, or other causes of concern should be evaluated. This evaluation should occur soon after injury and must be conducted by a qualified healthcare provider. EMTs are not qualified to conduct these evaluations in the field.

Spine Examination

If there is a potential spine injury, examine the spine. To start, inspect for DCAP-BTLS and check the extremities for circulation, motor, or sensory problems. If there is impairment, note the level. You do not need to know the exact nerve impairment because this will not change your treatment.

Pain or tenderness when you palpate the spinal area is certainly a warning sign that a spinal injury may exist. Patients with spinal injuries may report constant or intermittent pain along the spinal column or in the extremities. A spinal cord injury may also produce pain independent of movement or palpation.

Other signs and symptoms of spinal injury include an obvious deformity as you gently palpate the spine; numbness, weakness, or tingling in the extremities; and soft-tissue injuries in the spinal region. Patients with severe spinal injury may lose sensation or experience paralysis below the suspected level of injury or be incontinent (loss of urinary or bowel control) **Figure 28-19**. Obvious injury to the head and neck may indicate injury to the cervical spine.

Injuries to the cervical area may limit the ability of the diaphragm to function fully and minimize the ability of the chest wall to fully expand. Another sign of spinal injury is abdominal excursion—when the patient is unable to breathe without the assistance of the abdomen.

Additional signs of spinal cord trauma are an inability to maintain body temperature, priapism (a persistent erection lasting more than 4 hours), and a loss of bowel or bladder control.

Reassessment

Repeat the primary assessment. Reassess vital signs and the chief complaint. Is the airway, breathing, and circulation still adequate? Recheck patient interventions. Are the treatments you provided for problems with the ABCs still effective? This is particularly important in patients with head or spinal injuries because these injuries can suddenly affect the respiratory, circulatory, and nervous systems. The patient's condition should be reassessed at least every 5 minutes.

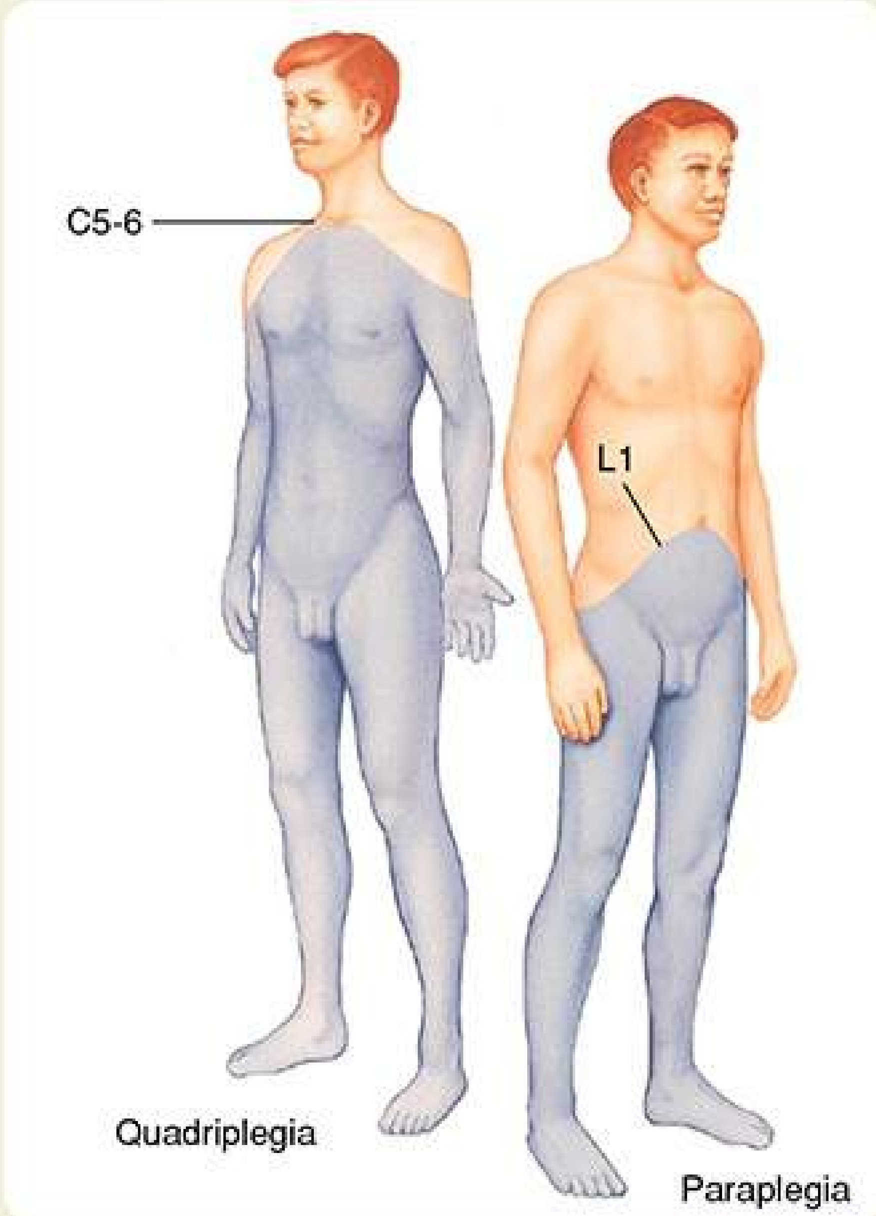

Figure 28-19 With severe spinal injuries, patients may lose sensation or experience paralysis below the suspected level of Injury.

Multiple interventions may be necessary in patients with head and spinal injuries. The effectiveness of positive-pressure ventilations, spinal immobilization, and treatments for shock may be determined only with both immediate and continuous observation after providing the intervention. If something is not working, try something else.

You have already established baseline vital signs as part of your assessment. Now is the time to compare those baseline vital signs with repeated vital signs. These changes will often tell you if treatments have been effective. For example, a dilated pupil may constrict with effective positive-pressure ventilations in an apneic head injury patient. Watch carefully for changes in the pulse, blood pressure, and respirations. If the ICP increases, the pulse may slow, blood pressure may rise, and respirations may become irregular. Document changes in the level of consciousness.

Rapid deterioration of neurologic signs following a head injury is a sign of an expanding intracranial hematoma or rapidly progressing brain swelling. You will notice a deterioration in a conscious patient's awareness of time, place, and person (self), in that order. You must act quickly to evaluate and treat these patients. The trauma patient with signs and symptoms of head injury who also displays signs of shock may have blood loss in another body cavity if hemorrhage is not seen externally. Neurogenic shock due to spinal cord injury without hemorrhage may also cause hypotension.

As discussed earlier, the appearance of clear or pink watery CSF from the nose, the ear, or an open scalp wound indicates that the dura and the skull have both been penetrated. You should make no attempt to pack the wound, ear, or nose in this situation. Cover the scalp wound, if there is one, with sterile gauze to prevent further contamination, but do not bandage it tightly.

Your local protocol for treatment of a suspected head injury should include the administration of high-flow oxygen and the application of a cervical collar, if indicated, as part of spinal immobilization. Reassessment should take place as the patient is transported to an appropriate trauma facility. Monitor the patient's condition and vital signs and relay this information to the receiving facility, especially if there is a significant or noteworthy change.

Special Populations

Infants, children, and adults may all have enough blood loss due to scalp lacerations to produce shock; however, this is more common in infants than in older children and adults. Provide oxygen, monitor the airway, treat for shock, and provide immediate transport.

A common response to head injuries, even among children with only very slight head injuries, is vomiting. This is sometimes the result of increased intracranial pressure. In managing such vomiting, pay particular attention to protecting the patient's airway.

When providing care for patients with suspected head and spinal injuries, it is essential to maintain good communication with other providers and give complete and detailed information to the destination facility. Key observations you relay help in the assessment and eventual treatment of your patient. Hospitals may better prepare for seriously injured patients with more advanced warning and a description of the most serious problems found during your assessment, and additional resources can be made available when you arrive. For example, a helicopter may be standing by for transport from a smaller hospital to a Level I trauma center. Larger hospitals may have trauma specialists or neurosurgeons available to meet you on arrival.

Your documentation should include the history you were able to obtain at the scene, your findings during your assessment, treatments you provided, and how the patient responded to them. How frequently you document repeat vital signs depends on the condition of your patient. More seriously injured patients should have documented vital signs every 5 minutes, whereas more stable patients should have documented vital signs every 15 minutes. Always follow local protocols. Take time after your verbal report to hospital staff to sit and make a complete and accurate record of the situation. This will be your only accepted legal memory of the call.

Many events that cause spinal or head injuries may eventually result in some type of litigation. As with all responses, proper documentation of what you observed and the treatment provided will be beneficial as time passes. You may be requested to testify as a witness at incidents years later, and proper and complete documentation recorded at the time of the incident will lay the framework for answering any questions that may be asked of you.

Emergency Medical Care of Head Injuries

Treat the patient with a head injury according to three general principles that are designed to protect and maintain the critical functions of the central nervous system:

1. Establish an adequate airway. If necessary, begin and maintain ventilation and provide supplemental oxygen.
2. Control bleeding, and provide adequate circulation to maintain cerebral perfusion. Begin cardiopulmonary resuscitation (CPR), if necessary. Be sure to follow standard precautions.
3. Assess the patient's baseline level of consciousness, and continuously monitor it.

As you continue to treat the patient, do not apply pressure to an open or compressed skull injury. In addition, you must assess and treat other injuries, dress and bandage open wounds as indicated in the treatment of soft-tissue injuries, splint fractures, anticipate and manage vomiting to prevent aspiration, be prepared for convulsions and changes in the patient's condition, and transport the patient promptly and with extreme care.

Managing the Airway

The most important step in the treatment of patients with head injury, regardless of the severity, is to establish an adequate airway. If the patient has an airway obstruction, perform the jaw-thrust maneuver to open the airway. Once the airway is open, maintain the head and cervical spine in a neutral, in-line position until you have placed a cervical collar and have secured the patient on a backboard **Figure 28-20**. Remove any foreign bodies, secretions, or vomitus from the airway. Make sure a suctioning unit is available, because you will often need to clear blood, saliva, or vomitus from the airway.

Once you have cleared the airway, check ventilation. If the respiratory control center of the brain has been injured, the rate and/or depth of breathing may be ineffective. Ventilation may also be limited by chest injuries or, if the spinal cord is injured, by paralysis of some or all of the muscles of respiration. Give supplemental oxygen to any patient with suspected head injury, particularly anyone who is having trouble breathing. This reduces hypoxia and possible cerebral edema. An injured brain is even less tolerant of hypoxia than a healthy brain, and studies have shown that supplemental oxygen can reduce brain damage; to be effective, however, it must be started as soon as possible. Do not wait until the patient becomes cyanotic. Continue to assist ventilations and administer supplemental oxygen until the patient reaches the hospital.

Figure 28-20 **A.** Maintain the head and cervical spine in a neutral in-line position. **B.** Apply a cervical collar as you finish the primary assessment.

▶ Circulation

If the heart is not beating, providing airway maintenance, ventilation, and oxygen accomplishes nothing. You must also begin CPR if the patient is in cardiac arrest.

Active blood loss aggravates hypoxia by reducing the available number of oxygen-carrying red blood cells. Although scalp lacerations rarely cause shock except in infants and children, they often cause the loss of large volumes of blood, which must be controlled. Bleeding inside the skull may cause the ICP to rise to life-threatening levels, even though the actual volume of blood loss inside the skull is relatively small.

You can almost always control bleeding from a scalp laceration by applying direct pressure over the wound. Remember to follow standard precautions. Use a dry, sterile dressing, folding any torn skin flaps back down onto the skin bed before applying pressure **Figure 28-21A**. In some instances, you will have to apply firm compression for several minutes to control bleeding **Figure 28-21B**. If you suspect a skull fracture, do not apply excessive pressure to the open wound. Otherwise, you may increase the ICP or push bone fragments into the brain. Bandages should not cover the mastoid process so that any apparent or developing sign of a basilar skull fracture still can be seen. If the bandage covers the patient's ears, remember that communication may become difficult because the patient's ability to hear will be decreased. To avoid limiting access to the patient's airway, do not cover the patient's mouth, nose, or jaw.

If the dressing becomes soaked, do not remove it. Instead, place a second dressing over the first. Continue applying manual pressure until the bleeding has been controlled, then secure the dressing in place with a soft, self-adhering roller bandage **Figure 28-21C**.

Shock that develops in a patient with a head injury is usually the result of hypovolemia caused by bleeding from other injuries. As with other trauma patients, shock in these cases indicates that the situation is critical. Such patients must be transported immediately to a trauma center. Maintain the airway while you protect the patient's cervical spine, ensure adequate ventilation, administer 100% oxygen, control obvious sites of bleeding with direct pressure, place the patient supine on a backboard, keep the patient warm, and provide immediate transport.

If the patient becomes nauseated or begins to vomit, elevate one side of the backboard to prevent aspiration. Be sure to maintain the head in the in-line neutral position, with the cervical collar in place. You should also have a suctioning unit available.

Cushing Triad

If the patient's head injuries are significant enough to cause a traumatic brain injury, the patient may begin to exhibit the signs of Cushing triad: increased blood pressure (hypertension), decreased heart rate (bradycardia), and irregular respirations such as Cheyne-Stokes respiration and Biot respiration. Cushing triad is also referred to as a herniation syndrome where the intracranial pressure is so great that it forces the brain stem and the midbrain through the foramen magnum, the hole at the base of the skull. If this process is allowed to continue, it is a fatal injury. If the patient exhibits these signs, it is commonly acceptable to perform controlled hyperventilation of your patient via positive-pressure ventilations at a rate of 20 breaths/min for adults. If capnography monitoring is in place, assisted ventilations can be delivered to target a goal $ETCO_2$ level of 30 to 35 mm Hg. Follow local protocols and your medical direction in regard to hyperventilation in the presence of herniation.

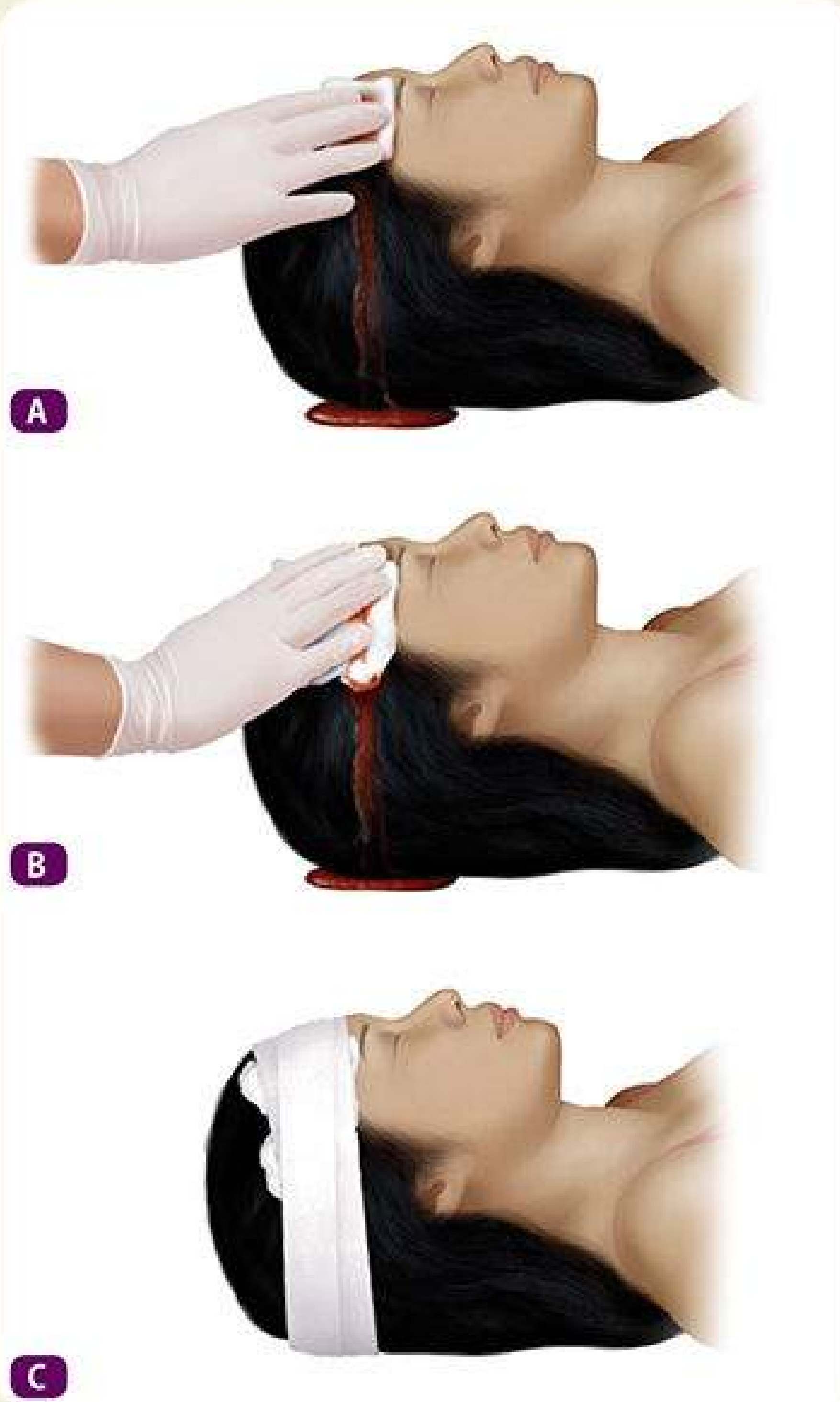

Figure 28-21

A. Use a dry sterile dressing to fold torn skin flaps back down onto the skin bed before applying pressure. **B.** If you do not suspect an open brain injury or skull fracture, apply firm compression for several minutes to control the bleeding. **C.** Secure the compression dressing in place with a soft, self-adhering roller bandage.

Words of Wisdom

Hypoxemia is one of the key indicators along with hypotension of a poor outcome in patients with traumatic brain injuries.

Emergency Medical Care of Spinal Injuries

Emergency medical care of a patient with a possible spinal injury begins, as does all patient care, with your protection; therefore, you must remember to follow standard precautions. Next, you must maintain the patient's airway while manually keeping the spine in the proper position, assess respirations, and give supplemental oxygen.

Managing the Airway

Knowing that improper handling of a spinal injury can leave a patient permanently paralyzed must not prevent you from properly addressing an airway obstruction. Remember, all patients without an airway will die. If a patient with a spinal injury has an airway obstruction, perform the jaw-thrust maneuver to open the airway **Figure 28-22**. Do not use the head tilt–chin lift maneuver because it extends the neck and may further damage the cervical spine. If the patient is unconscious, you can lift or pull the tongue forward so that you do not have to move the neck. Once the airway is open, hold the head still in a neutral, in-line position until it can be fully immobilized.

After you open the airway, consider inserting an oropharyngeal airway. If your patient accepts an oropharyngeal airway, be sure to monitor the airway closely. Have a suctioning unit available because you will often need to clear away blood, saliva, or vomitus. Provide supplemental oxygen. Continuously monitor the patient's airway and be prepared for any changes in the patient's condition based on your treatment.

Immobilization of the Cervical Spine

Establishing and maintaining the airway is your first priority. You must immobilize the head and trunk so that bone fragments do not cause further damage. Even small movements cause significant injury to the spinal cord. Follow the steps in **Skill Drill 28-1**:

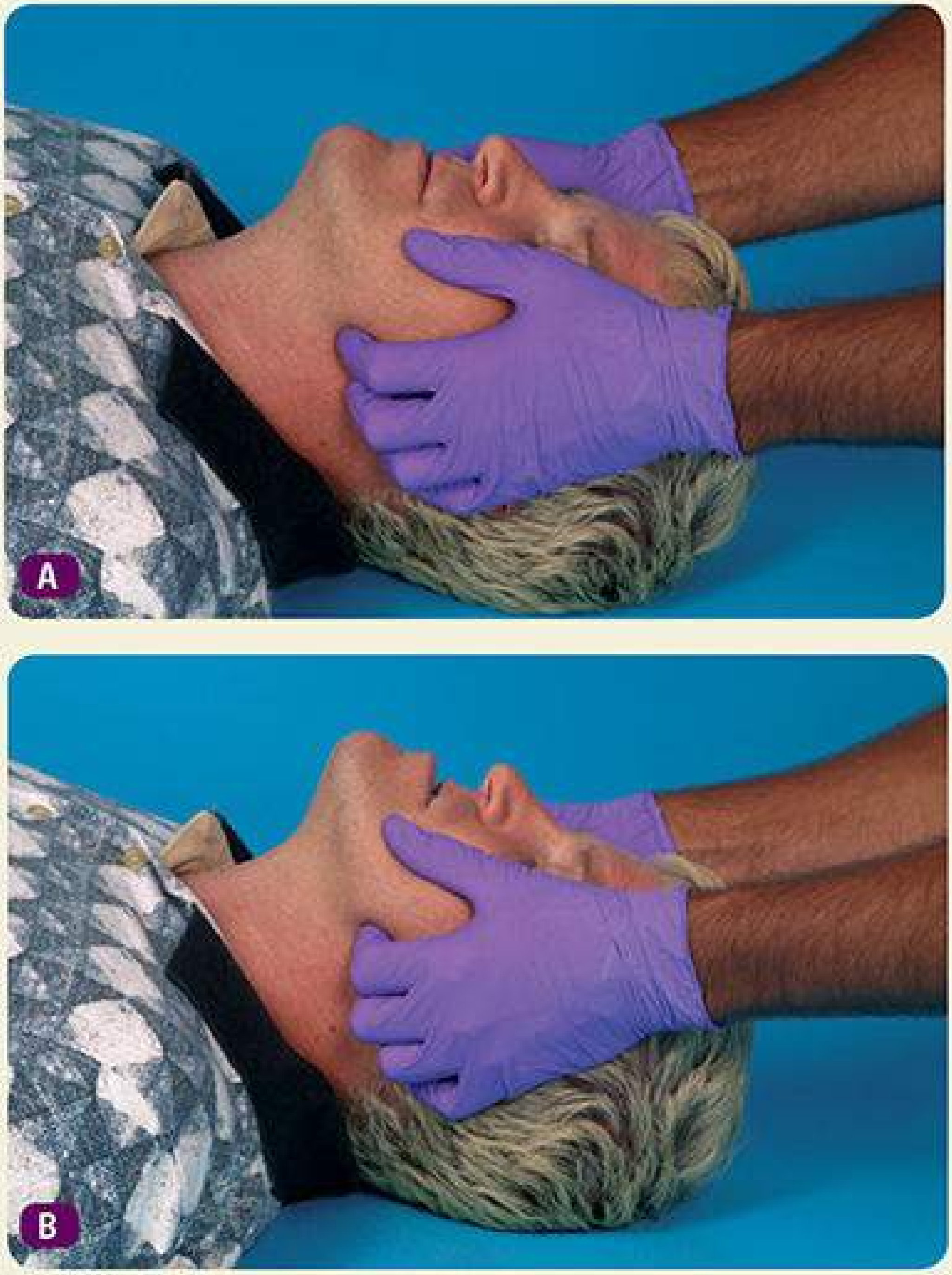

Figure 28-22 Jaw-thrust maneuver. **A.** Stabilize the neck in a neutral, in-line position. **B.** Push the angle of the lower jaw upward.

1. Take standard precautions. Begin manual in-line stabilization by holding or having someone firmly hold the head with both hands. Whenever possible, kneel at the head of the patient, and place your hands around the base of the skull on either side **Step 1**.
2. Support the lower jaw with your index and long fingers, while you are supporting the head with your palms. Then gently lift the head until the patient's eyes are looking straight ahead and the head and torso are in line. This neutral **eyes forward position** makes immobilization easier. Align the nose with the navel. Never twist, flex, or extend the head or neck excessively **Step 2**.

Skill Drill 28-1 Performing Manual In-Line Stabilization

Step 1

Take standard precautions. Kneel behind the patient and firmly place your hands around the base of the skull on either side.

Step 2

Support the lower jaw with your index and long fingers, and the head with your palms. Gently lift the head into a neutral, eyes forward position, aligned with the torso. Do not move the head or neck excessively, forcefully, or rapidly.

Step 3

Continue to manually support the head while your partner places a rigid cervical collar around the neck. Maintain manual support until you have completely secured the patient to a backboard.

3. Manually maintain this position as you continue to maintain the airway. Have your partner place a rigid cervical collar around the neck to provide more stability. Do not remove your hands from the patient's head until the patient's torso and head have been completely secured to a backboard. The patient must remain immobilized until he or she has been examined at the hospital **Step 3**.

You should never force the head into a neutral, in-line position. Do not move the head any farther if the patient reports any of the following symptoms:

- Muscle spasms in the neck
- Substantial increased pain
- Numbness, tingling, or weakness in the arms or legs
- Compromised airway or ventilations

In these situations, immobilize the patient in his or her current position.

Cervical Collars

Rigid cervical immobilization devices, or cervical collars, provide preliminary, partial support. A cervical collar should be applied to every patient who has a possible spinal injury based on the MOI, history, or signs and symptoms. Keep in mind, however, that cervical collars do not fully immobilize the cervical spine. Therefore, you must maintain manual support until the patient has been completely secured to a long or short backboard or vacuum mattress.

To be effective, a rigid cervical collar must be the correct size for the patient. The method for determining the correct size is provided by the manufacturer. Make sure you are familiar with the types of collars your service carries. The cervical collar should rest on the shoulder girdle and provide firm support under both sides of the mandible, without obstructing the airway or ventilation efforts in any way **Figure 28-23**. To apply a cervical collar, follow the steps in **Skill Drill 28-2**:

1. One EMT provides continuous manual in-line support of the head while the other EMT prepares the collar **Step 1**.
2. Measure the proper size collar according to the manufacturer's specifications. It is essential that the cervical collar fits properly. If you do not have the correct size collar, use a rolled towel around the patient's head; tape it to the backboard and provide supplemental continuous manual support **Figure 28-24** **Step 2**.
3. Begin by placing the chin support snugly underneath the chin **Step 3**.
4. Maintain head stabilization and neutral neck alignment, wrap the collar around the neck and secure the collar to the far side of the chin support **Step 4**.
5. Ensure that the collar fits properly and recheck that the patient is in a neutral, in-line position. Maintain in-line stabilization until the patient has been completely secured to the backboard **Step 5**.

Once the patient's head and neck have been manually stabilized, assess the pulse, motor, and sensory function in all extremities. Then assess the cervical spine area and neck. Keep in mind that the cervical collar is used to provide increased stability to the neck. It is used in addition to, not instead of, manual cervical stabilization. An improperly fitting collar will do more harm than good. In any case, maintain manual support until the patient has been fully secured to the backboard or vacuum mattress.

Figure 28-23 Proper fit is essential in applying a cervical collar. The collar should rest on the shoulder girdle and provide firm support under both sides of the mandible without obstructing the airway or any ventilation efforts.

Figure 28-24 If you do not have an appropriately sized cervical collar, you may use a rolled towel around the patient's head. Tape the towel to the backboard or mattress and provide continuous manual support.

Skill Drill 28-2 Application of a Cervical Collar

Step 1

Apply in-line stabilization.

Step 2

Measure the proper collar size.

Step 3

Place the chin support first.

Step 4

Wrap the collar around the neck and secure the collar.

Step 5

Ensure proper fit and maintain neutral, in-line stabilization until the patient is secured to a backboard.

Preparation for Transport

Supine Patients

A patient who is supine can be effectively immobilized by securing him or her to a long backboard or vacuum mattress. Another procedure for moving a patient from the ground to a backboard or vacuum mattress is the **four-person log roll**. In other cases, you may choose instead to slide the patient onto a backboard or vacuum mattress. The patient's condition, the scene, and the available resources will dictate the method you choose.

You should first take the necessary precautions and then direct the team from a kneeling position at the patient's head so that you can maintain manual in-line cervical immobilization. Your job is to ensure that the head, torso, and pelvis move as a unit, with your teammates controlling the movement of the body. If necessary, you may recruit bystanders to assist the team, but be sure to instruct them fully before moving the patient. To secure a patient to a backboard, follow the steps in **Skill Drill 28-3**:

1. Maintain in-line stabilization from a kneeling position at the patient's head. The EMT at the head will direct the log roll.
2. Assess pulse, motor, and sensory function in each extremity **Step 1**.
3. Apply an appropriately sized cervical collar **Step 2**.
4. The other team members should position the backboard and place their hands on the far side of the patient to increase their leverage. Instruct them to use their body weight and their shoulders and back muscles to ensure a smooth, coordinated pull, concentrating their pull on the heavier portions of the patient's body **Step 3**.
5. On command from the EMT at the head, the rescuers roll the patient toward themselves. One rescuer quickly examines the back while the patient is rolled on the side, and then slides the backboard behind and under the patient. The team rolls the patient back onto the backboard, avoiding independent rotation of the head, shoulders, or pelvis **Step 4**.
6. Ensure the patient is centered on the backboard **Step 5**.
7. Secure the upper torso to the backboard (without restricting the patient's breathing with the straps) once the patient is centered on the backboard **Step 6**. Consider padding voids between the patient and the backboard to make transport more comfortable and protect the patient.
8. Secure the pelvis and upper legs, using padding as needed. For the pelvis, use straps over the iliac crests and/or groin loops **Step 7**.
9. Begin to secure the head to the backboard by positioning a commercial immobilization device or towel rolls **Step 8**.
10. Secure the head by taping the towels across the forehead. To prevent airway problems and leave access to the airway, do not tape over the throat or chin. Avoid placing the sticky side of the tape on the patient's head. **Step 9**.
11. Check and readjust straps as needed to ensure that the entire body is snugly secured and will not slide during patient movement, but breathing is not restricted.
12. Reassess pulse, motor, and sensory function in each extremity, and continue to do so periodically **Step 10**.

> **Words of Wisdom**
>
> When utilizing a long backboard, ensure that the straps are tight enough to secure the patient but not so tight as to limit the movement of the patient's chest. Pulling the straps too tight may result in hypoventilation.

An alternative to the long backboard is to place the patient on a vacuum mattress. The vacuum mattress molds to the specific contours of the patient's body, reducing pressure point tenderness and therefore providing better comfort. The mattress also provides thermal insulation, potentially decreasing the risk of hypothermia, and is the standard equipment used to transport patients with spinal injuries in the United Kingdom. It is an excellent alternative to a backboard for older adults or patients with abnormal curvature of the spine. A drawback to the device is its thickness, requiring careful patient movement to maintain spinal stabilization during the application procedure. The vacuum mattress cannot be used for patients who weigh more than 350 pounds (159 kilograms).

Like a backboard, a vacuum mattress can be used on a supine, sitting, or standing patient.

A patient can be moved onto the vacuum mattress with a scoop stretcher or a log roll. For the scoop stretcher method, the mattress does not need to be partially rigid.

It is important to secure the patient sufficiently but without restricting the patient's breathing. If the patient is not secured sufficiently, this can cause excessive movement, increasing the risk of subsequent spinal cord injury.

Follow the steps in **Skill Drill 28-4** to immobilize a patient with a vacuum mattress:

1. Place the mattress on a flat surface near the patient. Make sure the head end of the mattress is at the patient's head **Step 1**.
2. Allow air to enter the mattress **Step 2**. The valve stem can remain open until the mattress is soft and pliable.
3. Smooth the mattress so that it is flat and level **Step 3**.
4. Remove any sharp or bulky items that may damage the vacuum mattress.
5. Connect the pump to the mattress **Step 4**.
6. Determine which method you will use to move the patient onto the mattress. If you will use the log roll method, evacuate the mattress until it is partially rigid **Step 5**. (This step is not needed if using the scoop stretcher method.) The surface should be smooth and the beads inside the mattress should be spread out as evenly as possible.

Skill Drill 28-3 Securing a Patient to a Long Backboard

Step 1

Apply and maintain manual cervical stabilization. Assess distal functions in all extremities.

Step 2

Apply a cervical collar.

Step 3

Rescuers kneel on one side of the patient and place hands on the far side of the patient.

Step 4

On command, rescuers roll the patient toward themselves, quickly examine the back, slide the backboard under the patient, and roll the patient onto the backboard.

Step 5

Center the patient on the backboard.

Step 6

Secure the upper torso first.

Step 7

Secure the pelvis and upper legs.

Step 8

Begin to secure the patient's head using a commercial immobilization device or rolled towels.

Step 9

Place tape across the patient's forehead to secure the immobilization device.

Step 10

Check all straps and readjust as needed. Reassess distal functions in all extremities.

7. Move the patient onto the vacuum mattress using one of the two methods: scoop stretcher or log roll **Step 6**. Throughout this procedure, maintain spinal alignment.
8. Scoop stretcher method (for this method, the mattress does not need to be partially rigid):
   a. Apply the scoop stretcher to the patient, then lift and transfer the patient onto the mattress.
   b. Position the patient so his or her head is in the head area of the mattress or very close to the mattress's top edge.
   c. Remove the scoop stretcher from around the patient and proceed with application of the vacuum mattress.
9. Log roll method (for this method, the mattress should be partially rigid):
   a. Place the mattress on a backboard or transfer device.
   b. Hold the mattress in place on the backboard, log roll the patient onto the backboard with the mattress on top of it. (The long backboard is used only for stabilization.)
   c. Position the patient so his or her head is very close to the top edge.
10. If the vacuum mattress is partially rigid, open the valve to allow air to enter **Step 7**. Keep the valve open until the mattress is pliable.
11. Conform the mattress to each side of the patient's head close to the shoulders, but not the top of the head **Step 8**. Continue to hold these "head blocks" that you have formed, and have a second person hold up the sides of the mattress to the patient's hips until the mattress is evacuated of air completely. Always form the mattress to meet the needs of the patient. Use additional rescuers if needed. Some patients may be more comfortable with their knees slightly bent.
12. Secure the patient's chest, hips, and legs in the mattress **Step 9**.

Skill Drill 28-4 Placing a Patient on a Full-Body Vacuum Mattress

Step 1

Place the mattress on a flat surface near the patient, with the head end of the mattress at the patient's head.

Step 2

Allow air to enter the mattress. Keep the valve stem open until the mattress is soft and pliable.

Step 3

Smooth the mattress. Remove any sharp or bulky items that may damage the mattress.

Step 4

Connect the pump to the mattress.

Step 5

Determine which method you will use to move the patient onto the mattress. If you will use the log roll method, evacuate the mattress until it is partially rigid (this step is not needed if using the scoop stretcher method). The surface should be smooth and the beads should be spread out as evenly as possible.

If using a scoop stretcher, you do not need to partially evacuate the mattress at this stage.

Step 6

Move the patient onto the vacuum mattress using the method you determined during the previous step. Maintain spinal alignment.

Step 7

If the vacuum mattress is partially rigid, open the valve to allow air to enter. Keep the valve open until the mattress is pliable.

Step 8

Conform the mattress to each side of the patient's head, close to the shoulders but not the top of the head. Continue to hold these "head blocks" that you have formed, and have a second person hold up the sides of the mattress to the patient's hips until the mattress is evacuated of air completely.

Step 9

Secure the patient's chest, hips, and legs.

Step 10

Secure the patient's head. Pad any voids at the top of the shoulders.

Step 11

Ensure the patient is as comfortable as possible, then evacuate the remaining air to achieve immobilization.

Step 12

Disconnect the vacuum pump and ensure that the valve is closed or secured.

Step 13

Reassess and adjust the straps around the chest, hips, and legs.

Step 14

Check the patient's neurovascular status and re-check all straps prior to lifting or moving the patient.

13. Secure the patient's head with medical tape **Step 10**. Pad any voids at the top of the shoulders.
14. If the patient is as comfortable as possible, evacuate the remaining air from the mattress to achieve rigid immobilization **Step 11**. (A portable suction unit can be used to evacuate some mattresses; see manufacturer recommendations.)
15. Disconnect the vacuum pump and ensure that the valve is closed or secured so the mattress is not accidentally deflated **Step 12**.
16. Reassess and adjust the straps around the chest, hips, and legs **Step 13**.
17. Check the patient's neurovascular status and re-check all straps prior to lifting or moving the patient **Step 14**.

Sitting Patients

Some patients with a possible spinal injury will be in a sitting position, such as after a vehicle crash. With these patients, you should use a short backboard or other short spinal extrication device to restrict movement of the cervical and thoracic spine. The short backboard is then secured to the long backboard.

The exceptions to this rule are situations in which you do not have time to first secure the patient to the short backboard, including the following situations:

- You or the patient is in danger.
- You need to gain immediate access to other patients.
- The patient's injuries justify urgent removal.

In these situations, your team should lower the patient directly onto a long backboard, using the rapid extrication technique as described in Chapter 8, *Lifting and Moving Patients*. Be sure that you provide manual stabilization of the cervical spine as you move the patient. Rapid extrication is indicated only in cases of life-threatening or limb-threatening injury. In all other cases, proceed with immobilization in a seated position. Follow the steps in **Skill Drill 28-5** to immobilize a sitting patient using a commercial immobilization device.

1. Take standard precautions. Take standard precautions. As with the supine patient, you must first stabilize the head and then maintain manual in-line stabilization until the patient has been secured to the long backboard or vacuum mattress.
2. Assess pulse, motor, and sensory function in each extremity.
3. Apply the cervical collar **Step 1**.

4. Insert an extrication device between the patient's upper back and the seat back **Step 2**.
5. Open the side flaps (if present), and position them around the patient's torso and snug to the armpits **Step 3**.
6. Once the extrication device has been properly positioned, secure the upper torso straps and then the mid-torso straps **Step 4**.
7. Position and fasten both groin (leg) straps. Check all torso straps to make sure they are secure. Make any adjustments necessary without excessive movement of the patient **Step 5**.
8. Pad any space between the patient's head and the extrication device as necessary.
9. Secure the forehead strap, and then fasten the lower head strap around the cervical collar **Step 6**.
10. Place the long backboard next to the patient's buttocks, perpendicular to the trunk **Step 7**.
11. Turn the patient parallel to the long backboard, and slowly lower him or her onto it.
12. Lift the patient (without rotating him or her), and slip the long backboard under the short board **Step 8**.
13. Secure the extrication device and long backboard together. Loosen or release the groin straps.
14. Reassess the pulse, motor, and sensory function in all four extremities. Document your findings, and prepare for immediate transport **Step 9**.

Standing Patients

You may arrive at a scene in which you find a patient standing or wandering around after a crash or injury. If the MOI and clinical indications suggest spinal injury, immobilize the patient to a long backboard before proceeding with assessment.

This process of immobilizing a patient found in the standing position requires three EMTs. Begin by establishing manual, in-line stabilization, and applying a cervical collar. Instruct the patient to remain still. Position the board upright directly behind the patient. The EMTs should be positioned with one on either side of the patient, and the third directly behind the patient, maintaining in-line stabilization. Next, the two EMTs at the patient's sides grasp the handholds at shoulder level or slightly above by reaching under the patient's arms. Carefully lower the patient as a unit under the direction of the EMT at the head. The EMT at the head must ensure that the patient's head stays against the board and must carefully rotate his or her hands as the patient is being lowered to maintain in-line stabilization. Remember that it is extremely uncommon for patients who are walking to have occult unstable cervical spine injuries that benefit from immobilization.

Skill Drill 28-5 Securing a Patient Found in a Sitting Position

Step 1

Take standard precautions. Stabilize the head and neck in a neutral, in-line position. Assess pulse, motor, and sensory function in each extremity. Apply a cervical collar.

Step 2

Insert an immobilization device between the patient's upper back and the seat.

Step 3

Open the side flaps, and position them around the patient's torso, snug around the armpits.

Step 4

Secure the upper torso flaps, then the mid-torso flaps.

Step 5

Secure the groin (leg) straps. Check and adjust the torso straps.

Step 6

Pad between the head and the device as needed. Secure the forehead strap and fasten the lower head strap around the cervical collar.

Step 7

Place a long backboard next to the patient's buttocks, perpendicular to the trunk.

Step 8

Turn and lower the patient onto the long backboard. Lift the patient, and slip the long backboard under the immobilization device.

Step 9

Secure the immobilization device and long backboard to each other. Loosen or release the groin straps. Reassess pulse, motor, and sensory function in each extremity.

▶Spinal Immobilization Devices

An injured spine is often very difficult to evaluate in a patient with a head injury. Sometimes, the patient has no neurologic loss. During assessment, pain in the spine may be missed because of shock or because the patient's attention is directed to more painful injuries. Evaluation is even more difficult if the patient is unconscious. Because any manipulation of the unstable cervical spine may cause permanent damage to the spinal cord, you must assume the presence of spinal injury in all patients who have sustained head injuries. Use manual in-line stabilization or a cervical collar and long backboard.

Short Backboards

There are several types of short backboards. The most common are the vest-type device **Figure 28-25** and the rigid short backboard. These devices are designed to immobilize and restrict movement of the head, neck, and torso. They are used to immobilize noncritical patients who are found in a sitting position and have possible spinal injuries.

Figure 28-25 A common short-board immobilization device is a vest-type device.

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As described earlier in this chapter, the first step in securing a patient to a short backboard is to provide manual, in-line support of the cervical spine. Assess the pulse, motor function, and sensation in all extremities; next assess the cervical area; and then apply an appropriately sized cervical collar.

Position the device behind the patient, and secure it to the torso. Evaluate how well the torso and groin are secured, and make adjustments as necessary. Avoid excessive movement of the patient. Next, evaluate the position of the patient's head. Pad behind the head as needed to maintain neutral, in-line stabilization.

Now secure the patient's head to the device. Once the head is secured, you may release manual support of the head. Rotate or lift the patient to the long backboard. At this point, you must reassess the pulse, motor function, and sensation in all four extremities to determine whether the change in position has affected the patient's vital signs or neurologic status. Finally, you should secure the patient to the long backboard.

Long Backboards

There are several types of long backboards that provide full-body spinal immobilization **Figure 28-26**. These devices also provide motion restriction to the head, neck, torso, pelvis, and extremities. Long backboards are used to immobilize patients who are found in any position (standing, sitting, supine), sometimes in conjunction with short backboards.

Securing a patient to a long backboard was described in detail earlier in this chapter. Briefly, you should begin by providing manual, in-line support of the head. Assess pulse, motor function, and sensation in all extremities, and assess the cervical area. Then apply an appropriately sized cervical collar, and proceed as follows:

Figure 28-26 Long backboards provide full body spinal immobilization, including the head, neck, torso, pelvis, and extremities.

YOU are the Provider — PART 4

Full spinal immobilization is applied, assisted ventilations are continued, and the patient is loaded into the ambulance. An EMR from the engine company drives the ambulance so your partner can help you with the patient in the back. You begin transport to a local trauma center and reassess the patient's vital signs en route.

Recording Time: 11 Minutes	
Level of consciousness	Responsive only to deep painful stimuli
Respirations	6 breaths/min and irregular (baseline); ventilations are being assisted
Pulse	64 beats/min; regular and bounding

Skin	Pink, warm, and dry
Blood pressure	192/100 mm Hg
Spo_2	96% (on oxygen)

7. What further treatment is indicated for this patient?
8. What should you specifically monitor this patient for during transport?

1. Position the device.
2. Log roll the patient onto the device. You may also move the patient onto the device using a suitable lift or slide or by using a scoop stretcher. As you maintain in-line support, your partner should kneel by the patient's head and direct the other two EMTs as you roll the patient. Your partner's job is to make sure that the head, torso, and pelvis move as a unit. As the patient's back comes into view, quickly assess its condition if you did not do so during initial assessment. One EMT should position the device under the patient. Then, at your partner's command, roll the patient onto the backboard.
3. If there are spaces between the patient's head and torso and the backboard, fill them with padding.
4. Secure the torso to the device by applying straps across the chest, pelvis, and legs. Adjust these straps as needed. Then secure the patient's head to the board.
5. Reassess pulse, motor function, and sensation in all extremities.
6. When the patient has been properly secured, you can safely lift the backboard or turn it on its side, if necessary.

Helmet Removal

As you plan your care of a patient wearing a helmet, ask yourself the following questions:

- Is the patient's airway clear?
- Is the patient breathing adequately?
- Can you maintain the airway and assist ventilations if the helmet remains in place?
- Can the face guard be easily removed to allow access to the airway without removing the helmet?
- How well does the helmet fit?
- Can the patient move within the helmet?
- Can the spine be immobilized in a neutral position with the helmet on?

A helmet that fits well prevents the patient's head from moving and should be left on, provided (1) there are no impending airway or breathing problems, (2) it does not interfere with assessment and treatment of airway or ventilation problems, and (3) you can properly immobilize the spine. You should also leave on the helmet if there is any chance that removing it will further injure the patient.

Remove a helmet if (1) it is a full-face helmet **Figure 28-27**, (2) it makes assessing or managing airway problems difficult and removal of a face guard to improve airway access is not possible, (3) it prevents you from properly immobilizing the spine, or (4) it allows excessive head movement. Finally, always remove a helmet from a patient who is in cardiac arrest.

Sports helmets are typically open in the front and may or may not include an attached face mask. The mask can be removed without affecting helmet position or function by simply removing or cutting the straps that hold it to the helmet, thus allowing easy access to the airway **Figure 28-28**. A patient who is involved in full contact sports may be wearing bulky pads to protect various body regions, such as shoulder pads. Leaving a helmet in place whenever possible is preferred because it helps the body maintain an in-line neutral position. If the helmet is removed, be sure to provide padding to compensate for the shoulder pads and maintain in-line positioning of the body.

Preferred Method

Removing a helmet should always be at least a two-person job; however, the technique for helmet removal depends on the actual type of helmet worn by the patient. One EMT provides constant in-line support as the other EMT performs the various moves; you and your partner should not move at the same time. You should first consult with medical control, if possible, about your decision to remove a helmet. When you decide to do so, follow the steps in **Skill Drill 28-6**:

Figure 28-27 A full-face helmet, such as this motorcycle helmet, should be removed from the patient.

Figure 28-28 The mask on most sports helmets can be removed without affecting helmet position or function. **A.** Stabilize the patient's head and helmet. Remove the face mask in one of two ways: **B.** Use a trainer's tool designed for cutting retaining clips, or **C.** Unscrew the retaining clips from the face mask. **D.** After the face mask is removed, the helmet can be immobilized against the backboard and a BVM can be used effectively.

1. Begin by kneeling at the patient's head. Your partner should kneel on one side of the patient, at the shoulder area.
2. Open the face shield, if there is one, and assess the patient's airway and breathing. Remove eyeglasses if the patient is wearing them **Step 1**.
3. Stabilize the helmet by placing your hands on either side of it, with your fingers on the patient's lower jaw to prevent movement of the head. Once your hands are in position, your partner can loosen the face strap **Step 2**.
4. Once the strap has been loosened, your partner should place one hand on the patient's lower jaw at the angle of the jaw and the other behind the head at the occipital region. Once your partner's hands are in position, you may pull the sides of the helmet away from the patient's head **Step 3**.
5. Gently slip the helmet halfway off the patient's head, stopping when the helmet reaches the halfway point **Step 4**.
6. Your partner then slides his or her hand from the occiput to the back of the head. This will prevent the head from snapping back once the helmet has been completely removed **Step 5**.
7. With your partner's hand in place, remove the helmet, and stabilize the cervical spine.
8. Apply the cervical collar, and then secure the patient to the backboard.
9. With large helmets or small patients, you may need to pad under the shoulders to prevent flexion of the neck. If shoulder pads or heavy clothing are in place, you may need to pad behind the patient's head to prevent extension of the neck **Step 6**.

Skill Drill 28-6 Removing a Helmet

Step 1

Kneel at the patient's head with your partner at one side. Open the face shield to assess airway and breathing. Remove eyeglasses if present.

Step 2

Prevent head movement by placing your hands on either side of the helmet and fingers on the lower jaw. Have your partner loosen the strap.

Step 3

Have your partner place one hand at the angle of the lower jaw and the other at the occiput.

Step 4

Gently slip the helmet about halfway off, then stop.

Step 5

Have your partner slide the hand from the occiput to the back of the head to prevent the head from snapping back.

Step 6

Remove the helmet and stabilize the cervical spine. Apply a cervical collar and secure the patient to a long backboard. Pad as needed to prevent neck flexion or extension.

Alternate Method

An alternate method for removal of football helmets has also been used. The advantage of this method is that it allows the helmet to be removed with the application of less force, therefore reducing the likelihood of motion occurring at the neck. The disadvantage of this method is that it is slightly more time consuming. The first step involves removal of the chin strap. This can be cut or carefully unsnapped. Be careful during removal of the chin strap to avoid jarring the neck or head and causing excessive motion. Next, remove the face mask. The face mask is anchored to the helmet by plastic clips (loop straps) secured by screws. These can be removed with a screwdriver or cut with a knife. After the face mask has been removed, the jaw pads can be popped out of place. This can be accomplished with the use of a tongue depressor **Figure 28-29A**. You can then place your fingers inside the helmet, allowing greater control of the helmet during removal as the helmet is gently rocked back off the top of the head. The person at the side of the patient controls the head by holding the jaw with one hand and the occiput with the other **Figure 28-29B**. Padding is inserted behind the occiput to prevent neck extension. If the shoulder pads are in place, appropriate padding must be placed behind the head to prevent hyperextension. As with the previously described method, the person at the side of the patient's chest is responsible for making sure that the head and neck do not move during removal of the helmet.

Remember that small children may require additional padding to maintain the in-line neutral position. Children are not small adults. They have smaller airways and proportionally larger heads, so padding is important to maintain the airway. Pad under the shoulders to the toes, as needed, to avoid excessive neck flexion **Figure 28-30**. In addition, place blanket rolls between the child and the sides of an adult-sized backboard to prevent the child from slipping to one side or the other **Figure 28-31**. Appropriately sized backboards are available for children.

Special Populations

You are likely to find infants and children who have been in motor vehicle crashes and are still in their car seats. Follow your local protocols regarding spinal immobilization techniques. See Chapter 34, *Pediatric Emergencies*, for a complete discussion on removing pediatric patients from car seats and performing spinal stabilization maneuvers.

YOU are the Provider — PART 5

Your partner continues to assist the patient's ventilations while you reassess his condition and vital signs. His Glasgow Coma Scale score remains unchanged from the previous readings. You call the trauma center to give your radio report and advise the center of your estimated time of arrival.

Recording Time: 16 Minutes	
Level of consciousness	Responsive only to deep painful stimuli
Respirations	6 breaths/min and irregular (baseline); ventilations are being assisted
Pulse	70 beats/min; regular and bounding
Skin	Pink, warm, and dry
Blood pressure	188/98 mm Hg
Spo_2	98% (on oxygen)

You deliver the patient to the emergency department and give your verbal report to the attending physician. After further assessment and treatment in the emergency department, the patient is taken to radiology for a CT scan, which reveals an epidural hematoma.

9. What is an epidural hematoma?

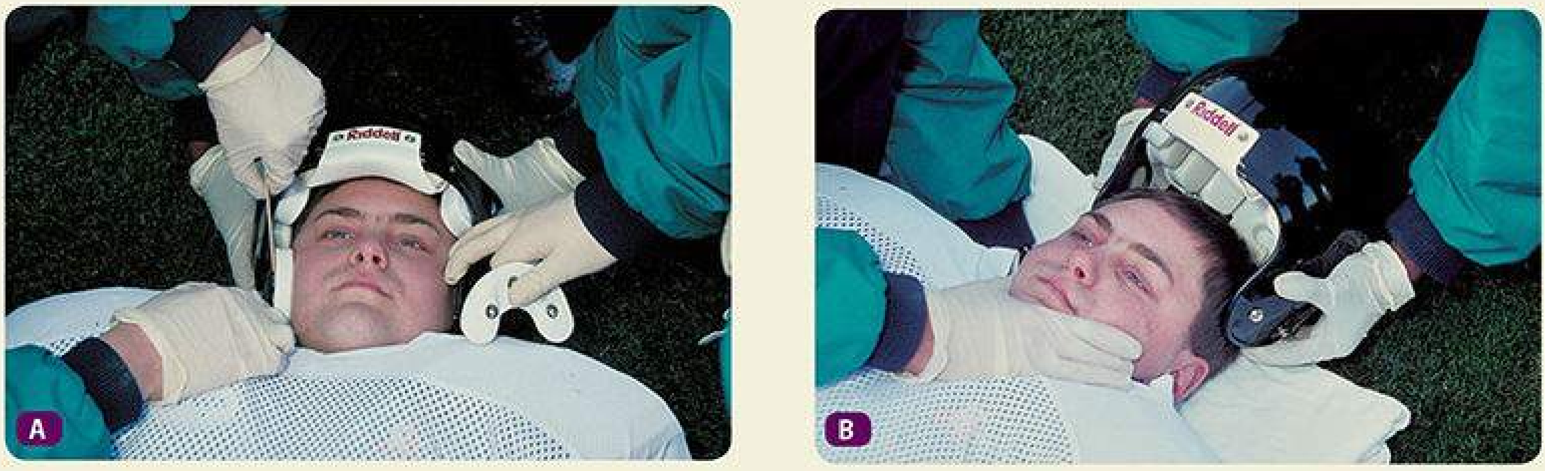

Figure 28-29 **A.** The jaw pads can be removed from the inside of a football helmet with the aid of a tongue depressor. **B.** Place the fingers inside the helmet and gently rock it out of place. The person at the side controls the lower jaw with one hand and the occiput with the other. Insert padding behind the occiput to prevent neck extension.

Figure 28-30 Children have proportionately larger heads than adults, so you may need to place padding under the shoulders to avoid excessive flexion of the head.

Figure 28-31 Place blanket rolls between the child and the sides of an adult-sized backboard to prevent the child from slipping to one side or the other.

YOU are the Provider — SUMMARY

1. Why is the structure of the cranium considered to be a mixed blessing in terms of blood flow, oxygen levels, and swelling?

The cranium does an excellent job of protecting the brain from direct trauma following minor injuries. The hard shell of the cranium provides protection for the brain from the bumps and blows that occur as a part of everyday life. However, the very fact that the cranium is a hard shell makes it a mixed blessing following a significant head injury. The cranium's rigid, unyielding structure allows little, if any, expansion of the brain. Furthermore, its hard and somewhat irregular internal surface can injure the brain and its blood vessels following significant head trauma.

2. What is the difference between a primary and a secondary brain injury?

A traumatic brain injury (TBI) can be classified into two categories: primary (direct) injury and secondary (indirect) injury.

Primary brain injury is injury to the brain and its associated structures that occurs immediately on impact to the head. It can occur following a penetrating injury, such as a stabbing, a gunshot wound, or if a bone fragment is driven into the brain following a skull fracture; however, it more commonly occurs following blunt force trauma.

Secondary brain injury refers to the after effects of the primary head injury. It includes abnormal processes such as cerebral edema, increased intracranial pressure (ICP), cerebral ischemia and hypoxia, and infection. Secondary brain injury can occur anywhere from a few minutes to several days following the initial head injury.

3. What are your most immediate treatment priorities for this patient?

As with any patient, your initial treatment must focus on what will kill him or her first. Your patient's breathing rate and quality—slow and irregular—is not adequate and requires immediate treatment. You should instruct your partner to stabilize the patient's head with his knees while he assists the patient's ventilations with a BVM and high-flow oxygen. If a law enforcement officer is available, ask him or her to stabilize the patient's head while your partner assists his ventilations.

Consider inserting a simple airway adjunct. If the patient does not have a gag reflex, insert an oropharyngeal (oral) airway. Use of a nasopharyngeal (nasal) airway should be avoided in patients with a head injury, especially if you observe fluid drainage from the nose. This sign could indicate a mid-face fracture, in which case a nasal airway could inadvertently penetrate the brain. If a simple airway adjunct is not an option, keep the airway open with the jaw-thrust maneuver and maintain the patient's head in a neutral position.

While your partner is managing the patient's airway, you should control the bleeding from the laceration to his head. Use just enough pressure to control the bleeding; if a skull fracture is present, too much pressure could drive fractured bone fragments into his brain. Quickly scan the rest of the patient's body for any other external bleeding and control it as well. Remember the objective of the primary assessment: find it, fix it, and move on.

4. Where should you focus your secondary assessment of this patient?

When the patient is unconscious or has experienced a significant mechanism of injury, the entire body should be assessed to look for life-threatening injuries that were not grossly apparent in the primary assessment. If immediate threats to the patient's life are found, they should be treated immediately.

Emphasis should be placed on the patient's head and face because this area appears to be where the patient experienced the most injury. Assess the integrity of the skull by gently palpating it and noting any areas of deformity, crepitus, or instability. Although you have already bandaged the laceration on the patient's head, you should reassess the bandage to ensure that the bleeding is controlled.

Look in the ears for fluid drainage and look behind the ears for Battle sign. Fluid or blood drainage from the ears may contain cerebrospinal fluid which would indicate a basilar skull fracture.

Assess the size, equality, and reactivity of the patient's pupils. The nerves that control the dilation and constriction of the pupils are very sensitive to ICP. Normally, both pupils should briskly constrict when a light is shone into either of the eyes. Pupils that are sluggish (slow) to react could indicate early increased ICP and/ or cerebral hypoxia. Unequal or bilaterally fixed and dilated (blown) pupils are later, more ominous signs of increased ICP and indicate pressure on one or both oculomotor nerves.

Palpate the facial bones for stability and note any deformities or crepitus.

Patients with a significant head injury should also be assumed to have a cervical spine injury until proven otherwise. Blunt force trauma that is significant enough to render the patient unconscious could easily fracture a cervical vertebra. Palpate the cervical spine for obvious deformities and then apply a cervical collar. Manually stabilize the patient's head until full spinal immobilization has been achieved (cervical collar, backboard, straps, head blocks).

Your secondary assessment of any critically injured patient should not take an exorbitant amount of time. Address only life-threatening injuries and remain focused on preparing the patient for immediate transport.

5. What is this patient's Glasgow Coma Scale score?

Your patient opens his eyes in response to painful stimuli; therefore, you should assign a score of 2 for eye opening. He is making unrecognizable sounds; therefore, you should assign a score of 2 for verbal response. You noted that his arms were flexed and drawn in toward his body (decorticate posturing); therefore, you should assign a score of 3 for motor response. Based on these findings, the patient's present Glasgow Coma Scale (GCS) score is 7, which indicates a severe traumatic brain injury.

6. What is the likely explanation for the patient's vital signs?

Your patient's current vital signs represent a classic trio of findings in patients with a traumatic brain injury and increased ICP. Hypertension, bradycardia, and irregular respirations—called Cushing triad—indicate significant cerebral edema and increased ICP.

A predictable response of the injured brain is swelling; this causes cerebral edema and a decrease in cerebral perfusion pressure (CPP) because there is little room in the cranium for the brain to swell. In an attempt to maintain cerebral blood flow, and thus CPP, arterial blood pressure increases, which presents with hypertension, and the cerebral blood vessels dilate. Bradycardia occurs as a reflex response to the increase in the patient's blood pressure.

Pressure on the respiratory centers of the brainstem causes a variety of abnormal respiratory patterns. Irregular respirations—slow or fast—are the third component of Cushing triad. Cheyne-Stokes respirations are characterized by a pattern of rapid breathing (tachypnea), followed by slow breathing (bradypnea), and periods of apnea. Central neurogenic hyperventilation is characterized by deep, rapid breathing; this pattern is similar to Kussmaul respirations, but without an acetone breath odor. Biot respirations, also called ataxic respirations, are characterized by an irregular rate, pattern, and depth of breathing with intermittent periods of apnea.

7. What further treatment is indicated for this patient?

Continue to ensure adequate oxygenation and ventilation and take steps to decrease the ICP and maximize cerebral blood flow. Continue to assist the patient's ventilations; however, do not hyperventilate him. Hyperventilation with high-flow oxygen constricts the blood vessels in the brain, and while this may cause a slight decrease in the ICP, it also pushes oxygenated blood away from the brain, potentially causing a decrease in cerebral perfusion pressure and further brain injury.

Consider elevating the head of the backboard to a 30-degree angle to reduce the ICP. Elevating the backboard greater than 30 degrees however, may cause blood (and oxygen) to leave the brain by gravity, thus causing a decrease in cerebral perfusion, and should be avoided.

Notifying the receiving facility early is critical in the treatment of a patient with a traumatic brain injury. Report your findings, any treatment that you provided, the patient's response to your treatment, and your estimated time of arrival. This will allow the receiving facility adequate time to prepare to receive the patient.

8. What should you specifically monitor this patient for during transport?

The importance of reassessing the brain-injured patient cannot be overemphasized. Patients with increased ICP commonly vomit and experience seizures. Be prepared to turn the backboard to the side and suction the patient's airway if vomiting occurs. If the patient experiences a seizure, continue to assist his ventilations and do not attempt to restrain him.

Carefully and frequently monitor the patient's vital signs, specifically, the blood pressure and oxygen saturation. A single episode of hypotension (a systolic BP of less than 90 mm Hg) in the adult with a traumatic brain injury is associated with a significant increase in mortality because it causes a decrease in cerebral perfusion. A single drop in the patient's oxygen saturation to below 90% is also associated with a significant increase in mortality; ensure the continual delivery of high-flow oxygen and adequate ventilation!

Frequently reassess the patient's GCS score and pupils, and observe for signs of brain herniation. If directed by local protocol or online medical control, ventilate the patient at a rate of 20 breaths/min if signs of brain herniation are observed.

If possible, request an ALS ambulance at the scene, if it does not delay your scene time, or consider an ALS intercept during transport, provided that it does not cause a delay in transport. The most important intervention for the patient with a traumatic brain injury, however, is to rapidly transport him or her to a definitive care facility as soon as possible.

9. What is an epidural hematoma?

Your patient was diagnosed with an epidural hematoma, which is an accumulation of blood between the skull and dura mater. An epidural hematoma is almost always the result of a blow to the head that produces a fracture of the thin temporal bone (recall that the patient had a compressed area over the temporal region of his skull). The middle meningeal artery courses along the groove in the temporal bone, so it is prone to laceration or rupture when the temporal bone is fractured. When this occurs, brisk arterial bleeding will result in rapidly progressing symptoms. The patient with an epidural hematoma typically has an immediate loss of consciousness; this may be followed by a brief return of consciousness (lucid interval), after which the patient's level of consciousness rapidly declines and he or she manifests with signs and symptoms of increasing ICP. *This is consistent with how your patient presented*.

EMS Patient Care Report (PCR)

Date: 1-13-16	**Incident No.:** 012609	**Nature of Call:** Head injury	**Location:** 147 Scottie Dr.

Dispatched: 0220	**En Route:** 0221	**At Scene:** 0225	**Transport:** 0236	**At Hospital:** 0245	**In Service:** 0256

Patient Information

Age: 22 **Sex:** M **Weight (in kg [lb]):** 155 lb (70 kg)	**Allergies:** Unknown **Medications:** Unknown **Past Medical History:** Unknown **Chief Complaint:** Head injury; decreased LOC

Vital Signs

Time: 0230	**BP:** 190/104	**Pulse:** 60	**Respirations:** 6	**Spo_2:** 94%
Time: 0236	**BP:** 192/100	**Pulse:** 64	**Respirations:** 6	**Spo_2:** 96%
Time: 0241	**BP:** 188/98	**Pulse:** 70	**Respirations:** 6	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Full spinal immobilization

Narrative

Medic 11 dispatched to a nightclub for a male patient who was assaulted. En route, law enforcement personnel, who were present at the scene, advised that the patient was struck in the side of the head with a baseball bat and was unconscious. On arrival at the scene, found the patient, a 22-year-old male, lying supine on the ground; a large pool of blood was under his head. He was motionless and his breathing appeared slow and irregular. Manual c-spine stabilization was initiated immediately and the patient's airway was opened with the jaw-thrust maneuver. Primary assessment revealed that he was responsive only to deep painful stimuli. His airway was clear of secretions or foreign bodies, his breathing was slow and irregular, and he was bleeding from a large laceration to the temporal region of his skull. The patient's gag reflex was intact, so an oral airway was not inserted. A nasal airway was avoided because of the potential for occult skull fracture. Patient's ventilations were assisted with a BVM and high-flow oxygen, and bleeding from the scalp laceration was controlled with a light pressure dressing. Secondary assessment revealed no gross trauma to the rest of the body. Assessment of the head revealed a depression over the area of the laceration. Pupils were bilaterally dilated and sluggish to react to light. There was no evidence of Battle sign or fluid drainage from the ears or nose. Facial bones were stable. Initial GCS score of 7 was assigned (eye opening, 2; verbal response, 2; motor response, 3). Engine company 4 arrived to provide assistance; as they retrieved spinal immobilization equipment, initial vital signs were obtained. Applied full spinal immobilization, loaded patient into ambulance, and began transport. EMR from assisting engine company drove the ambulance because of patient care demands that required two EMTs. En route to the hospital, reassessed vital signs and elevated the head end of the backboard to a 30-degree angle. Continued to assist ventilations at a rate of 10 breaths/min and noted that ventilations consistently produced adequate chest rise. Oxygen saturation remained greater than 95%. Notified trauma center of the patient's condition and our estimated time of arrival. Reassessment revealed no change in patient's condition; he remained responsive only to deep painful stimuli and his GCS score remained at 7. Pupils remained bilaterally dilated and sluggish to react to light. Delivered patient to emergency department and gave verbal report to attending physician. Medic 11 cleared the hospital and returned to service at 0256.**End of report**

Prep Kit

Ready for Review

- The nervous system of the human is divided into two anatomic parts: the central nervous system and the peripheral nervous system.
- The central nervous system is composed of the brain and the spinal cord; the peripheral nervous system includes a network of nerve fibers, like cables, that transmit information to and from the body's organs to and from the brain.
- The central nervous system is well protected by bony structures; the brain is protected by the skull and the spinal cord is protected by the bones of the spinal column.
- The central nervous system is also covered and protected by three layers of tissue called the meninges. The layers are called the dura mater, the arachnoid, and the pia mater.
- A head injury is a traumatic injury to the head that may result in injury to soft tissue, bony structures, or the brain.
- A traumatic brain injury is a severe head injury that can be a life threat or leave the patient with life-altering injuries.
- The cervical, thoracic, and lumbar portions of the spinal column can be injured through compression such as in a fall, unnatural motions such as overextension from trauma, pulling forces such as from a hanging, or a combination of mechanisms. Each of these may also cause injury to the spinal cord encased in these regions of bone, causing permanent neurologic injury or death.
- Motor vehicle crashes, direct blows, falls from heights, assault, and sports injuries are common causes of spinal injury. A patient who has experienced any of these events may have also sustained a head injury.
- Treat the patient with a head injury according to three general principles that are designed to protect and maintain the critical functions of the central nervous system: establish an adequate airway, control bleeding, and reassess the patient's baseline level of consciousness.
- Treat the patient with a spinal injury by maintaining the airway while keeping the spine in proper alignment, assess respirations, and give supplemental oxygen.
- In those situations in which your patient has problems with the ABCs or has other conditions for which you decide a rapid transport to the hospital is needed, rapid immobilization of the spine and quick loading into the ambulance may be indicated. Reduction of on-scene time and recognition of a critical patient increases the patient's chances for survival or a reduction in the amount of irreversible damage.
- Infants and young children are more susceptible to shock. Provide oxygen, monitor the airway, treat for shock, and provide immediate transport.
- Older people are at higher risk for a subdural hematoma developing. Signs and symptoms of the condition may not occur for several hours,days, or weeks. Be sure to get a thorough history of any previous trauma.

Vital Vocabulary

anterograde (posttraumatic) amnesia Inability to remember events after an injury.

axial loading injuries Injuries in which load is applied along the vertical or longitudinal axis of the spine, which results in load being transmitted along the entire length of the vertebral column; for example, falling from a height and landing on the feet in an upright position.

basilar skull fractures Usually occur following diffuse impact to the head (such as falls, motor vehicle crashes); generally result from extension of a linear fracture to the base of the skull and can be difficult to diagnose with a radiograph.

Battle sign Bruising behind an ear over the mastoid process that may indicate a skull fracture.

cerebral edema Swelling of the brain.

closed head injury Injury in which the brain has been injured but the skin has not been broken and there is no obvious bleeding.

concussion A temporary loss or alteration of part or all of the brain's abilities to function without actual physical damage to the brain.

coup-contrecoup injury Dual impacting of the brain into the skull; coup injury occurs at the point of impact; contrecoup injury occurs on the opposite side of impact, as the brain rebounds.

epidural hematoma An accumulation of blood between the skull and the dura mater.

eyes forward position A head position in which the patient's eyes are looking straight ahead and the head and torso are in line.

four-person log roll The recommended procedure for moving a patient with a suspected spinal injury from the ground to a long backboard or other spinal immobilization device.

intervertebral disk The cushion that lies between two vertebrae.

intracerebral hematoma Bleeding within the brain tissue (parenchyma) itself; also referred to as an intraparenchymal hematoma.

intracranial pressure (ICP) The pressure within the cranial vault.

involuntary activities Actions of the body that are not under a person's conscious control.

linear skull fractures Account for 80% of skull fractures; also referred to as nondisplaced skull fractures; commonly occur in the temporal-parietal region of the skull; not associated with deformities to the skull.

meninges Three distinct layers of tissue that surround and protect the brain and the spinal cord within the skull and the spinal canal.

open head injury Injury to the head often caused by a penetrating object in which there may be bleeding and exposed brain tissue.

primary (direct) injury An injury to the brain and its associated structures that is a direct result of impact to the head.

raccoon eyes Bruising under the eyes that may indicate a skull fracture.

retrograde amnesia The inability to remember events leading up to a head injury.

secondary (indirect) injury The after effects of the primary injury; includes abnormal processes such as cerebral edema, increased intracranial pressure, cerebral ischemia and hypoxia, and infection; onset is often delayed following the primary brain injury.

subarachnoid hemorrhage Bleeding into the subarachnoid space, where the cerebrospinal fluid circulates.

subdural hematoma An accumulation of blood beneath the dura mater but outside the brain.

traumatic brain injury (TBI) A traumatic insult to the brain capable of producing physical, intellectual, emotional, social, and vocational changes.

voluntary activities Actions that we consciously perform, in which sensory input or conscious thought determines a specific muscular activity.

Assessment *in Action*

You are called to an automotive body shop for an assault patient. Law enforcement personnel have arrived and declared the scene safe. You and your partner find a 44-year-old man seated in an office holding the left side of his head. According to bystanders, the patient was struck on the side of his head with a tire iron during a dispute with another employee. He was unconscious for approximately 3 minutes.

1. While performing a secondary assessment of the patient you find a depressed area above the patient's left ear. This indicates that the patient could have:

   A. an intracerebral hemorrhage.
   B. a subdural hematoma.
   C. a subarachnoid hemorrhage.
   D. an epidural hematoma.

2. Your transport time to the appropriate hospital is going to be 30 minutes. What support should you call for, based on your assessment and findings?

   A. Additional drivers
   B. An ALS intercept
   C. A police escort
   D. Another transport unit

3. When you secure this patient to a backboard, what area of the body should you secure last?

   A. Head
   B. Upper torso
   C. Pelvis
   D. Lower legs

4. During transport, the patient has a loss of consciousness. The time between the two periods of unconsciousness is referred to as the:

A. lucid interval.
B. recognition period.
C. danger zone.
D. coherent stage.

5. Which of the following describes the initial signs of a head injury?

   A. Runny nose and watering eyes
   B. Decreased level of consciousness, confusion, nausea
   C. Dizziness and coughing
   D. Decrease in blood pressure, pulse, and respirations

6. During transport when you reassess the patient you find the left pupil dilated and fixed. What does this indicate?

   A. Decreased blood pressure
   B. Increased blood pressure
   C. Increased intracranial pressure
   D. Drug abuse

7. An epidural hematoma is nearly always the result of a blow to the head that produces a linear fracture in what region of the cranium?

   A. Frontal
   B. Parietal
   C. Occipital
   D. Temporal

8. Discuss the pathophysiology of an epidural hematoma and a subdural hematoma.
9. Explain the difference between a primary (direct) brain injury and a secondary (indirect) brain injury.
10. What actions should you take to help prevent secondary brain injuries?

CHAPTER 29

Chest Injuries

National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Chest Trauma

Recognition and management of

› Blunt versus penetrating mechanisms (pp 1034–1036, 1041–1048)
› Open chest wound (pp 1034–1036)
› Impaled object (pp 1034–1036)

Pathophysiology, assessment, and management of

› Blunt versus penetrating mechanisms (pp 1034–1040)
› Hemothorax (pp 1036–1040, 1044)
› Pneumothorax (pp 1036–1042)
  • Open (pp 1036–1042)
  • Simple (pp 1036–1040, 1042–1043)
  • Tension (pp 1036–1040, 1043–1044)
› Cardiac tamponade (pp 1036–1040, 1045)
› Rib fractures (pp 1036–1040, 1045)
› Flail chest (pp 1036–1040, 1045–1046)
› Commotio cordis (pp 1036–1040, 1047–1048)

Knowledge Objectives

1. Explain the mechanics of ventilation in relation to chest injuries. (pp 1033–1034)
2. Describe the differences between an open and closed chest injury. (pp 1034–1035)

3. Recognize the signs of chest injury. (pp 1035–1036)
4. Describe the management of a patient with a suspected chest injury, including pneumothorax, hemothorax, cardiac tamponade, rib fractures, flail chest, pulmonary contusion, traumatic asphyxia, blunt myocardial injury, commotio cordis, and laceration of the great vessels. (pp 1041–1048)
5. Recognize the complications that can accompany chest injuries. (pp 1041–1048)
6. Explain the complications of a patient with an open pneumothorax (sucking chest wound). (pp 1041–1042)
7. Differentiate between a pneumothorax (open, simple, and tension) and hemothorax. (1041–1044)
8. Describe the complications of cardiac tamponade. (p 1045)
9. Describe the complications of rib fractures. (p 1045)
10. Describe the complications of a patient with a flail chest. (pp 1045–1046)

Skills Objectives

1. Describe the steps to take in the assessment of a patient with a suspected chest injury. (pp 1036–1039)
2. Demonstrate the management of a patient with a sucking chest wound. (pp 1041–1042)

Introduction

EMTs commonly encounter chest injuries. According to the Centers for Disease Control and Prevention (CDC), chest trauma causes more than 700,000 emergency department (ED) visits and more than 18,000 deaths in the United States annually. Given the location of the heart, lungs, and great blood vessels within the chest cavity, potentially serious injuries may occur. Chest injuries may be the result of blunt trauma, penetrating trauma, or both. Blunt trauma may occur from motor vehicle crashes or falls. Penetrating trauma may be due to shootings, stabbings, or other mechanisms, such as industrial or construction incidents.

Any injury that interferes with normal breathing must be treated without delay to minimize or prevent permanent damage to tissues that depend on a continuous supply of oxygen. Another major problem with chest injuries may be internal bleeding. Blood from lacerations of the thoracic organs or major blood vessels can collect in the chest cavity, compressing the lungs or heart. This may also occur when air collects in the chest and prevents the lungs from expanding. Your ability to act quickly to care for patients with these injuries can make the difference between a successful outcome and death.

This chapter begins with a review of the anatomy of the chest and the physiology of respiration. It then describes the common signs and symptoms of chest injuries and the proper emergency medical treatment for specific injuries.

Anatomy and Physiology

To understand and evaluate chest injuries in the prehospital setting, you must first understand the anatomy of the chest and the mechanism by which gases are exchanged during breathing. A quick review will help you understand the logic in the emergency treatment of chest injuries and the potential complications of that treatment.

A key point to remember is the difference between ventilation and oxygenation. Ventilation is the body's ability to move air in and out of the chest and lung tissue. This is described later in the section on mechanics of ventilation. Any injury that affects the patient's ability to move air in and out of the chest is serious and may be life threatening. Oxygenation is the process of delivering oxygen to the blood by diffusion from the alveoli following inhalation into the lungs. Oxygen must be delivered to the cells, and carbon dioxide (a waste product of cell function) must be removed from the body for proper organ system function.

The chest (thoracic cage) extends from the lower end of the neck to the diaphragm **Figure 29-1**. In a person who is lying down or who has just completed exhalation, the diaphragm may rise as high as the nipple line. Thus, a penetrating injury to the chest, such as a gunshot or stab wound, may also penetrate the lung and diaphragm and injure the liver or stomach.

The skin, muscle, and bones of the thoracic region have some unique features to allow for the ventilation process. Just under the normal three layers of skin, the epidermis, dermis, and subcutaneous layers, lies striated or skeletal muscle. This muscle extends between the ribs, forming the intercostal muscles. These muscles, innervated from the spinal nerves originating in the cervical region C6 and C7, allow the chest to expand on contraction and allow for the active portion of ventilation to occur. A patient who has sustained a spinal cord injury in that region may be unable to move the intercostal muscles and may breathe entirely with the diaphragm. Often called belly breathing, this is considered a clinical or positive diagnostic finding indicating cord damage at or above the level of C6 and C7. In very young children, the intercostal muscles are not yet developed. Children therefore have a tendency to breathe with their diaphragms. This is considered normal for this age group and does not typically indicate spinal cord injury.

YOU are the Provider — PART 1

At 1020 hours, you are dispatched to a construction site for a man with a chest injury. The caller, whose supervisor asked him to call 9-1-1, was unable to provide the dispatcher with the exact mechanism of injury. You respond to the scene, which is located about 5 miles away.

1. What major organs and structures lie within the chest cavity?
2. What injuries commonly result from blunt chest trauma? Penetrating chest trauma?

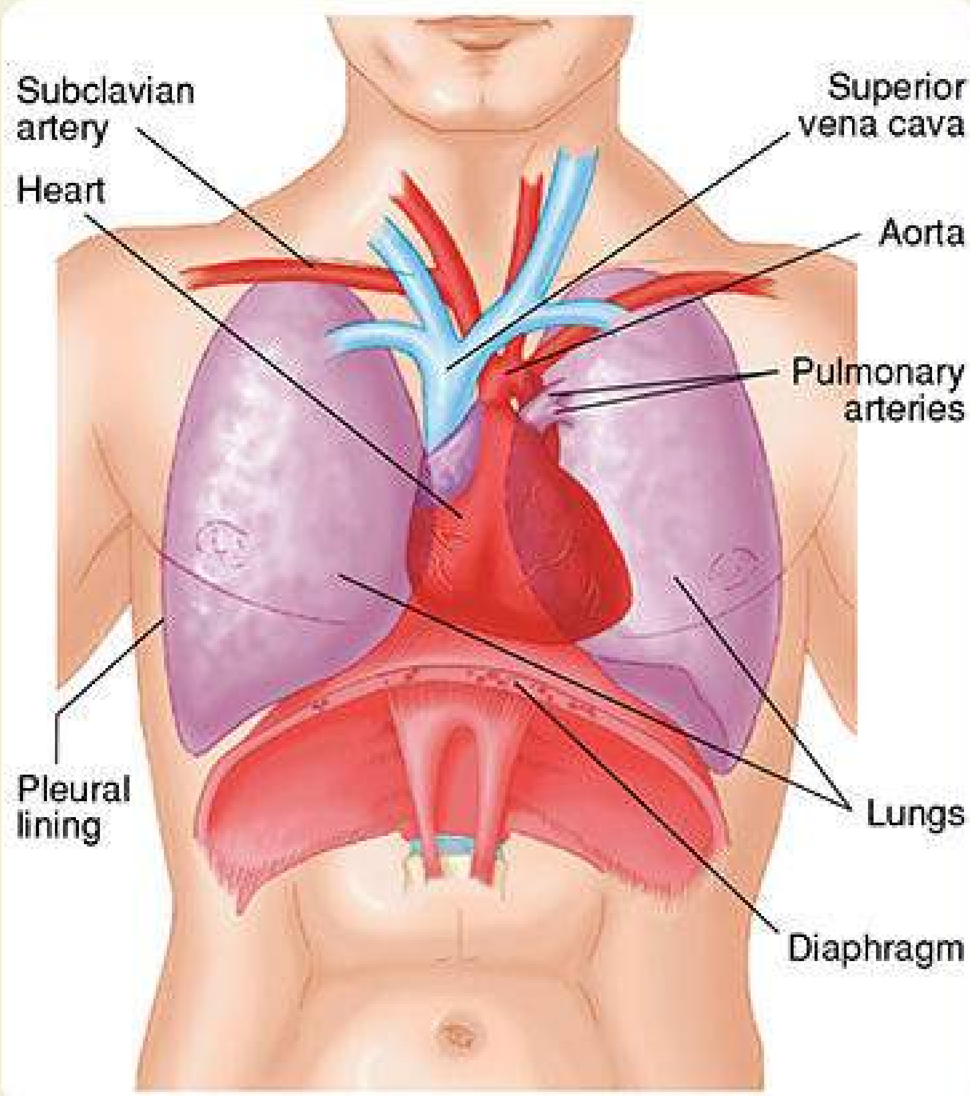

Figure 29-1 A view of the anterior aspect of the chest shows the major organs beneath the surface.

Lying close to each rib along the bottom (inferior) and slightly posterior to the lowest margin of each rib is the neurovascular bundle, composed of a network of nerves, arteries, and veins. Consider this structure when evaluating patients who have sustained rib fractures, because this may be a source of significant bleeding into the pleural space, creating a hemothorax. The ribs themselves create a protective and functional cage around the vital organs. Each side of the chest (hemithorax) contains lung tissue that is separated into lobes. The right lung has three lobes, and the left lung has two lobes. The left lobe formation allows space for the heart to reside; this is called the cardiac notch. A thin membrane called the pleura covers each of the lungs and the thoracic cavity. The inner chest wall has a lining called the parietal pleura, and a lining called the visceral pleura covers the lung. Between these two linings is a small amount of pleural fluid that allows the lungs to move freely against the inner chest wall as a person breathes. Pleural fluid also creates surface tension to allow the lungs to adhere to the rib cage, thus allowing the mechanics of ventilation to occur.

The contents of the chest are partially protected by the ribs, which are connected in the back to the vertebrae and in the front, through the costal cartilages, to the sternum **Figure 29-2**. The trachea, in the middle of the neck, divides into the left and right mainstem bronchi, which supply air to the lungs. The thoracic cage also contains the heart and the great vessels: the aorta, the right and left subclavian arteries and their branches, the pulmonary arteries, and the superior and inferior venae cavae. The esophagus runs through the back of the chest, connecting the pharynx above with the stomach and the abdomen below. The esophagus, trachea, and great vessels lie in the mediastinum, a cavity or space centrally located in the thorax. This location is where a thoracic aortic dissection can occur—a severing of the aorta that can occur when the body is exposed to traumatic forces. At the bottom of the chest, the diaphragm is a muscle that separates the thoracic cavity from the abdominal cavity.

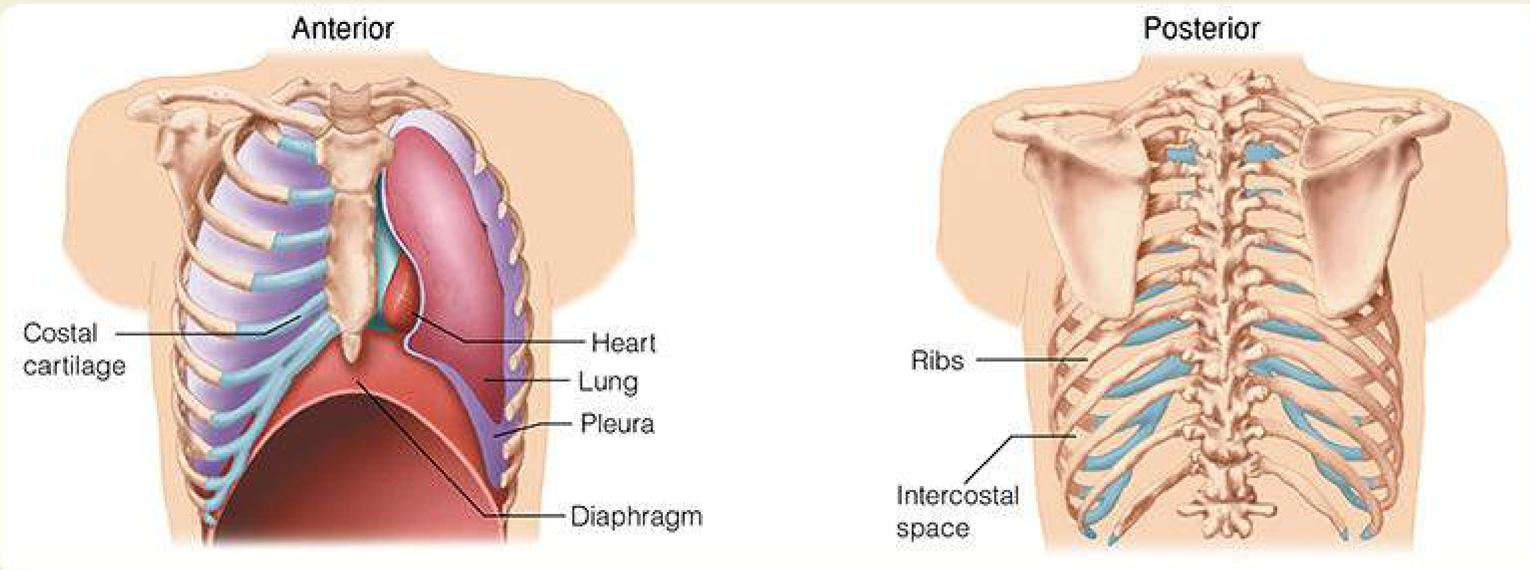

Figure 29-2 The organs within the chest are protected by the ribs, which are connected in back to the vertebrae and in front, through the costal cartilage, to the sternum.

Mechanics of Ventilation

When you inhale, the intercostal muscles between the ribs contract, elevating and expanding the rib cage. At the same time, the diaphragm contracts or flattens and pushes the contents of the abdomen down. The intrathoracic pressure inside the chest decreases, creating a negative pressure differential. Air then enters the lungs through the nose and mouth, which is the path of least resistance from the ambient air space to the upper and lower airway. When you exhale, the intercostal muscles and diaphragm relax, and the tissues move back to their normal positions, allowing air to be exhaled **Figure 29-3**. In a normal respiratory system, relaxation of the thoracic muscles and the diaphragm is a relatively passive function. Normal physiology dictates that the body should not have to work to breathe when in a resting state. When you are assessing the patient, you should be able to recognize when there is an increase in the work of breathing and equate that with respiratory distress and a life threat.

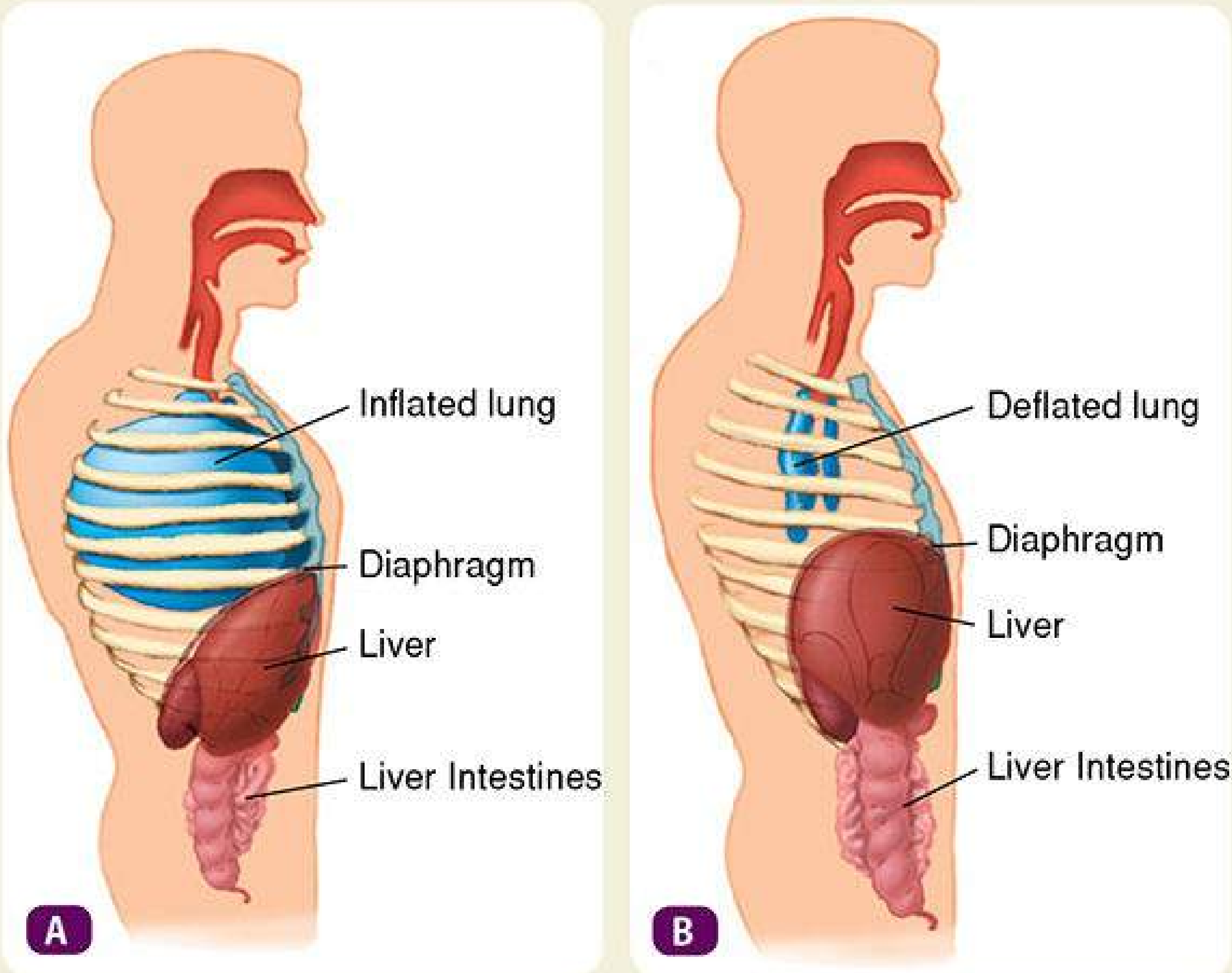

Figure 29-3 The anatomy of the thoracic cavity during inspiration **(A)** and expiration **(B)**.

A, B: © Jones & Bartlett Learning.

Note that the nerves supplying the diaphragm (the phrenic nerves) exit the spinal cord at C3, C4, and C5. Refer to Chapter 6, *The Human Body*, for a review of the spinal column. A patient whose spinal cord is injured below the C5 level may lose the power to move the intercostal muscles, but the diaphragm should still be able to contract. The patient will still be able to breathe because the phrenic nerves remain intact, but the injury may cause belly breathing. Patients with spinal cord injuries at C3 or above can lose their ability to breathe entirely **Figure 29-4**.

Figure 29-4 A patient who sustains a spinal cord injury below the level of C5 and is paralyzed can still breathe spontaneously because the phrenic nerves, which cause the diaphragm to contract, originate at the C3, C4, and C5 levels.

As discussed in Chapter 10, *Airway Management*, tidal volume is the amount of air in milliliters (mL) that is moved into or out of the lungs during a single breath. The average tidal volume for a man is approximately 500 mL. If you multiply this amount of air by the number of breaths/min, the result is called the minute ventilation or minute volume (the amount of air moved through the lungs in 1 minute). If you change either of these numbers (increase or decrease the rate or volume), then you can affect the amount of air moving through the system. For example, if you move 600 mL at the normal rate of 12 breaths/ min, then the minute volume is 7,200 mL (7.2 L). If you increase the ventilation rate by four extra breaths a minute, then the minute volume increases to 9,600 mL (9.6 L). Conversely, if the amount of tidal volume decreases, then the minute volume will drop along with it.

This information is important because if the patient is only able to inhale small amounts of air (in the case of a chest injury or a reactive airway pathology), the patient will need to exceed the normal respiratory rate range of 12 to 20 breaths/min to make up the difference in the minute volume. Remember that the average bag-valve mask (BVM) consists of a self-inflating bag that contains 1,000 to 1,500 mL of air. This device can quickly overinflate the lungs, causing gastric distention, and impair the function of the lungs. Overventilation can also increase intrathoracic pressure (pressure inside the chest), reducing cardiac output and potentially worsening chest injuries such as pneumothorax. In addition, there is the risk of causing acid-base imbalance and blood gas imbalance by "blowing off" carbon dioxide faster than the body needs to get rid of it.

Injuries of the Chest

Recall the discussion of kinematics in Chapter 24, *Trauma Overview*. There are two basic types of chest injuries: open and closed. As the name implies, a **closed chest injury** is one in which the skin is not broken. This type of injury is generally caused by blunt trauma, such as when a person strikes a steering wheel or an air bag in a motor vehicle crash, is struck by a falling object, or is struck in the chest by some object during a fight or physical assault **Figure 29-5**. These types of injuries often cause significant contusions in both the cardiac muscle (cardiac contusion) and the lung tissue (pulmonary contusion), thus impairing the function of those organs.

If the heart is damaged in this manner, it may not be able to refill with blood or blood may not be pumped with enough force out of the heart, creating a form of inadequate tissue oxygenation called cardiogenic shock. Any bruising of the lung tissue can result in exponential loss of the surface area where oxygen and carbon dioxide exchange occurs. This impairment can cause a decrease in available oxygen (hypoxia) and an increase in carbon dioxide in the blood (hypercarbia), leading to alterations of consciousness and possible death if not recognized and treated. Rib fractures create sharp broken bone ends that can lacerate lung tissue and cause further vessel damage with every movement of the chest wall. This type of bleeding can be hidden from external view and rapidly lead to hypovolemic shock.

Figure 29-5 Closed chest injuries usually result from blunt trauma, such as when a patient strikes the steering wheel or an air bag in a motor vehicle crash or is struck by a falling object. A closed chest injury can occur even when a seat belt is worn.

Courtesy of ED, Royal North Shore Hospital/NSW Institute of Trauma & Injury.

Words of Wisdom

The ability to pump blood depends on having a functional pump (the heart), an adequate volume of blood to be pumped, and an appropriate amount of resistance to the pumping mechanism. Collectively, these properties help determine cardiac output. Cardiac output is the volume of blood delivered to the body in 1 minute. Any injury that limits the heart's pumping ability, the delivery of blood to the heart, the blood's ability to leave the heart, or the heart rate will affect cardiac output.

An **open chest injury** is generally caused by penetrating trauma. Some object, such as a knife, a bullet, a piece of metal, or the broken end of a fractured rib, penetrates the chest wall itself **Figure 29-6**. The damage occurring from this type of trauma typically is instant. However, the symptoms of these injuries may take time to develop as the damaged vessels continue to bleed or the lung collapses from a puncture. Occasionally, the object that penetrates and creates an open chest injury remains in place. This is referred to as an impaled object. When you have a patient with an impaled object, do not attempt to move or remove the object because it may be occluding the hole in the vessel that has been punctured. If you remove the object, the patient may bleed heavily. Another reason to not remove the impaled object from the chest is that the objects that cause tissue damage on entry will likely cause damage on removal, resulting in further injury. The removal is best left for the surgeon. Any alteration from this standard should come directly from online medical control.

Figure 29-6 Open chest injuries occur when an object or the broken end of a fractured rib penetrates the chest wall.

In blunt trauma, a blow to the chest may fracture the ribs, the sternum, or whole areas of the chest wall, bruise the lungs and the heart, and even damage the aorta. Almost one-third of people who are killed immediately in car crashes die as a result of traumatic rupture of the aorta. Although the skin and chest wall are not penetrated in a closed injury, broken ribs may lacerate the contents of the chest. Damage to the chest wall structures may result in decreased ability of patients to ventilate on their own. Also, vital organs can be torn from their attachment in the chest cavity without any break in the skin; this condition can cause serious and life-threatening bleeding that is unseen outside the body.

Signs and Symptoms of Chest Injury

Important signs and symptoms of chest injury include:

- Pain at the site of injury
- Pain localized at the site of injury that is aggravated by or increased with breathing
- Bruising to the chest wall

YOU are the Provider — PART 2

You arrive at the scene and ensure it is safe. You are directed to the patient by a coworker. The patient, a 19-year-old man, was struck in the left side of the chest by a two-by-four board that was thrown from a table saw when another coworker was cutting it. You find the patient sitting on the ground; he is conscious and alert but restless and is experiencing respiratory distress. He tells you that it hurts to breathe.

Recording Time: 0 Minutes	
Appearance	Restless; obvious respiratory distress
Level of consciousness	Conscious and alert, but restless
Airway	Open; clear of secretions and foreign bodies

Breathing	Increased rate; labored
Circulation	Radial pulses, strong and rapid; skin, pink and moist; no obvious external bleeding

Your partner applies high-flow oxygen via nonrebreathing mask as you perform a secondary assessment. The patient denies any other injuries, and coworkers confirm that he did not lose consciousness.

3. How should you proceed with your secondary assessment?

- **Crepitus** (the sensation felt when broken bone ends grind together) with palpation of the chest
- Any penetrating injury to the chest
- Dyspnea (difficulty breathing, shortness of breath)
- Hemoptysis (coughing up blood)
- Failure of one or both sides of the chest to expand normally with inspiration
- Rapid, weak pulse and low blood pressure
- Cyanosis around the lips or fingernails

After a chest injury, any change in normal breathing is a particularly important sign. A healthy, uninjured adult usually breathes at a rate ranging from 12 to 20 breaths/min without difficulty and without pain. The chest should rise and fall in a symmetric pattern with each breath. Respirations of fewer than 12 breaths/min or of more than 20 breaths/min may indicate inadequate breathing. Patients with chest injuries often have **tachypnea** (rapid respirations) and shallow respirations because it hurts to take a deep breath. Note that the patient may be making breathing attempts but may not actually be moving air. Chest wall trauma may interfere with the ability to actually move air. Check the respiratory rate and see if there is actual air movement from the mouth and/or nose. This is best accomplished through the use of auscultation of multiple locations on the chest wall for adequate breath sounds.

As with any other injury, pain and tenderness are common at the point of impact as a result of a bruise or fracture. The normal process of breathing usually aggravates pain. Irritation of or damage to the pleural surfaces causes a characteristic sharp or sticking pain with each breath when these normally smooth surfaces slide on one another. This sharp pain is called *pleuritic pain*, or *pleurisy.*

In an injured patient, dyspnea, or difficulty breathing, has many causes, including airway obstruction, damage to the chest wall, improper chest expansion because of the loss of normal control of breathing, or lung compression because of accumulated blood or air in the chest cavity. Dyspnea in an injured patient indicates potential compromise of lung function; prompt, vigorous support of oxygenation and ventilation with prompt transport are required.

Hemoptysis, the spitting or coughing up of blood, usually indicates that the lung itself or the air passages have been damaged. With a laceration of the lung tissue, blood can enter the bronchial passages and is coughed up as the patient tries to clear the airway.

A rapid, weak pulse and low blood pressure are the principal signs of hypovolemic shock, which can result from extensive bleeding from lacerated structures within the chest cavity, where the great vessels and heart are located. Shock following a chest injury may also result from insufficient oxygenation of the blood by the poorly functioning lungs, from an increase in intrathoracic pressure from air or blood in the chest, or from direct injury to the heart itself.

Cyanosis in a patient with a chest injury is a sign of inadequate respiration. The classic blue or ashen gray appearance around the lips and fingernails indicates that blood is not being oxygenated sufficiently. Patients with cyanosis are unable to provide a sufficient supply of oxygen to the blood through the lungs and require immediate ventilation and oxygenation.

Many of these signs and symptoms occur simultaneously. When any one of them develops as a result of a chest injury, the patient requires prompt hospital care. Remember that the principal reason for concern about a patient who has a chest injury is that his or her body has no means of storing oxygen; it is supplied and used continuously, even during sleep. Any interruption in this supply can be rapidly lethal and must be treated aggressively.

Patient Assessment

Scene Size-up

As you arrive on the scene, observe for hazards and threats to the safety of the crew, bystanders, and the patient. Consider the possibility that the area where the patient is located may be a crime scene; therefore, make every attempt to not disturb potential evidence. Ensure that the police are on scene at incidents involving violence, such as assaults or gunshot wounds. Begin the encounter with scene safety as the highest priority. If you determine that power company, fire department, or advanced life support (ALS) units are needed, call for them early.

Ensure that you and your crew take standard precautions, and put on a minimum of gloves and eye protection. Put several pairs of gloves in your pocket for easy access in case your gloves tear or there are multiple patients with bleeding. Because of the color of blood and the fact that it easily soaks through clothing, you can often identify patients with bleeding as you approach the scene. However, darker clothing may mask signs of bleeding, so you must remain vigilant when the mechanism of injury (MOI) suggests the patient may be bleeding.

As you observe the scene, look for indicators and significance of the MOI. This helps you develop an early index of suspicion for underlying injuries in a patient who has sustained a significant MOI. Chest injuries are common in motor vehicle crashes, falls, industrial incidents, and assaults. Determine the number of patients, and consider spinal stabilization.

Words of Wisdom

Air bags can hide signs, such as seat belt marks, that would suggest that a significant force or blow occurred to the chest. Maintain a high degree of suspicion for severe injuries when an air bag has deployed.

Primary Assessment

During your primary assessment, you must quickly identify and treat potential life threats and determine priority of patient care and transport. Life-threatening hemorrhage, when present, should be addressed immediately, even before airway concerns.

As you approach, note the patient's level of consciousness. Responsive patients may be able to tell you their chief complaint. Note not only what they say, but also how they say it. Difficulty speaking may indicate several problems, and chest injury is an important one. Perform a rapid physical examination of the patient. Look for obvious injuries, the appearance of blood, and difficulty breathing. Look for cyanosis, irregular breathing, and chest rise and fall on only one side. Observe the neck, looking for accessory muscle use while breathing; also look for extended or engorged external jugular veins. If no obvious problems are seen, begin looking for them by focusing on the ABCs. The initial general impression will help you develop an index of suspicion for serious injuries and determine your sense of urgency for medical intervention. A good question to ask yourself is, "How sick is this patient?" Patients with significant chest injuries will "look" sick and are often frightened or anxious. Keep in mind that you are rapidly searching for life threats and you will repeat the physical examination in a more detailed manner later in the assessment if time and patient condition allow.

Addressing life threats begins with the assessment of airway and breathing unless life-threatening uncontrolled bleeding is seen. Ensure that the patient has a clear and patent airway. Normal breathing should be effortless, and any deviation from this pattern should be cause for concern. How you assess and manage the airway depends a great deal on whether you suspect a spinal injury. A significant number of patients with traumatic chest injuries also have spinal injuries, and proper precautions should be taken when blunt trauma is present. Be suspicious, and protect the spine early in your care. While you are considering immobilization of the cervical spine, note whether the jugular veins are distended. If you note this finding, it can be the result of a tension pneumothorax (significant ongoing air accumulation in the pleural space) or injury to the heart that allows bleeding into the pericardium, creating a cardiac tamponade, otherwise referred to as a pericardial tamponade.

Once you have determined the patient has a patent airway, determine whether breathing is present and adequate. With chest injuries, begin by inspecting for DCAP-BTLS, and look for equal expansion of the chest wall. Listen with a stethoscope to each side of the chest. Absent or decreased breath sounds on one side usually indicate significant damage to a lung, preventing it from expanding properly. Be alert to the pattern of symmetric rise and fall of the patient's chest wall. If the chest wall does not expand on each side when the patient inhales, the chest muscles may have lost their ability to work appropriately. Loss of muscle function may be the result of a direct injury to the chest wall, or it may be related to an injury of the nerves that control those muscles. Check also for **paradoxical motion**, an abnormality associated with multiple fractured ribs, in which one segment (often referred to as a flail segment) of the chest wall moves opposite the remainder of the chest; that is, out with expiration and in with inspiration.

If you determine the patient has penetrating trauma, address this life threat at once. This condition may interfere with the normal mechanics of breathing and can cause the patient's condition to worsen quickly. For quick initial care, you can use your gloved hand to occlude an open chest wound. When further dressings can be applied, apply an **occlusive dressing** to all penetrating injuries to the chest. Depending on local protocol, the dressing may be taped on three sides to allow air to escape during exhalation. Apply oxygen with a nonrebreathing mask at 15 L/min. Provide positive-pressure ventilation with 100% oxygen if breathing is inadequate based on the patient's level of consciousness and breathing rate and quality. Positive-pressure ventilation may be particularly important for the patient with a flail chest that compromises ventilation. However, positive-pressure ventilation overcomes the normal physiologic functions, and, if your patient has a pneumothorax (collapsed lung), you can quickly worsen the injury. Be diligent with auscultation of breath sounds, and evaluate the effectiveness of your ventilatory support with signs of circulation to the skin. Be aware of decreasing oxygen saturation (Spo_2) values because they may indicate the development of hypoxia. Watch for signs of an impending tension pneumothorax, such as increasingly poor compliance during ventilation (difficulty delivering breaths to the patient).

Assess the patient's pulse. Determine whether it is present and adequate. If the pulse is too fast or too slow, or if the skin is pale, cool, or clammy, consider your patient to be in shock. You need to treat aggressively to reverse the cause of shock and support the patient's circulatory system. In the early stage of shock, the body compensates for blood loss by increasing the heart rate. Be alert for this change, especially if tachycardia is still present beyond a few minutes after the initial adrenaline rush from the incident or injury. External bleeding may or may not be significant, but if it is considered life threatening, address this threat immediately. Bleeding inside the chest can be significant and, as discussed earlier, can be a quick cause of death. Control external bleeding with direct pressure and a bulky trauma dressing.

Priority patients are considered patients who have a problem with their airway, breathing, and/or circulation. Sometimes the priority is obvious, and the decision to transport quickly is also easy. At other times, what is happening outside the body may not provide obvious clues to the seriousness of what is happening inside the body. Pay attention to subtle clues such as the appearance of the skin, level of consciousness, or a sense of impending doom in the patient. These symptoms are not as grand as a large gash across the chest or air being sucked into the chest; however, they can be equally important indicators of a life-threatening condition. When you find signs of poor perfusion or inadequate breathing, transport quickly and perform the remainder of the assessment en route to the emergency department. A delay on the scene to perform a lengthy assessment will reduce the chances of survival for your patient. With chest injuries, when in doubt, transport rapidly to a hospital. Table 29-1 lists the "deadly dozen" chest injuries.

Table 29-1 Deadly Dozen Chest Injuries

1. Airway obstruction
2. Bronchial disruption
3. Diaphragmatic tear
4. Esophageal injury
5. Open pneumothorax
6. Tension pneumothorax
7. Massive hemothorax
8. Flail chest
9. Cardiac tamponade
10. Thoracic aortic dissection (leakage from a traumatic aneurysm of the portion of the aorta that lies within the chest)
11. Myocardial contusion
12. Pulmonary contusion

History Taking

Once you have identified and treated life threats, you can move on to gathering a history from the patient. If you have not yet done so, determine and investigate the patient's chief complaint and further investigate the MOI. Identify any associated signs and symptoms and pertinent negatives. If the patient was assaulted with a blunt object such as a bat, further evaluate the spinal region for injury because the force may have been transferred through the body from the point of impact. If the patient fell from a great height and is reporting chest discomfort or dyspnea, this may distract the patient from recognizing that he or she has fractures or is bleeding from the extremities. Palpation of the chest will typically cause direct pain at the site of the fracture. When a patient reacts to the pain, be certain to verify where the pain was located in relationship to the area being touched.

YOU are the Provider — PART 3

Your secondary assessment reveals bruising and crepitus on the left side of the chest and diminished breath sounds over that same side; no paradoxical chest wall movement is noted. The trachea is midline, and the jugular veins are nondistended. Your partner takes the patient's vital signs and reports them to you.

Recording Time: 5 Minutes	
Respirations	24 breaths/min; labored
Pulses	110 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	138/88 mm Hg
Oxygen saturation (Spo_2)	95% (on oxygen)

4. On the basis of your assessment findings, what injury or injuries should you suspect?
5. How should you proceed with your treatment of this patient?

Pertinent negatives when examining the chest include no associated shortness of breath, no rapid breathing, no absent or abnormal breath sounds, and no areas of deformity or abnormal movement. In a patient with a suspected spinal cord injury, equal expansion of the chest and movement of the rib cage and the diaphragm can confirm that there is nerve conduction to that region of the body.

Obtaining a SAMPLE history from a patient with a chest injury may not seem very important. Regardless, a basic evaluation of signs and symptoms, allergies, medications, pertinent medical history, including respiratory or cardiovascular disease, and last oral intake should be completed when time allows. The events leading to the emergency should also be identified. Questions about the events surrounding the incident should focus on the MOI: the speed of the vehicle or height of the fall, the use of safety equipment such as a helmet, air bag, seat belt, or life jacket, the type of weapon used, the number of penetrating wounds, and so on. A SAMPLE history can be obtained quickly in most situations and can certainly be obtained while accomplishing other tasks. However, if the patient has a loss of consciousness, it will no longer be possible to obtain the information.

Secondary Assessment

In a patient who has an isolated injury to the chest with a limited MOI, such as in a stabbing, you should focus your assessment on the isolated injury, the patient's chief complaint, and the body region affected. Ensure that wounds are identified and the bleeding is controlled. Note the location and extent of the injury. Assess all underlying systems. Examine the anterior and posterior aspects of the chest wall, and be alert to changes in the patient's ability to maintain adequate respirations.

It is important in patients with a chest injury not to focus only on a chest wound. With significant trauma, you should quickly assess the entire patient from head to toe. If there is significant trauma (such as a blunt trauma or gunshot wound) likely affecting multiple systems, start with a rapid physical examination of the body, looking for DCAP-BTLS to determine the nature and extent of thoracic injury. This examination will help to determine all of the injuries and the extent of the injuries. Inspection or visualization of the region looking for deformities, such as asymmetry of the left and right sides of the chest or shoulder girdle, may reveal the presence of multiple rib fractures, crush injuries, or significant chest wall injury. Identification of discrete areas of contusion or abrasion may pinpoint a specific point of impact. The presence of puncture wounds or other penetrating injuries indicates a possible open chest injury that should be managed accordingly. Be alert for associated burns, which may alter respiratory mechanics. Palpate for tenderness to localize the injury and the presence of fractures. Look for lacerations and local swelling. Application of this systematic approach to patient assessment minimizes the chance of missing a significant injury.

Once you have stabilized airway, breathing, and circulation problems and have checked the patient from head to toe to identify injuries, obtain a baseline set of vital signs. This activity should include assessment of pulse, respirations, blood pressure, skin condition, and pupils. Each of these is considered a sign indicating how your patient is tolerating the injuries. Consider these signs as a window to the functioning of the vital organs. This baseline set of vital signs will be used to evaluate changes in the patient's condition. Because patients with chest injury have so much potential for rapid deterioration, they should be reevaluated every 5 minutes or less. This will allow you to quickly recognize changes in the vital sign numbers or trends.

Special Populations

In older patients with reduced bone density or more fragile bones, even minor trauma to the chest wall can cause significant injury to the underlying tissues and organs. Older patients may have also sustained a number of fractures to the rib cage. Be alert for these injuries and for signs and symptoms of respiratory compromise, even in lower energy mechanisms of injury. Older patients also have a decreased amount of physiologic reserve and are likely to decompensate quickly following an injury.

If you find an accelerated pulse rate or respiratory rate, the chest injury may be causing either a decrease in available oxygen (hypoxia) or blood loss that results in a decreased number of red blood cells that can carry oxygen (hypoxemia). The increased respiratory rate is often associated with an obvious increase in work of breathing. This can be identified by noting increased use of the accessory muscles in the face, neck, and chest to assist in the movement of air. In the later stages of injuries, the pulse rate can slow as the myocardium becomes starved for oxygen and the body is no longer able to keep up with the demands. The respiratory rate may drop as the brain becomes starved for oxygen and overloaded with carbon dioxide and other waste products. These are usually signs of impending cardiopulmonary arrest. In the case of increasing pressure on the heart from the pleural space or the pericardial space, the blood pressure may exhibit a narrowing pulse pressure as the systolic and diastolic pressures come closer together. This is a result of the inability of the heart to fill with an adequate volume of blood and contract normally.

Reassessment

The reassessment identifies how your patient's condition is changing. It should focus on repeating the primary assessment, reassessing the chief complaint, and reassessing interventions performed. Reevaluate the patient's airway, breathing, pulse, perfusion, and bleeding. Has breathing improved now that the wound is sealed, or has it become more difficult? If assisting ventilations with a BVM, is it becoming increasingly difficult to deliver breaths to the patient? Other interventions should also be assessed to determine if they are effective. For example, are pulse oximeter values rising now that the patient is receiving oxygen? Reassess vital signs and compare them to vital signs taken earlier. Vital signs are a snapshot in time. They must be reassessed frequently to be able to trend the patient's status and determine if they are compensating versus decompensating. Does a drop in blood pressure and tachycardia indicate increasing pressure in the chest? Many chest injuries will worsen during transport to the hospital because of the seriousness of the injuries. An astute reassessment will help identify worsening conditions in a timely manner so that they can be addressed.

Provide appropriate spinal immobilization of any patient who has blunt trauma with suspected spinal injuries. Maintain an open airway, be prepared to suction the patient, and consider an oropharyngeal or nasopharyngeal airway. Whenever you suspect significant bleeding, provide high-flow oxygen. If needed, provide assisted ventilation using a BVM with high-flow oxygen. If significant bleeding is visible, you must control the bleeding. If you find penetrating trauma to the chest wall, place an occlusive dressing over the wound. Use caution to avoid increasing the work of breathing and pain. Be prepared to provide positive-pressure ventilation if the patient's efforts are not effective. If the patient has signs of hypoperfusion, treat aggressively for shock and provide rapid transport to the appropriate hospital. Do not delay transport of a seriously injured trauma patient to complete nonlifesaving treatments such as splinting extremity fractures; instead, complete these types of treatments en route to the hospital.

Communicating with hospital staff early when your patient has a significant MOI to the chest can help them be prepared with appropriate equipment and personnel when you arrive. If a penetrating injury is present, describe it in your report, along with what you have done to care for it. Your documentation should be complete and thorough. Describe all injuries and the treatment given. Remember, your documentation is your legal record of what happened.

Special Populations

In young children, the rib cage is very flexible and does not provide the same level of protection that the adult rib cage provides. This flexibility can allow any significant injury or compression of the rib cage to be masked because the ribs give way to the pressure and do not fracture. However, it is important to remember that the organs that underlie the rib cage have been exposed to that force and are likely injured. This flexibility of the ribs may result in fractures that are hidden on examination, and the only indication you may have of compromise is increased work of breathing or alterations in vital signs. This age group is often injured in pedestrian or bicycle collisions that involve vehicles. In auto-pedestrian collisions, children often turn toward the vehicle instead of away as adults do, thus resulting in direct impact to the chest by the bumper or hood. Children also may not be cognizant of height or distances and, therefore, may be prone to falls from distances greater than twice their height, resulting in severe trauma.

Complications and Management of Chest Injuries

Pneumothorax

In any chest injury, damage to the heart, lungs, great vessels, and other organs in the chest can be complicated by the accumulation of air in the pleural space. This is a dangerous condition called a **pneumothorax** (commonly called a collapsed lung). In this condition, air enters through a hole in the chest wall or the surface of the lung as the patient attempts to breathe, causing the lung on that side to collapse **Figure 29-7**. As a result, any blood that passes through the collapsed portion of the lung is not oxygenated, and hypoxia can develop. If the lung is collapsed past 30% to 40% you may hear diminished breath sounds on that side of the chest. Absent breath sounds are a significant finding in chest trauma and may indicate the development of a tension pneumothorax, discussed later. Depending on the size of the hole and the rate at which air fills the cavity, the lung may collapse in a few seconds or a few hours. In the uncommon situation when the hole is in the chest wall, you can hear a sucking sound as the patient inhales and the sound of rushing air as he or she exhales. For this reason, an open or penetrating wound to the chest wall is often called an **open pneumothorax** or a **sucking chest wound** **Figure 29-8**.

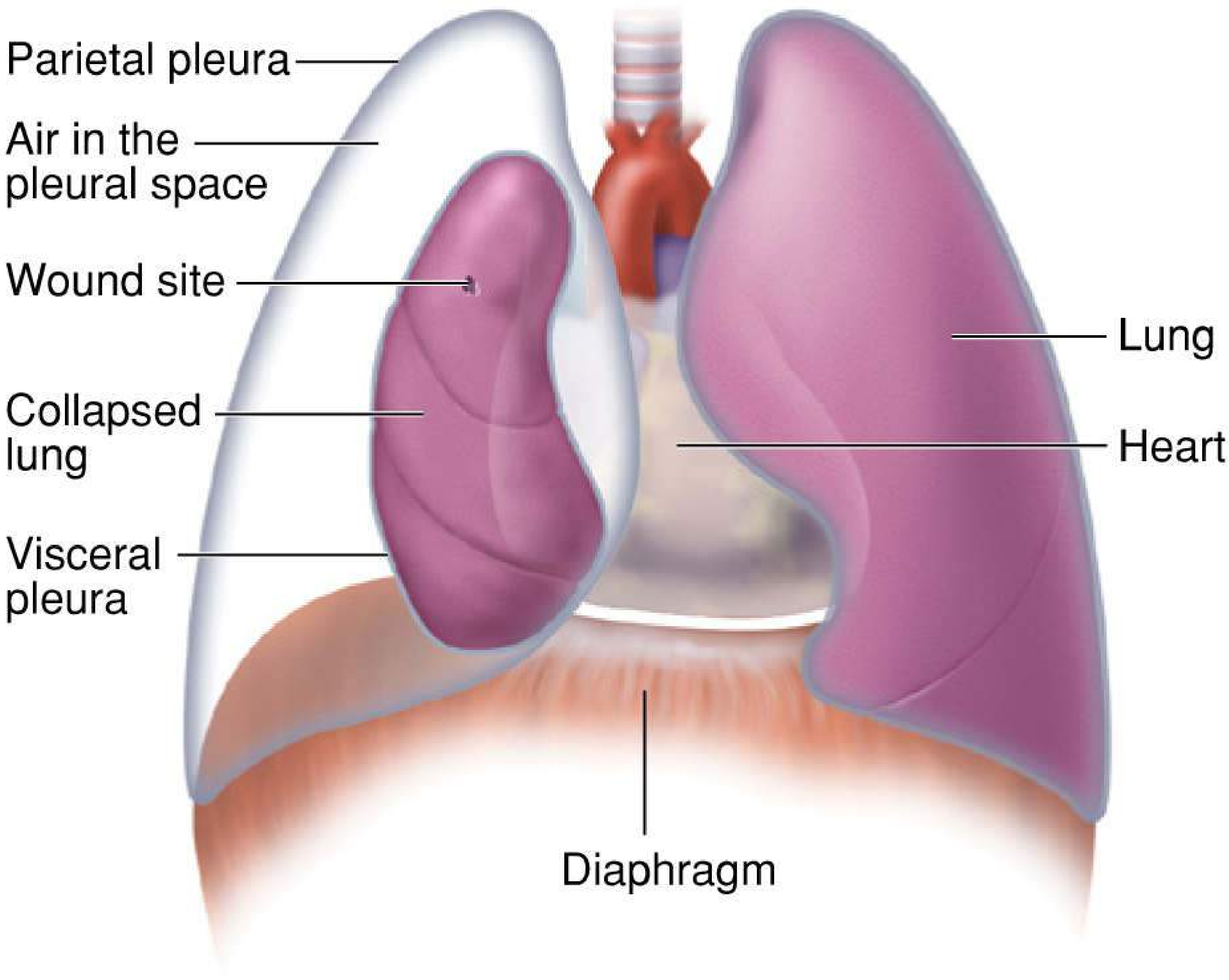

Figure 29-7 Pneumothorax occurs when air leaks into the space between the pleural surfaces from an opening in the chest wall or the surface of the lung. Air in the pleural space causes the lung to collapse.

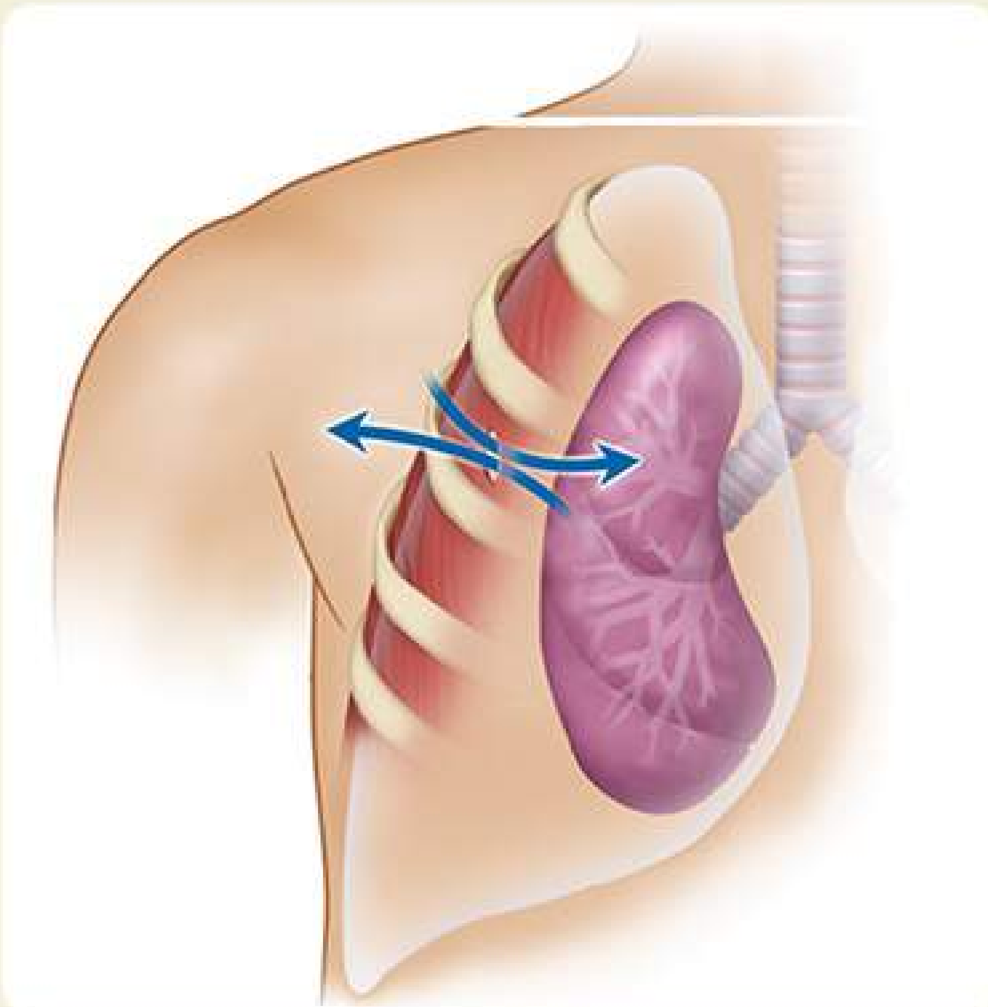

Figure 29-8 With a sucking chest wound, air passes from the outside into the pleural space and back out with each breath, creating a sucking sound.

This type of injury is a true emergency requiring immediate emergency medical care and transport. Initial emergency care, after clearing and maintaining the airway and then providing oxygen, is to rapidly seal the open wound with an occlusive dressing. The purpose of the dressing is to seal the wound and prevent air from being sucked into the chest through the wound. Two types of occlusive dressings are available: commercial vented occlusive dressings and improvised occlusive dressings that utilize petroleum jelly (Vaseline)-based gauze, aluminum foil, or plastic. Vented occlusive dressings contain a one-way valve, called a **flutter valve**, that allows air to leave the chest cavity but not return **Figure 29-9**. Follow local protocol and manufacturer's guidelines if you utilize such a dressing. An improvised occlusive dressing may be taped to the patient on only three sides of the dressing to simulate a flutter valve or taped on all four sides of the dressing, depending on your local protocol **Figure 29-10**. Regardless of which type of dressing you carry, use a dressing that is large enough so that it is not pulled or sucked into the chest cavity. Careful observation is required after the placement of an occlusive dressing. The occlusive seal or a clot in the injury may allow a tension pneumothorax to develop. If signs of a tension pneumothorax develop, it is suggested that the occlusive dressing be vented by opening it on one side to allow air to be released from the chest. Sometimes you may hear a sudden release of air pressure when you remove one side of the dressing. Adhere to standard precautions, and be aware that if there is clotting present, it may be expelled with the force of the buildup of pressure. This situation can develop even after a flutter valve has been applied.

Figure 29-9 A commercial occlusive dressing may be used to seal all four sides of a sucking chest wound. **A.** An Asherman Chest Seal, which is vented. **B.** A HALO Chest Seal, which is unvented.

Words of Wisdom

When you use an occlusive dressing to seal an open chest wound, record the type of material used, whether three or four sides were sealed, and any changes noted afterward: skin color, vital signs, breath sounds, and particularly the patient's level of anxiety.

Words of Wisdom

While pneumothorax is often discussed in the context of trauma, there are other potential causes, such as lung disease, **spontaneous pneumothorax**, or scuba diving injuries.

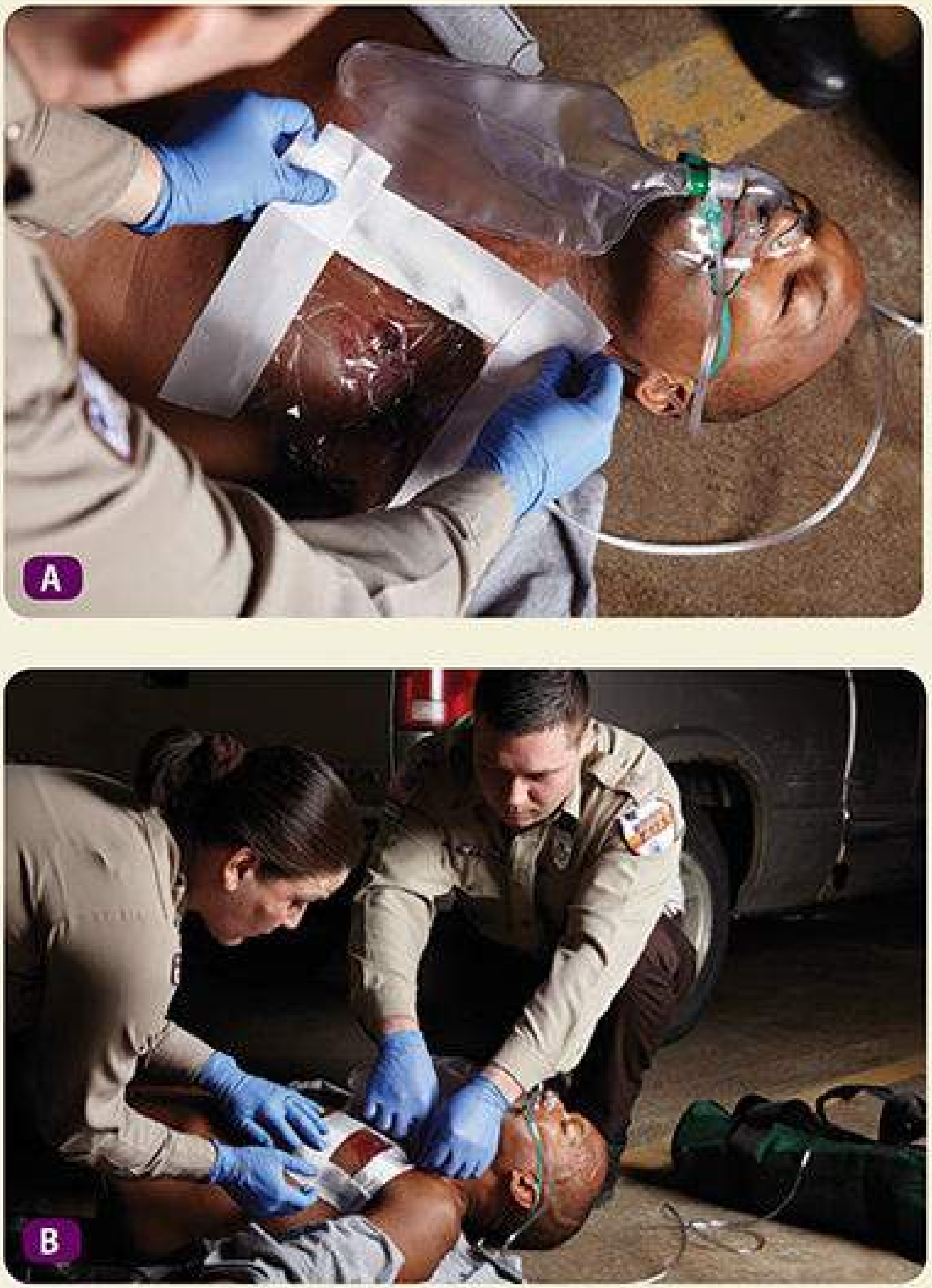

Figure 29-10 **A.** An improvised vented occlusive dressing seals three sides of a sucking chest wound, with the fourth left open as a flutter valve. **B.** Sealing the fourth side makes the dressing unvented, which limits drainage and air flow but increases the possibility of tension pneumothorax developing.

Simple Pneumothorax

Any pneumothorax that does not result in major changes in the patient's cardiac physiology is referred to as a **simple pneumothorax**. These are commonly the result of blunt trauma that results in fractured ribs. As in the spontaneous pneumothorax, the simple pneumothorax is often difficult to diagnose. The lung has to collapse a significant amount before the effects will be heard as decreased breath sounds. The more common findings are similar to other types of pneumothoraces: dyspnea or increased work of breathing exhibited as increased rate; tachypnea, and accessory muscle use; and decreasing oxygen saturation on the pulse oximeter. Another sign of pneumothorax can be a crackling sensation felt on palpation of the skin (also called *subcutaneous emphysema*), which indicates that air escaping from a lacerated lung is leaking into the tissues of the chest wall. Late findings can be decreased breath sounds on the injured side as well as lethargy and cyanosis. Be vigilant because the simple pneumothorax can often worsen or deteriorate into a tension pneumothorax or develop complications like bleeding or hemothorax. The treatment for a simple pneumothorax is much like any treatment for respiratory compromise; provide a high concentration of oxygen. Monitor oximeter readings and breath sounds, and treat underlying causes of the injury. As in all pneumothorax treatment, adding positive-pressure ventilation will cause the pathology to advance rapidly and possibly cause a tension pneumothorax to develop. However, you should not withhold positive-pressure ventilation if the patient needs the support. Simply be aware of the risk, and plan on how to resolve complications. Most patients with this problem require ALS intervention, so call for it early.

Words of Wisdom

Be cautious about providing positive-pressure ventilation to a patient with a suspected pneumothorax. The positive pressure may cause the size of the pneumothorax to increase. If the patient requires positive-pressure ventilation, you must provide it, but be certain to communicate your concerns about the underlying pneumothorax at the receiving hospital.

Tension Pneumothorax

A potential complication that may develop following chest injuries with pneumothorax is a **tension pneumothorax** **Figure 29-11**. This can occur when there is significant ongoing air accumulation in the pleural space. This air gradually increases the pressure in the chest, first causing the complete collapse of the affected lung and then pushing the mediastinum (the central part of the chest containing the heart and great vessels) into the opposite pleural cavity. This prevents blood from returning through the venae cavae to the heart, decreasing cardiac output, causing shock, and ultimately leading to death.

Tension pneumothorax occurs more commonly as a result of closed, blunt injury to the chest in which a fractured rib lacerates a lung or bronchus. Only very rarely does a tension pneumothorax arise spontaneously.

A patient with a tension pneumothorax will have chest pain, tachycardia, marked respiratory distress, and absent or severely decreased lung sounds on the affected side with signs of shock such as hypotension or altered mental status. The patient may also exhibit jugular vein distention (JVD), cyanosis, or tracheal deviation, but these signs are not always present. Jugular vein distention is best assessed for with the patient sitting at a 45-degree angle. Tracheal deviation, if seen, is a late and grave finding and is a sign that the patient requires immediate intervention.

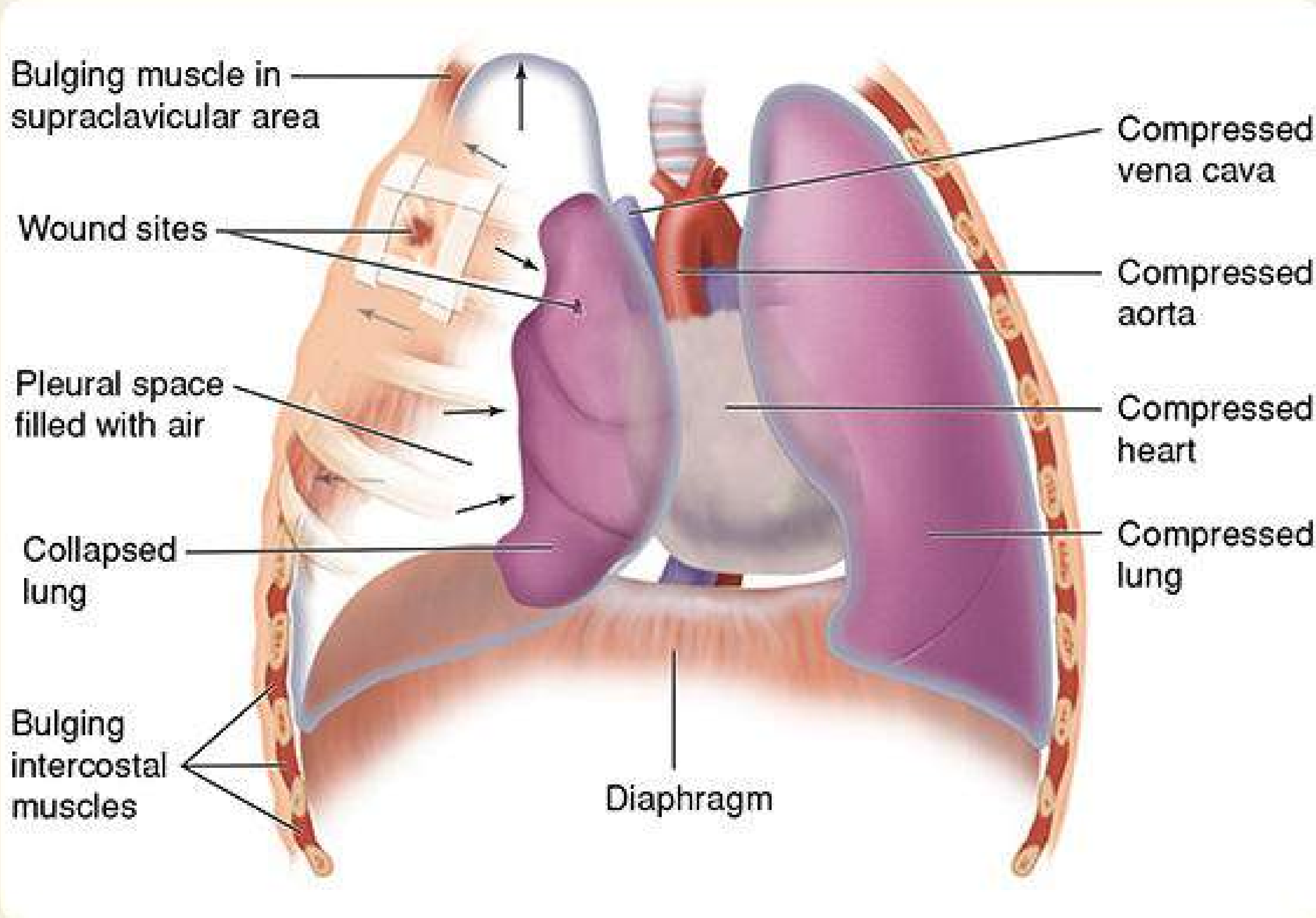

Figure 29-11 A tension pneumothorax can develop if a penetrating chest wound is bandaged tightly and air from a damaged lung cannot escape. The air then accumulates in the pleural space, eventually causing compression of the heart and great vessels. If a dressing sealed on four sides with no vent is used, monitor for signs of tension pneumothorax developing and prepare to vent one side of the dressing.

Relieving a tension pneumothorax that is the result of blunt trauma is often done by inserting a needle through the rib cage into the pleural space; however, this procedure typically is performed by ALS personnel or emergency department staff depending on local protocols. A tension pneumothorax is a life-threatening condition. Be prepared to support ventilation with high-flow oxygen, and request ALS support or transport immediately to the closest hospital.

Hemothorax

In blunt and penetrating chest injuries, blood can collect in the pleural space from bleeding around the rib cage or from a lung or great vessel. This condition is called a **hemothorax** **Figure 29-12**. Suspect a hemothorax if the patient has signs and symptoms of shock without any obvious external bleeding or apparent reason for the shock state, or decreased breath sounds on the affected side, an indication that the lung is being compressed by the blood. Because the bleeding is typically caused by severe damage within the chest cavity, there is virtually no way to control the bleeding in the prehospital setting. The only person who can treat this condition is a surgeon. The presence of air and blood in the pleural space is known as a **hemopneumothorax**. Again, because the injury has occurred within the walls of the chest, the treatment involves providing rapid transport to the nearest facility capable of performing surgery.

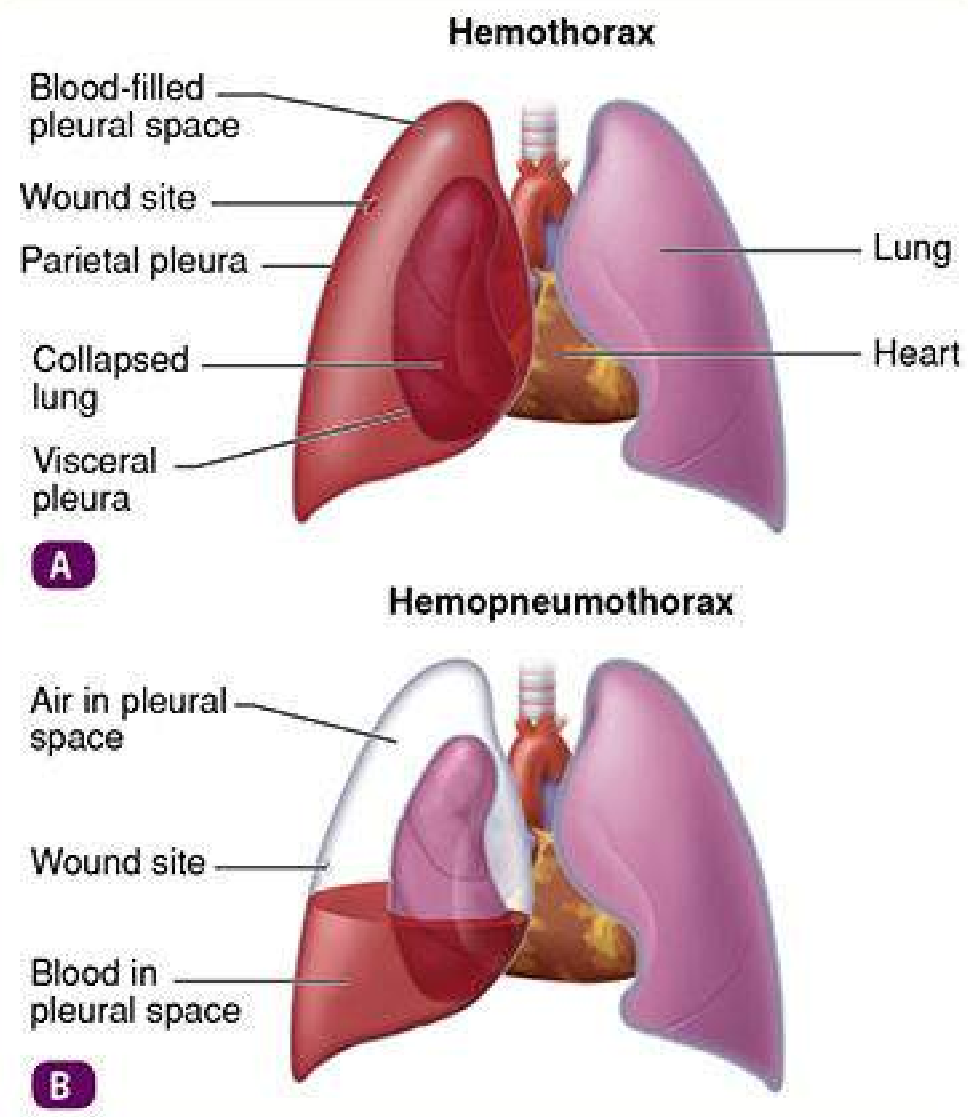

Figure 29-12 **A.** A hemothorax is a collection of blood in the pleural space produced by bleeding within the chest. **B.** When both blood and air are present, the condition is a hemopneumothorax.

YOU are the Provider PART 4

The patient is placed onto the stretcher and loaded into the ambulance. While continuing to provide high-flow oxygen via nonrebreathing mask, you reassess his condition and vital signs shortly before departing the scene.

Recording Time: 10 Minutes	
Level of consciousness	Conscious, but confused and restless
Respirations	28 breaths/min; labored and shallow
Pulse	124 beats/min; weak at the radial artery
Skin	Cool, clammy, and pale; cyanosis around the mouth
Blood pressure	104/58 mm Hg
Spo_2	88% (on oxygen)

Breath sounds are now inaudible on the entire left side of his chest, and you note that cyanosis is developing around his mouth. His jugular veins appear somewhat distended, and his trachea is midline. The closest appropriate facility is about 10 minutes away, so you instruct your partner to begin transport at once.

6. What is most likely happening to your patient?
7. Should you adjust your current treatment? If so, how?

Cardiac Tamponade

Cardiac tamponade (pericardial tamponade) occurs more commonly in the presence of penetrating chest trauma, although it may occur in blunt trauma. Cardiac tamponade occurs when the protective membrane around the heart (**pericardium**), the pericardial sac, fills with blood or fluid, perhaps from a ruptured, torn, or lacerated coronary artery or vein **Figure 29-13**. The pericardial sac can also fill as a result of cancer or an autoimmune disease such as lupus. As the fluid amount increases, the heart is less able to fill with blood during each relaxation phase. As a result, the heart cannot pump an adequate amount of blood and the patient experiences a decrease in systemic blood flow, or cardiac output. The signs of this condition are often subtle until the situation is dire. The signs and symptoms, referred to as Beck's Triad, include distended or engorged jugular veins seen on both sides of the trachea, a narrowing pulse pressure (the difference between the systolic and diastolic blood pressure numbers), and muffled heart sounds. An associated and more commonly noticed sign is a decrease in mental status as blood flow decreases to the brain. The heart muscle is unique in that it needs to be stretched to create a good contraction to pump blood out of the ventricles. This mechanism can fail because of tamponade and can be directly related to a decrease in blood returning to the heart from a loss of blood or from some blockage of the returning veins. Because this injury is inaccessible, your role in treatment is supportive. Oxygen should never be withheld from a patient who needs it; provide positive-pressure ventilation to any patient who is hypoventilating or apneic. Rapidly transport the patient to a facility that is capable of intervention.

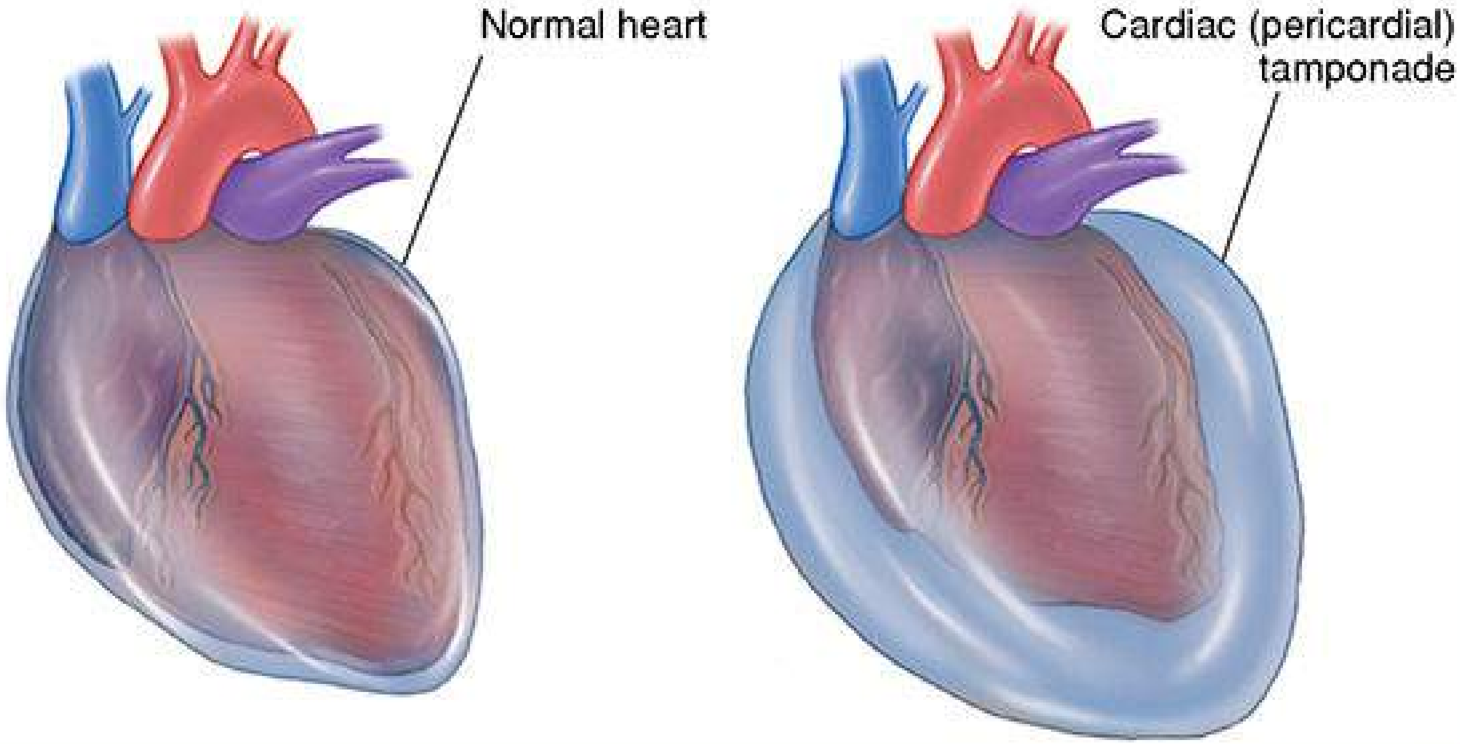

Figure 29-13 Cardiac pericardial tamponade is a potentially fatal condition in which fluid builds up within the pericardial sac, causing compression of the heart's chambers and dramatically impairing its ability to pump blood to the body.

Words of Wisdom

In a trauma situation, even a small amount of fluid in the pericardial sac is enough to cause fatal pericardial tamponade. (Occasionally, fluid in surprisingly large amounts may collect in the pericardial sac as a result of chronic medical conditions like cancers and autoimmune diseases, or due to infection.)

Rib Fractures

Rib fractures are very common, particularly in older people, whose bones are brittle. Because the upper four ribs are well protected by the bony girdle of the clavicle and scapula, a fracture of one of these upper ribs is a sign of a very substantial MOI.

Be aware that a fractured rib that penetrates into the pleural space may lacerate the surface of the lung, causing a pneumothorax, a tension pneumothorax, a hemothorax, or a hemopneumothorax.

Patients with one or more cracked ribs will report localized tenderness and pain when breathing. The pain is the result of broken ends of the fracture rubbing against each other with each inspiration and expiration. Patients will tend to avoid taking deep breaths, and their breathing will be rapid and shallow instead. They will often hold the affected portion of the rib cage in an effort to minimize the discomfort. Patients with rib fractures should receive supplemental oxygen during assessment and transport if they are experiencing any respiratory distress.

Flail Chest

Ribs may be fractured in more than one place. If three or more ribs are fractured in two or more places or if the sternum is fractured along with several ribs, a segment of chest wall may be detached from the rest of the thoracic cage Figure 29-14. This condition is known as **flail chest**. In what is called paradoxical motion, the detached portion of the chest wall moves opposite of normal: It moves in instead of out during inhalation and out instead of in during exhalation. This occurs because of negative pressure that has built up in the thorax. Breathing with a flail chest can be painful and ineffective, and hypoxemia easily results. A flail segment seriously interferes with the body's normal mechanics of ventilation and must be addressed quickly. Paradoxical motion is a late sign of flail segment; therefore, an absence of paradoxical motion does not mean the patient does not have a flail segment.

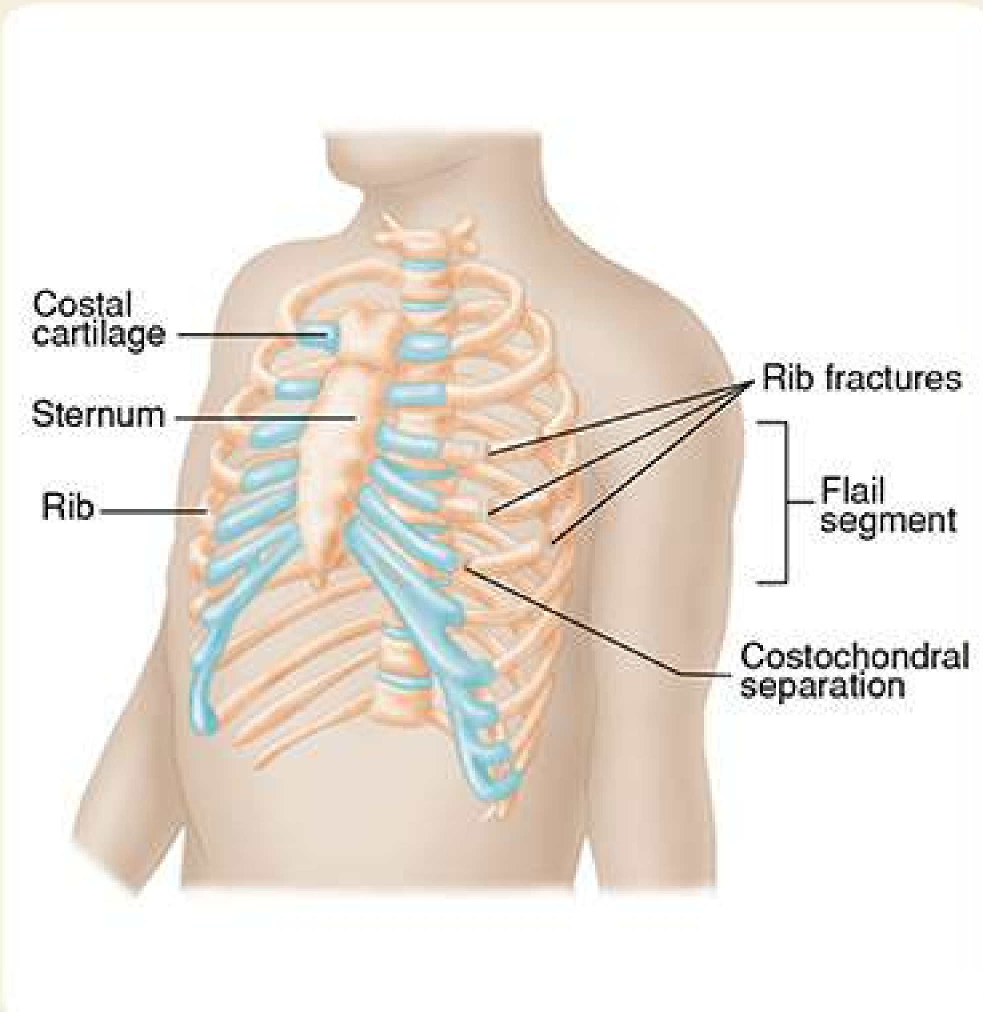

Figure 29-14 When three or more adjacent ribs are fractured in two or more places, a flail chest results. A flail segment will move paradoxically when the patient breathes.

Treatment of a patient with a flail chest should include maintaining the airway, providing respiratory support if necessary, giving supplemental oxygen, and performing ongoing assessments for possible pneumothorax or other respiratory complications. Treatment may also include positive-pressure ventilation with a BVM. In the past, treatment included splinting of the flail segment with bulky dressings. However, restricting chest wall movement is no longer recommended and positive-pressure ventilation is now preferred.

Keep in mind that although flail chest itself is a serious condition, it suggests an injury that was forceful enough to cause other serious internal damage and possible spinal injury. Often the flail chest contributes less to the patient's ventilation difficulties than does the underlying pulmonary contusion (bruised lung segment).

YOU are the Provider — PART 5

You call for ALS support but find out that the closest unit is 15 miles away, so you elect to continue treatment and transport. After reassessing the patient's condition, you have your partner call a radio report to the receiving facility.

Recording Time: 15 Minutes	
Level of consciousness	Conscious, but confused and restless
Respirations	28 breaths/min; labored and shallow
Pulse	128 beats/min; weak at the radial artery
Skin	Cool and clammy; cyanosis around the mouth
Blood pressure	90/60 mm Hg
Spo_2	92% (on oxygen)

You arrive at the hospital and find a physician and nurse waiting for you in the ambulance bay. The patient is quickly taken into a treatment room, where further assessment is performed. After the physician performs a needle thoracentesis, the patient's condition improves. After returning to service, you follow up with the hospital and learn that the patient had a tension hemopneumothorax.

8. What is a tension hemopneumothorax?
9. Should you attempt to distinguish a tension pneumothorax from a tension hemopneumothorax? Why or why not?

Other Chest Injuries

Pulmonary Contusion

In addition to fracturing ribs, any severe blunt trauma to the chest can also injure or bruise the lung. The pulmonary alveoli become filled with blood, and fluid accumulates in the injured area, leaving the patient hypoxic. Severe **pulmonary contusion** should always be suspected in patients with a flail chest and usually develops over a period of hours. If you believe that a patient may have a pulmonary contusion, provide supplemental oxygen and positive-pressure ventilation as needed to ensure adequate oxygenation and ventilation.

Other Fractures

In addition to the rib fractures you have already learned about, there are other types of fractures that should be discussed.

Sternal Fractures

Any suspected fracture of the sternum should increase your index of suspicion for injuries to the underlying organs because the amount of force required to break the sternum is significant. There may be involvement of the lungs, great vessels, and the heart itself.

Clavicle Fractures

Whereas this fracture is also covered under skeletal injuries, it is important to mention here that the clavicle overlies and protects a large neurovascular bundle (nerve, artery, and vein) that can be significantly damaged or disrupted should injury to the clavicle occur. The pain, deformity, and swelling that accompany a clavicle fracture can also detract from assessment of the first and second ribs in proximity to the fracture. Suspect upper rib fractures in medial clavicle fractures, and be alert to possible signs of pneumothorax development.

Traumatic Asphyxia

Sometimes a patient will experience a sudden, severe compression of the chest, which produces a rapid increase in pressure within the chest. This may occur in an unrestrained driver who hits a steering wheel, a pedestrian who is compressed between a vehicle and a wall, or a patient who is pinned under a vehicle. The sudden increase in intrathoracic pressure results in a characteristic appearance, including distended neck veins, cyanosis in the face and neck, and hemorrhage into the sclera of the eye, signaling the bursting of small blood vessels **Figure 29-15**. This is called **traumatic asphyxia**. These findings suggest an underlying injury to the heart and possibly a pulmonary contusion. Provide ventilatory support with supplemental oxygen and monitor the patient's vital signs as you provide immediate transport.

Figure 29-15 Traumatic asphyxia.

Blunt Myocardial Injury

Blunt trauma to the chest may injure the heart itself, making it unable to maintain adequate blood pressure. There is much debate in the medical literature about how to assess **myocardial contusion**, or bruising of the heart muscle. Often the pulse is irregular, but dangerous rhythms such as ventricular tachycardia and ventricular fibrillation are uncommon. There is no specific diagnostic test at this time, and there is no prehospital treatment for the condition. Still, you should suspect myocardial contusion in all cases of severe blunt injury to the chest. Carefully check the patient's pulse, and note any irregularities. Also note any change in blood pressure because this can be a direct result of the injury to the myocardium. Often the patient's signs and symptoms can mimic a heart attack in which the patient may report chest pain or discomfort that is similar in nature to cardiac symptoms. Provide supplemental oxygen, and transport immediately.

Commotio Cordis

Commotio cordis is a blunt chest injury caused by a sudden, direct blow to the chest (over the heart) that occurs only during a critical portion of a person's heartbeat. The result may be immediate cardiac arrest. This phenomenon has occurred after patients were struck with softballs, baseballs, bats, snowballs, fists, and even kicks during kickboxing. The force of the blow to the chest is commonly at speeds of 35 to 40 miles per hour. The blunt force causes a lethal abnormal heart rhythm called ventricular fibrillation. The ventricular fibrillation responds positively to early defibrillation if provided within the first 2 minutes after the injury. Commotio cordis is more commonly associated with sports-related injuries, although it should be suspected in all cases in which the person is unconscious and unresponsive after a blow to the chest. Due to the risk of commotio cordis in sports, many youth baseball and softball leagues now recommend or require the use of chest protectors.

Laceration of the Great Vessels

The chest contains several large blood vessels: the superior vena cava, the inferior vena cava, the pulmonary arteries, four main pulmonary veins, and the aorta, with its major branches distributing blood throughout the body. Injury to any of these vessels may be accompanied by massive, rapidly fatal hemorrhage. Any patient with a chest wound who shows signs of shock may have an injury to one or more of these vessels. Frequently, significant blood loss is unseen because it remains within the chest cavity. Remain alert to signs and symptoms of shock and to changes in the baseline vital signs, such as tachycardia and hypotension.

Words of Wisdom

Transection of the aorta may cause up to 15% of deaths from motor vehicle crashes. Given that the body's entire blood volume passes through this vessel, the high mortality associated with such an injury comes as no surprise. Aortic injuries are rapidly fatal, often causing cardiac arrest prior to hospital arrival, or even prior to arrival of EMS. Most of the people who are still alive when EMS personnel arrive can survive with prompt management, including surgical intervention.

Emergency treatment in these cases includes cardiopulmonary resuscitation, if appropriate, ventilatory support, and supplemental oxygen. Immediate transport to the hospital may be critical. Occasionally, some of the patients can be treated. The overwhelming majority of injuries to the great vessels in the chest are rapidly fatal.

YOU are the Provider — SUMMARY

1. What major organs and structures lie within the chest cavity?

Critical organs and structures in the chest cavity include the trachea, large bronchi, lungs, great vessels (eg, aorta, venae cavae), heart, esophagus, and the left and right subclavian arteries and their branches. The heart, trachea, great vessels, and a portion of the esophagus reside within the mediastinum—the space between the lungs.

Each side of the chest (hemithorax) contains lung tissue that is separated into lobes. The right lung has three lobes, and the left lung has two lobes to allow space for the heart. The space in the left hemithorax where the heart resides is called the cardiac notch.

A thin lining called the visceral pleura covers the lungs, and the parietal pleura covers the inner chest wall. A small amount of pleural fluid is found between the pleurae. The space in between the visceral and parietal pleurae—the pleural space—is a potential space because the pleurae are in direct contact with each other. However, if trauma occurs to the lungs, blood or air could accumulate between the two pleurae, creating an actual space.

2. What injuries commonly result from blunt chest trauma? Penetrating chest trauma?

Blunt (closed) chest trauma occurs when an object strikes the chest (eg, a steel pipe during an assault) or when the chest strikes an object (eg, chest impacts the steering wheel during a car crash). The severity of the injury depends on the amount of energy that the chest wall absorbs. Although the skin and chest wall are not penetrated by blunt force trauma, injury to the intrathoracic organs may be severe.

Rib fractures are a common injury associated with blunt chest trauma. In some cases, a single rib is fractured; in other cases, several ribs are fractured in more than one place (flail chest). A flail chest can impair ventilation because the section of fractured ribs collapses and puts pressure on the lung during inhalation. A fractured rib can also perforate an internal chest organ, such as the lung, causing air to leak out of the lung and into the pleural space (pneumothorax). If air moves freely between the pleural space and lung, the injury is called a simple pneumothorax. In a tension pneumothorax, the lung is completely collapsed, and the heart and great vessels (eg, aorta, venae cavae) are compressed as pressure shifts across the mediastinum. This causes ventilatory compromise, decreased cardiac output, and shock. A hemothorax, which may be caused by blunt or penetrating chest trauma, occurs when blood, rather than air, fills the pleural space.

Blunt force chest trauma can also cause bruising of the lung (pulmonary contusion) or the heart muscle (myocardial contusion). Other injuries include shearing injuries of the aorta, traumatic asphyxia, and commotio cordis.

In a penetrating (open) chest injury, the chest wall itself is penetrated by an object such as a knife or bullet, resulting in injury to vital organs in the thoracic cavity. Two common injuries caused by penetrating chest trauma are sucking chest wounds (open pneumothorax) and cardiac (pericardial) tamponade. Sucking chest wounds cause various degrees of ventilatory compromise, depending on the size of the hole in the chest wall. As a result of cardiac tamponade, the amount of blood pumped decreases and the patient will experience shock from a decrease in systemic blood flow.

3. How should you proceed with your secondary assessment?

For patients with an isolated injury, your secondary assessment should focus on that area of the body—in this case, the chest and adjacent structures.

Expose the patient's chest, and assess for obvious signs of injury, such as bruising, lacerations, or abrasions. Observe the chest wall for symmetry. Asymmetrical chest movement indicates decreased airflow into one lung. Look for any sections of the rib cage that collapse during inhalation and bulge during exhalation (paradoxical chest movement); this indicates a flail chest injury.

Palpate the chest wall to determine if it is stable, if there are any deformities, or if you feel crepitus—the sensation felt when broken bone ends grind together. Chest wall crepitus is a clear indicator of one or more fractured ribs.

Auscultate the apices (top) and bases (bottom) of both lungs. Decreased or absent breath sounds over the injured side of the chest indicate decreased or absent airflow into that lung and should immediately increase your index of suspicion for a pneumothorax.

Based on the mechanism of injury—blunt chest trauma—you should also assess the trachea and jugular veins. Note whether the trachea is in the midline position or if it appears to be deviated to one side or the other. Bear in mind that if the patient has a tension pneumothorax, tracheal deviation is an extremely late sign; a midline trachea does not rule out such an injury. Observe the jugular veins to determine if they appear to be normal, distended, or flat. Jugular vein distention is best assessed with the patient sitting at a 45-degree angle. The presence of jugular vein distention in the context of chest trauma suggests a tension pneumothorax or cardiac tamponade, although it is often not present until the injury is well progressed. Conversely, collapsed jugular veins suggest a hemothorax or shock.

Further assessment beyond that discussed is based on any other symptoms the patient may report and any obvious injuries that you observe.

4. On the basis of your assessment findings, what injury or injuries should you suspect?

On the basis of the mechanism of injury—blunt trauma to the chest—and the findings of your primary and secondary assessments, you should suspect that your patient has rib fractures and a pneumothorax. He has obvious chest wall bruising, labored breathing, crepitus to palpation (indicates at least one fractured rib), and diminished breath sounds on the same side that the injury occurred.

Depending on the size of the lung perforation and the rate at which air fills the pleural space, the lung may collapse in a few seconds or a few hours. Breath sounds on the injured side are diminished because the collapsing lung is not fully expanding during inhalation.

Because a pneumothorax impairs oxygenation and ventilation, begin treatment immediately and prepare for rapid transport to the hospital. If the lung on the injured side collapses totally, pressure will shift to the opposite side of the chest—compressing the heart, aorta, and venae cavae in the process—and begin collapsing the unaffected lung; this condition is called a tension pneumothorax and is an immediately life-threatening condition that can result in profound shock and cardiac arrest.

5. How should you proceed with your treatment of this patient?

Patients with a pneumothorax need high-flow oxygen, continual close monitoring, and prompt transport to the hospital.

Be especially concerned about the adequacy of the patient's breathing, and continuously monitor it. Your patient is tachypneic, which is common in patients with chest injuries; his respirations are labored, and it hurts when he breathes. Patients with chest injuries often breathe shallowly on purpose in an attempt to minimize the pain (respiratory splinting). It may be helpful to allow the patient to hold a pillow or similar object to his chest; this will help stabilize any rib fractures and may make it easier for him to breathe.

If his respirations become too shallow (indicating a marked tidal volume reduction), he will not move adequate amounts of air into his lungs during inhalation; this will only worsen any hypoxemia that already exists from the pneumothorax itself. If this occurs, begin assisting his ventilations with a BVM attached to high-flow oxygen. Other signs of inadequate breathing, which may also necessitate assisted ventilations, include a falling oxygen saturation (despite administration of high-flow oxygen), cyanosis, and a decreasing level of consciousness.

Continue to monitor the patient's level of consciousness and vital signs. If he begins experiencing signs of shock (decreased level of consciousness, pallor, weak pulses, hypotension), suspect a developing tension pneumothorax. If this occurs, consider an ALS intercept, if possible. Paramedics can perform a needle thoracentesis (also called a chest decompression). If an ALS ambulance is not available, continue rapid transport, frequently reassess the patient, and notify the receiving facility as early as possible.

6. What is most likely happening to your patient?

Compared with previous assessments, your patient's clinical condition has obviously deteriorated. He is now confused; is more tachypneic; his respirations are still labored, but are now shallow; cyanosis is developing around his mouth (perioral cyanosis); his radial pulses are weak; and his oxygen saturation has fallen to 88% despite high-flow oxygen via nonrebreathing mask. Although his systolic blood pressure is still above 100 mm Hg, compared with your previous reading of 138/88 mm Hg, this is a significant decrease. The patient's signs and symptoms indicate worsened hypoxemia and hypoperfusion (shock).

The additional signs of inaudible (absent) breath sounds on the injured side of his chest and the appearance of jugular vein distention indicate that the entire left lung has collapsed, and pressure is now shifting across the mediastinum toward the unaffected lung. Your patient now has a tension pneumothorax!

7. Should you adjust your current treatment? If so, how?

A tension pneumothorax is an immediate life threat and requires aggressive treatment.

The patient now has clear evidence of inadequate breathing (decreased level of consciousness [confusion]; falling oxygen saturation; labored, shallow breathing; and cyanosis), which is causing inadequate oxygenation and ventilation. Begin assisting his ventilations with a BVM. In doing so, however, exercise caution; ventilating too rapidly or with too much force could worsen his condition.

You must also initiate shock treatment. At a minimum, cover the patient with a blanket to keep him warm. Patients with any injury or condition that impairs their ability to breathe are often resistant to being placed in a supine position; this is especially true if they are conscious. If the patient becomes unconscious, however, place him in a supine position and continue to assist his ventilations.

Patients with a tension pneumothorax need an immediate needle thoracentesis (chest decompression). If it will not delay your transport time (you are only 10 minutes away from the hospital), intercept an ALS unit, if possible. Otherwise, notify the receiving facility, continue ventilation assistance and shock treatment, and get the patient to the emergency department as soon as possible.

8. What is a tension hemopneumothorax?

In some cases, when a fractured rib perforates a lung, blood from the injured lung also accumulates in the pleural space; this is called a hemopneumothorax because the pleural space contains both blood and air. The amount of blood that accumulates in the pleural space depends on the size and severity of the lung injury.

As blood and air continue to accumulate in the pleural space, the lung on the injured side collapses and pressure shifts across the mediastinum toward the uninjured lung. In a tension hemopneumothorax, the patient experiences respiratory impairment from both blood and air in the pleural space, but also experiences internal blood loss of varying severity.

9. Should you attempt to distinguish a tension pneumothorax from a tension hemopneumothorax? Why or why not?

It is impractical to attempt to distinguish a tension pneumothorax from a tension hemopneumothorax in the prehospital setting. Both conditions cause impaired ventilation and perfusion; this is what you should focus on when treating the patient. Provide high-flow oxygen, assist ventilations as needed, initiate shock treatment, and transport without delay.

Attempting to distinguish one injury from the other may only delay treatment and transport, thereby increasing the chance of a negative outcome.

EMS Patient Care Report (PCR)

Date: 11-5-16	**Incident No.:** 012709	**Nature of Call:** Chest injury		**Location:** 233 Indian Hills Dr.	
Dispatched: 1020	**En Route:** 1020	**At Scene:** 1028	**Transport:** 1035	**At Hospital:** 1045	**In Service:** 1053

Patient Information

Age: 19
Sex: M
Weight (in kg [lb]): 66 kg (145 lb)

Allergies: Penicillin
Medications: None
Past Medical History: None
Chief Complaint: Difficulty breathing secondary to chest injury

Vital Signs

Time: 1030	**BP:** 138/88	**Pulse:** 110	**Respirations:** 24	**Spo_2:** 95%
Time: 1035	**BP:** 104/58	**Pulse:** 124	**Respirations:** 28	**Spo_2:** 88%
Time: 1040	**BP:** 90/60	**Pulse:** 128	**Respirations:** 28	**Spo_2:** 92%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** NC NRM BVM	**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation / **Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Shock treatment, blanket for warmth, pillow to chest for pain relief

Narrative

Medic 30 dispatched to a construction site for a patient with a "chest injury." On arrival at the scene, a coworker directed the EMS crew to the patient, a 19-year-old man. He was found sitting on the ground. He was conscious, but restless; his airway was patent; his breathing was labored; and no gross external bleeding was noted. Patient reports chest pain and difficulty breathing after being struck in the left anterior part of the chest by a 2 × 4 board, which was thrown from a table saw when another coworker was cutting it. He denies any other injuries, and coworkers confirm that there was no loss of consciousness. Applied oxygen at 15 L/min via nonrebreathing mask and performed further assessment. Obvious bruising was noted to left anterior part of the chest, as was crepitus on palpation. Remainder of chest wall was stable. Breath sounds were diminished to left side of the chest. No paradoxical chest wall movement was noted, jugular veins were nondistended, and trachea was midline. Obtained vital signs, placed patient onto stretcher, and loaded him into the ambulance. Reassessed patient's condition and vital signs and noted obvious deterioration. He was now confused, more tachypneic, and his respirations were markedly shallow. Oxygen saturation read 88%, and skin was now cool and clammy, with perioral cyanosis. Breath sounds were now absent on the left side of the chest. Began assisting ventilations with BVM attached to high-flow oxygen and initiated transport. Intercept with ALS unit was not possible because it would have caused a significant delay in transport. Covered patient with a blanket for warmth, continued ventilation assistance, and reassessed patient every 5 minutes throughout transport. Delivered patient to hospital, gave verbal report to attending physician, and transferred patient care to hospital staff. Medic 30 returned to service at 1053.**End of report**

Prep Kit

Ready for Review

- A penetrating chest injury has the potential to penetrate the lung and diaphragm and injure the liver or stomach.
- Chest injuries are classified as closed or open. Closed injuries are often the result of blunt force trauma, and open injuries are the result of an object penetrating the skin and/or chest wall.
- Blunt trauma may result in fractures to the ribs and the sternum.
- Life-threatening hemorrhage must be addressed immediately during the primary assessment, even before airway or breathing concerns.
- During the primary assessment, if an injury is encountered that interferes with the ability of the patient to oxygenate or ventilate, the injury must be addressed quickly.
- Any penetrating injury to the chest may result in air entering the pleural space and may cause pneumothorax. An occlusive dressing should be placed on this injury as soon as it is identified.
- When a penetrating injury creates a hole in the chest wall, you may hear a sucking sound as the patient inhales. This is called an open pneumothorax.
- A simple pneumothorax is a result of blunt trauma, such as fractured ribs.
- A spontaneous pneumothorax may be the result of rupture of a weak spot on the lung, allowing air to enter the pleural space and accumulate. This often results from nontraumatic injuries and may occur during times of physical activity such as exercise.
- A pneumothorax may progress to a tension pneumothorax and cause cardiac arrest.
- Hemothorax is the result of blood accumulating in the pleural space after a traumatic injury when the vessels of the lung are lacerated and leak blood.
- A flail chest segment is three or more ribs broken in two or more places. Positive-pressure ventilation may be particularly important for the patient with a flail chest that compromises ventilation.
- All patients with chest injuries should receive high-flow oxygen or ventilation with a BVM.
- Pulmonary contusion, which is bruising of or injury to lung tissue after traumatic injury, may interfere with oxygen exchange in the lung tissue.
- Myocardial contusion is bruising of the heart muscle after traumatic injury. This condition may have the same signs and symptoms as a heart attack, including an irregular pulse. Remember that this is an injury to the heart muscle from trauma, not from a heart attack.
- Commotio cordis occurs from a direct blow to the chest during a critical portion of the patient's heartbeat. It may result in immediate cardiac arrest.
- Cardiac tamponade is when blood collects in the space between the pericardial sac and the heart. This condition results in pressure building up inside the pericardial sac until the heart cannot pump effectively; cardiac arrest may occur quickly.
- The great vessels of the body are located in the mediastinum. These large vessels may be lacerated or tear after traumatic injury and cause heavy, unseen bleeding inside the patient's chest cavity.
- Any patient who has signs of shock with a chest injury, even with unseen bleeding, should make you suspicious of unseen, life-threatening bleeding inside the chest cavity.

Vital Vocabulary

cardiac tamponade (pericardial tamponade) Compression of the heart as the result of buildup of blood or other fluid in the pericardial sac, leading to decreased cardiac output.

closed chest injury An injury to the chest in which the skin is not broken, usually caused by blunt trauma.

commotio cordis A blunt chest injury caused by a sudden, direct blow to the chest that occurs only during the critical portion of a person's heartbeat.

crepitus A grating or grinding sensation caused by fractured bone ends or joints rubbing together.

flail chest A condition in which three or more ribs are fractured in two or more places or in association with a fracture of the sternum so that a segment of the chest wall is effectively detached from the rest of the thoracic cage.

flutter valve A one-way valve that allows air to leave the chest cavity but not return; formed by taping three sides of an occlusive dressing to the chest wall, leaving the fourth side open as a valve; may also be part of a commercial vented occlusive dressing.

hemopneumothorax The accumulation of blood and air in the pleural space of the chest.

hemothorax A collection of blood in the pleural cavity.

myocardial contusion Bruising of the heart muscle.

occlusive dressing An airtight dressing that protects a wound from air and bacteria; a commercial vented version allows air to passively escape from the chest, while an unvented dressing may be made of petroleum jelly-based (Vaseline) gauze, aluminum foil, or plastic.

open chest injury An injury to the chest in which the chest wall itself is penetrated by a fractured rib or, more frequently, by an external object such as a bullet or knife.

open pneumothorax An open or penetrating chest wall wound through which air passes during inspiration and expiration, creating a sucking sound; also referred to as a sucking chest wound.

paradoxical motion The motion of the portion of the chest wall that is detached in a flail chest; the motion—in during inhalation, out during exhalation—is exactly the opposite of normal chest wall motion during breathing.

pericardium The fibrous sac that surrounds the heart.

pneumothorax An accumulation of air or gas in the pleural cavity.

pulmonary contusion Injury or bruising of lung tissue that results in hemorrhage.

simple pneumothorax Any pneumothorax that is free from significant physiologic changes and does not cause drastic changes in the vital signs of the patient.

spontaneous pneumothorax A pneumothorax that occurs when a weak area on the lung ruptures in the absence of major injury, allowing air to leak into the pleural space.

sucking chest wound An open or penetrating chest wall wound through which air passes during inspiration and expiration, creating a sucking sound. See also *open pneumothorax*.

tachypnea Rapid respirations.

tension pneumothorax An accumulation of air or gas in the pleural cavity that progressively increases pressure in the chest that interferes with cardiac function with potentially fatal results.

traumatic asphyxia A pattern of injuries seen after a severe force is applied to the chest, forcing blood from the great vessels back into the head and neck.

Assessment *in Action*

You and your partner are dispatched to the rodeo arena for a person reporting shortness of breath and chest pain. On arrival you are escorted to a first aid trailer where you find a man in his mid 30s seated in a chair and leaning forward clutching his chest. He tells you that he was riding a bull when he was thrown off. He states that he landed hard on his right side and heard a "loud pop."

1. The patient finds it difficult to take a deep breath and speak. On the basis of this information, what should be your first intervention?

   A. Take vital signs.
   B. Apply a bulky dressing to the right side of the chest.
   C. Administer high-flow oxygen.
   D. Immobilize the patient on a backboard.

2. Exposure of the patient's chest reveals a large bruise on the lateral aspect of the right side of the chest. When you palpate the area, the patient yells out in extreme pain and states that he cannot take a deep breath. What condition should you suspect?

   A. Cardiac tamponade
   B. Rib fractures
   C. Spontaneous pneumothorax
   D. Pulmonary contusion

3. Potential complications associated with fractured ribs may include all of the following EXCEPT*:*

   A. pneumothorax.
   B. tension pneumothorax.
   C. hemothorax.
   D. upper airway obstruction.

4. Which of the following blood vessels can be lacerated by a fractured rib?

A. Aorta
B. Brachial artery
C. Intercostal artery or vein
D. Jugular vein

5. How often should this patient be reevaluated?

A. Every 5 minutes
B. Every 10 minutes
C. Every 15 minutes
D. Every 20 minutes

6. Diagnostic tools are used to assist you in assessing the severity of your patient's condition. What diagnostic tool is most commonly used to evaluate the effectiveness of the respiratory system?

A. End-tidal carbon dioxide detector
B. Peak flow meter
C. Pulse oximeter
D. Automated blood pressure

7. While en route to the hospital, the patient suddenly grabs your arm and states that he can't breathe. He appears pale, diaphoretic, and extremely anxious. Reassessment of the chest reveals diminished breath sounds on the right side and subcutaneous emphysema. You suspect which of the following conditions is developing in the patient?

A. Cardiac tamponade
B. Tension pneumothorax
C. Myocardial contusion
D. Pulmonary contusion

8. You are still 30 minutes away from the hospital. On the basis of the patient's current signs and symptoms, what is the most appropriate management?

A. Assist ventilations with a BVM and continue transport.
B. Call for ALS assistance and continue transport.
C. Reassure the patient and continue transport.
D. Attempt to place a needle in the right side of the chest.

9. How can a tension pneumothorax develop as the result of fractured ribs?

10. Spinal cord injury should be suspected in patients with chest injury. The intercostal muscles receive nerve impulses from specific spinal nerves. Where are these nerves located?

CHAPTER

30

Abdominal and Genitourinary Injuries

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National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Abdominal and Genitourinary Trauma

› Recognition and management of
- Blunt versus penetrating mechanisms (pp 1059–1062, 1069–1071, 1073–1075, 1077–1078)
- Evisceration (pp 1062, 1071–1072)
- Impaled object (pp 1068, 1078)

› Pathophysiology, assessment, and management of
- Solid and hollow organ injuries (pp 1058–1059, 1062–1072, 1075–1078)
- Blunt versus penetrating mechanisms (pp 1059–1062, 1064–1071, 1073–1079)
- Evisceration (pp 1062, 1064–1069, 1071–1072)
- Injuries to the external genitalia (pp 1074–1079)
- Vaginal bleeding due to trauma (pp 1074–1079)
- Sexual assault (p 1079)

Knowledge Objectives

1. Describe the anatomy and physiology of the abdomen; include an explanation of abdominal quadrants and boundaries and the difference between hollow and solid organs. (pp 1057–1059)
2. Describe some special considerations related to the care of pediatric patients and geriatric patients who have experienced abdominal trauma. (pp 1058–1059, 1065)

3. Define closed abdominal injuries; provide examples of the mechanisms of injury (MOI) likely to cause this type of trauma, and common signs and symptoms exhibited by patients who have experienced this type of injury. (pp 1059–1060)
4. Define open abdominal injuries; include the three common velocity levels that distinguish these injuries, provide examples of the MOI that would cause each, and common signs and symptoms exhibited by patients who have experienced this type of injury. (pp 1061–1062)
5. Describe the different ways hollow and solids organs of the abdomen can be injured and include the common signs and symptoms exhibited by patients depending on the organ(s) involved. (pp 1062–1064)
6. Explain assessment of a patient who has experienced an abdominal injury; include common indicators that help determine the MOI and whether it is a significant or insignificant MOI. (pp 1064–1069)
7. Explain the emergency medical care of a patient who has sustained a closed abdominal injury, including blunt trauma caused by a seat belt or air bag. (pp 1069–1070)
8. Explain the emergency medical care of a patient who has sustained an open abdominal injury, including penetrating injuries and abdominal evisceration. (pp 1070–1072)
9. Describe the anatomy and physiology of the female and male genitourinary system; include the differences between the hollow and solid organs. (pp 1072–1073)
10. Discuss the types of traumatic injuries sustained by the male and female genitourinary system, including the kidneys, urinary bladder, and internal and external genitalia. (pp 1073–1075)
11. Explain assessment of a patient who has experienced a genitourinary injury; include special considerations related to patient privacy and determining the MOI. (pp 1075–1077)
12. Explain the emergency medical care of a patient who has sustained a genitourinary injury to the kidneys, urinary bladder, external male genitalia, female genitalia, and rectum. (pp 1077–1079)
13. Explain special considerations related to a patient who has experienced a genitourinary injury caused by a sexual assault, including patient treatment, criminal implications, and evidence management. (p 1079)

Skills Objectives

1. Demonstrate proper emergency medical care of a patient who has experienced a blunt abdominal injury. (pp 1069–1070)
2. Demonstrate proper emergency medical care of a patient who has a penetrating abdominal injury with an impaled object. (pp 1070–1071)
3. Demonstrate how to apply a dressing to an abdominal evisceration wound. (pp 1071–1072)

Introduction

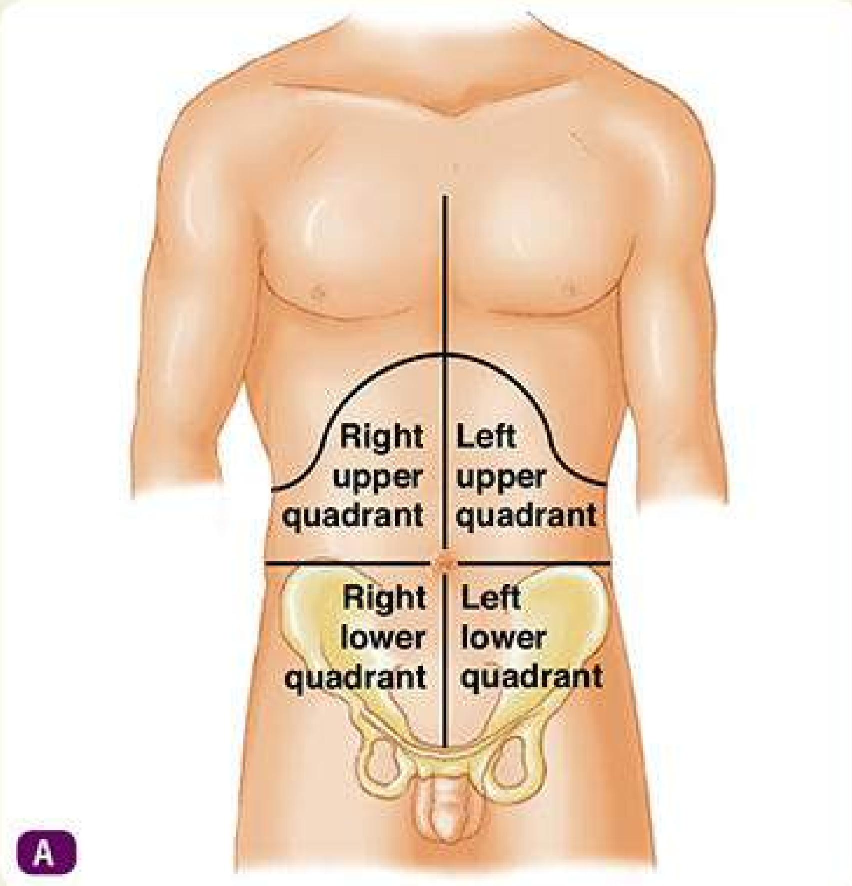
The abdomen is the major body cavity extending from the diaphragm to the pelvis. It contains organs that make up the digestive, urinary, and genitourinary systems. Although any of these organs can be injured, some organs are better protected than others. It is important for you to know the anatomy of the abdominal and pelvic cavities and where the organs are located. You must also understand the functions of the organs so that if an injury occurs, you can assess its seriousness.

Significant trauma to the abdomen can occur from blunt trauma, penetrating trauma, or both. Injuries to the abdomen that go unrecognized or untreated are a leading cause of traumatic death. Similarly, trauma to the genitourinary system is often overlooked, despite 10% of all trauma patients having some form of genitourinary injury. Such injuries can result in life-altering consequences, such as incontinence, infertility, or impotence. It is paramount that you maintain a high index of suspicion if there is a mechanism of injury (MOI) that suggests an abdominal or genitourinary injury and share those findings with the receiving hospital prior to and on arrival.

Anatomy and Physiology of the Abdomen

Abdominal Quadrants

The abdomen is divided into four general quadrants **Figure 30-1**. Two imaginary lines intersect at the umbilicus, dividing the abdomen into four equal areas. These areas are the right upper quadrant (RUQ), left upper quadrant (LUQ), right lower quadrant (RLQ), and left lower quadrant (LLQ). Remember, right and left refer to the patient’s right and left, not yours.



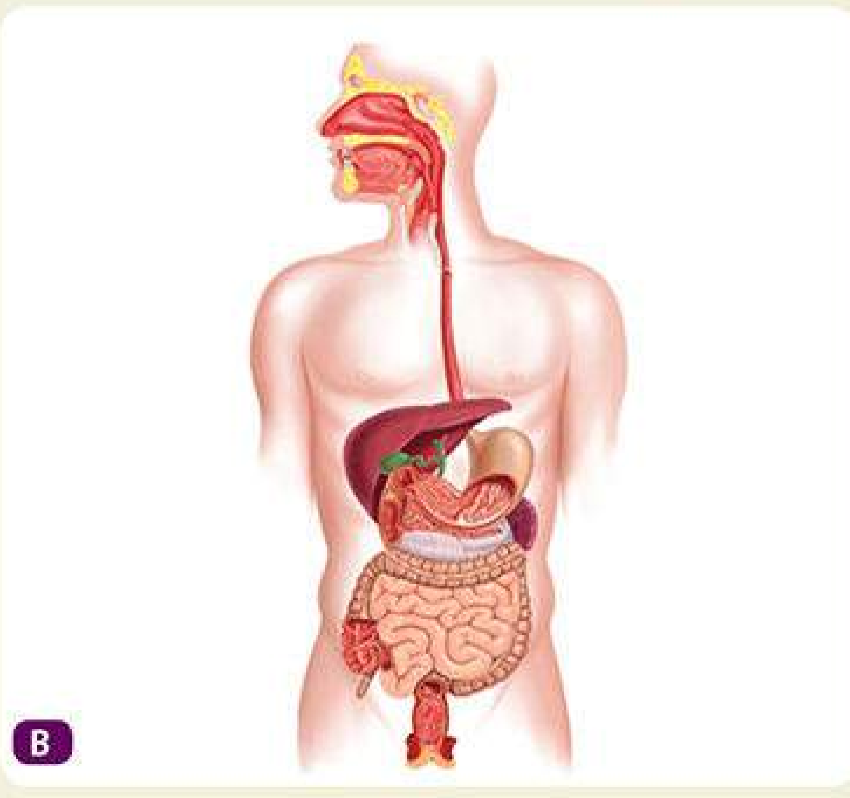


Figure 30-1 **A.** The abdomen is often referred to by quadrants. **B.** Many organs in the abdomen lie in more than one quadrant.

YOU are the Provider — PART 1

You and your partner are working a special event—the annual rodeo. While on standby, you witness a rider being thrown and trampled by a bull. After a rodeo clown distracts and corrals the bull, the rider, a 20-year-old man, slowly gets up and begins to walk. He is clutching his abdomen with one hand and rubbing his lower back with the other hand.

1. How do hollow organ injuries differ from solid organ injuries?
2. How should you focus your assessment of a patient with potential intra-abdominal bleeding?

The quadrant location of bruising or pain can show which organs are possibly involved in a traumatic injury. Organs commonly found in the right upper quadrant are the liver, gallbladder, duodenum of the intestines, and a small portion of the pancreas. The stomach occupies most of the left upper quadrant but it shares this space with the spleen. The pancreas occupies some of this space but is mostly posterior to the region. The left lower quadrant holds both the large and small intestines, notably the descending colon and the left half of the transverse colon. The right lower quadrant also holds portions of the large and small intestines that include the ascending colon and the right half of the transverse colon. The distal end of the descending colon, called the appendix, is located in this region. Swelling and inflammation are common in this region, because the appendix is a common source of intra-abdominal infection—severe infection and even septic shock may occur if it ruptures.

Special Populations

In pediatric patients, the liver and spleen are very large in proportion to the size of the abdominal cavity and are more easily injured. The soft, flexible ribs of infants and young children do not protect these two organs very well and may allow injury to underlying organs, even without fracturing the ribs.

Hollow and Solid Organs

The abdomen contains both hollow and solid organs, any of which may be damaged. **Hollow organs**, including the stomach, large and small intestines, ureters, and urinary bladder, are actually structures through which materials pass **Figure 30-2**. Most of these organs will contain food that is in the process of being digested, urine that is being passed to the urinary bladder for release, or bile. When ruptured or lacerated, these organs spill their contents into the **peritoneal cavity** (the abdominal cavity), causing an intense inflammatory reaction and possible infection. The lining of the peritoneal cavity, the **peritoneum**, may become inflamed and painful—a condition known as *peritonitis*. The intestines and stomach contain acid-like substances that aid in the digestive process. When these substances spill or leak into the peritoneal cavity, they cause pain and irritate the peritoneum. The first signs of peritonitis are severe abdominal pain, tenderness, and muscular spasm. Later, bowel sounds diminish or disappear as the bowel stops functioning. A patient may feel nauseous and may vomit; the abdomen may become distended and firm to touch; and infection may occur. Peritonitis is serious and may become life threatening.

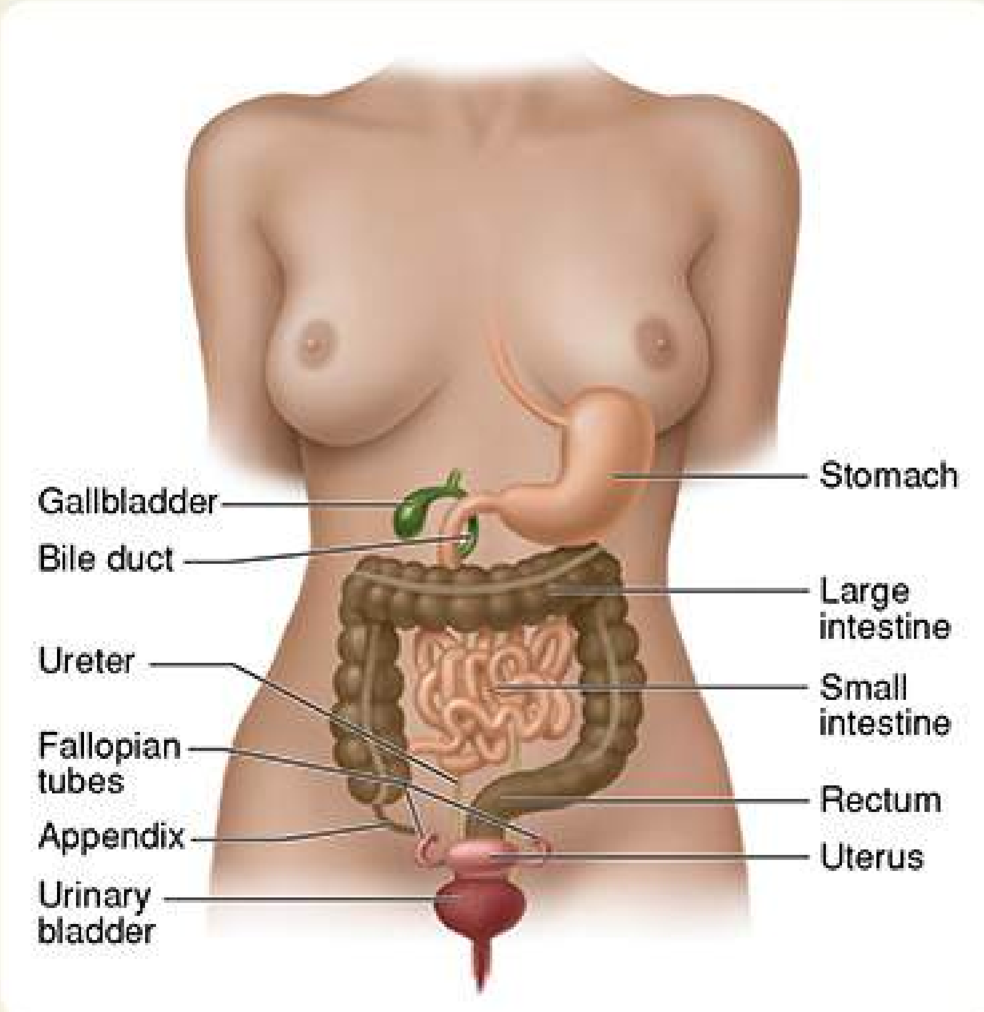


Figure 30-2 The hollow organs in the abdominal cavity are structures through which materials pass.

The small intestine is composed of the duodenum, the jejunum, and the ileum. The large intestine includes the cecum, the colon, and the rectum. The intestinal blood supply comes from the mesentery. The term *mesentery* refers to any fold of tissue that attaches an organ to the body wall. However, the majority of time the term is used in reference to the intestinal mesentery: a fold of tissue that contains a web of vessels, both arteries and veins, as well as nerves and lymphatic tissues. It connects the small intestine to the posterior of the abdominal wall. Both blunt and penetrating abdominal injuries affect this vasculature, and patients with injuries to the mesentery can bleed significantly into the peritoneal cavity. A common sign of bleeding in the abdomen is rigidity, with an almost boardlike feeling to the abdomen. Occasionally you will find bruising around the belly button (periumbilical bruising) or ecchymosis.

The **solid organs**, as their name suggests, are solid masses of tissue. They include the liver, spleen, pancreas, and kidneys **Figure 30-3**. It is here that much of the chemical work of the body—enzyme production, blood cleansing, and energy production—takes place. Solid organs have a rich blood supply, so injury can cause severe and unseen hemorrhage. The same is true of the aorta or inferior vena cava, whether the injury is open or closed. Blood may irritate the peritoneal cavity and cause the patient to report abdominal pain; however, this may not always occur. Therefore, the absence of pain and tenderness does not necessarily mean the absence of major bleeding in the abdomen.

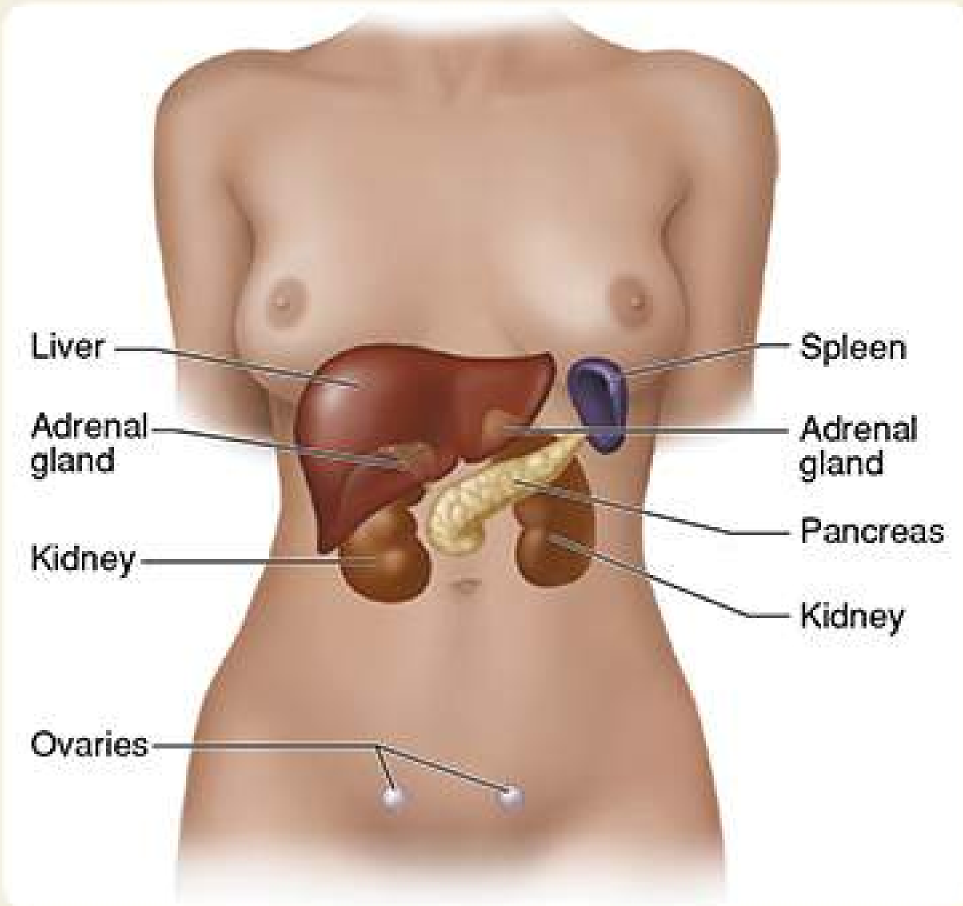


Figure 30-3 The solid organs are solid masses of tissue that do much of the chemical work in the body and receive a large, rich supply of blood.

Many solid organs, in addition to the great vessels, the abdominal aorta, and the inferior vena cava, are found in the retroperitoneal region (behind the peritoneum). This area also houses the kidneys, ureters, and urinary bladder. The majority of the pancreas is located in this region, which is why the pancreas is referred to as a retroperitoneal organ. The last portion of a hollow organ, the colon, occupies the lowest portion of the retroperitoneal space.

Special Populations

Falls are the most common mechanism of injury in geriatric patients. In addition to the typical orthopaedic injuries that a geriatric patient sustains in a fall, the abdominal organs that have lost some elasticity over time are exposed to forces that can damage them. Specifically, the aorta, liver, and spleen are at risk of injury from falls. If a geriatric patient's bones are brittle, they can fracture in a fall, creating dangerously sharp edges that can puncture internal organs.

Injuries to the Abdomen

Abdominal injuries may be as obvious as loops of intestines protruding from a penetrating injury, or they may be unseen such as a laceration to the liver or spleen. Traumatic injuries to the abdomen are considered open or closed, and can involve hollow and/ or solid organs.

Closed Abdominal Injuries

Closed abdominal injuries are those in which blunt force trauma, some type of impact to the body, results in injury to the abdomen without breaking the skin. Such a blow might come from the patient striking the handlebar of a bicycle or the steering wheel of a car, or when the patient is struck by a wooden board or baseball bat during a fight or assault Figure 30-4. Other mechanisms of injury include the following:

- Motorcycle crashes
- Falls
- Blast injuries
- Pedestrian injuries
- Compression
- Deceleration

Compression injuries are typically caused by a poorly placed lap belt. This creates an injury pattern called a clasp-knife injury, an exaggerated resistance of muscles, resembling the opening of a penknife or clasp knife. A compression injury can also be caused when a person is run over or rolled over by a vehicle or object. Deceleration injuries commonly occur when a person or the vehicle the person is traveling inside strikes a large immovable mass, such as a larger vehicle, a bridge abutment, or the ground.

Signs and Symptoms of a Closed Injury

Pain in the abdomen can often be deceiving because it is often diffuse in nature and may be referred from the site of injury to another location in the body. Most injured organs irritate the surrounding tissues. This commonly predictable radiation pattern can help you determine the source of the pain and possibly the site of the injury. In patients with liver and spleen injuries, and bleeding into the peritoneal space, pain is referred to the shoulder. For example, bleeding from an injury to the spleen can result in referred pain to the tip of the left shoulder. However, shoulder pain can be misleading, and injury to the liver or spleen could possibly be overlooked if the shoulder is also injured or if the MOI suggests that an impact or injury may have occurred in the shoulder girdle.

Figure 30-4 Blunt trauma to the abdomen can occur when a patient strikes the steering wheel of a vehicle as a result of a crash.

When a patient reports pain that is tearing and describes it as going from the abdomen posteriorly, he or she is often describing symptoms of an abdominal aneurysm that is dissecting. Pain that is following the angle from the lateral hip to the midline of the groin can be the result of damage to the kidneys or the ureters. Pain primarily located in the right lower quadrant can indicate an inflamed or ruptured appendix. Pain from the gallbladder due to direct injury or inflammation can be found just under the margin of the ribs on the right side or between the shoulder blades.

As blood and fluid from damaged organs flow into the peritoneal cavity, the common response is acute pain in the entire abdomen, which spreads as the blood or contaminant seeks out the voids in the peritoneal cavity. The resulting peritonitis or inflammation of the peritoneum can produce pain if the affected area is exposed to any jarring motion. This is commonly referred to as rebound tenderness. As an EMT, you do not need to produce rebound tenderness intentionally when examining the patient. It is often discovered when you are moving the patient onto the stretcher or into the ambulance.

Determining the location of the pain or referred pain can be more difficult when the patient has voluntary or involuntary guarding. In **guarding**, the patient either consciously or unintentionally stiffens the muscles of the surface of the abdomen. Most often it is the rectus abdominis muscles that are held tight, and the tightness can be mistaken for abdominal rigidity. This stiffening is a natural response to abdominal pain; the body is attempting to splint the area to prevent unnecessary movement and to avoid further pain.

Abdominal distention or swelling that occurs between the xiphoid process and the groin is often the result of free fluid, blood, or organ contents spilling into the peritoneal cavity. Swelling can also be the result of air in the form of gases from the bowel or from infection. Tenderness is another sign of a closed abdominal injury.

Additional signs of abdominal injury are bruising and discoloration. Another likely injury is lower rib fractures—a trauma that was forceful enough to break the ribs may also have damaged internal organs.

Closed abdominal injuries may initially appear as abrasions to the surface of the skin depending on the MOI, such as a physical assault or a pedestrian struck by a motor vehicle. In some circumstances, depending on how deep in the abdomen the injury occurs, it may take several minutes to hours for the contusion or hematoma to become present on the surface. Therefore, it is not prudent for you to rule out injury simply on the basis of absence of these findings.

Injuries From Seat Belts and Air Bags

Seat belts have prevented many thousands of injuries and saved many lives, including those of people who otherwise would have been ejected during a motor vehicle crash. However, seat belts occasionally cause blunt injuries of the abdominal organs. When worn properly, a seat belt lies below the anterior superior iliac spines of the pelvis and against the hip joints. If the seat belt lies too high, it can squeeze abdominal organs or great vessels against the spine when the vehicle suddenly decelerates or stops **Figure 30-5**. Occasionally, fractures of the lumbar spine have been reported. If you are called to the scene of such a crash, keep in mind that the use of seat belts in many cases turns what could have been a fatal injury into a manageable one. In later stages of pregnancy the gravid uterus displaces the urinary bladder to the anterior. This anatomic change allows the normally protected bladder to become more susceptible to injuries from impacts and the seat belt. Pregnant patients who adjust the lap belt portion for comfort as opposed to functionality can sustain further injuries.

In all current-model vehicles, the lap and diagonal (shoulder) safety belts are combined into one so that they may not be used independently. Of course, people can still place the diagonal portion of the belt behind their back, significantly reducing the effectiveness of this design. Remember to inspect beneath the air bag for signs of damage to the steering column.

Words of Wisdom

Hospital personnel depend on you to record scene findings that explain the mechanism of injury. For example, thoroughly document your observations about the vehicle the patient was driving or riding in as a passenger. Notes about deployment of air bags and the condition of the exterior and the steering column help in the assessment of possible internal injuries.

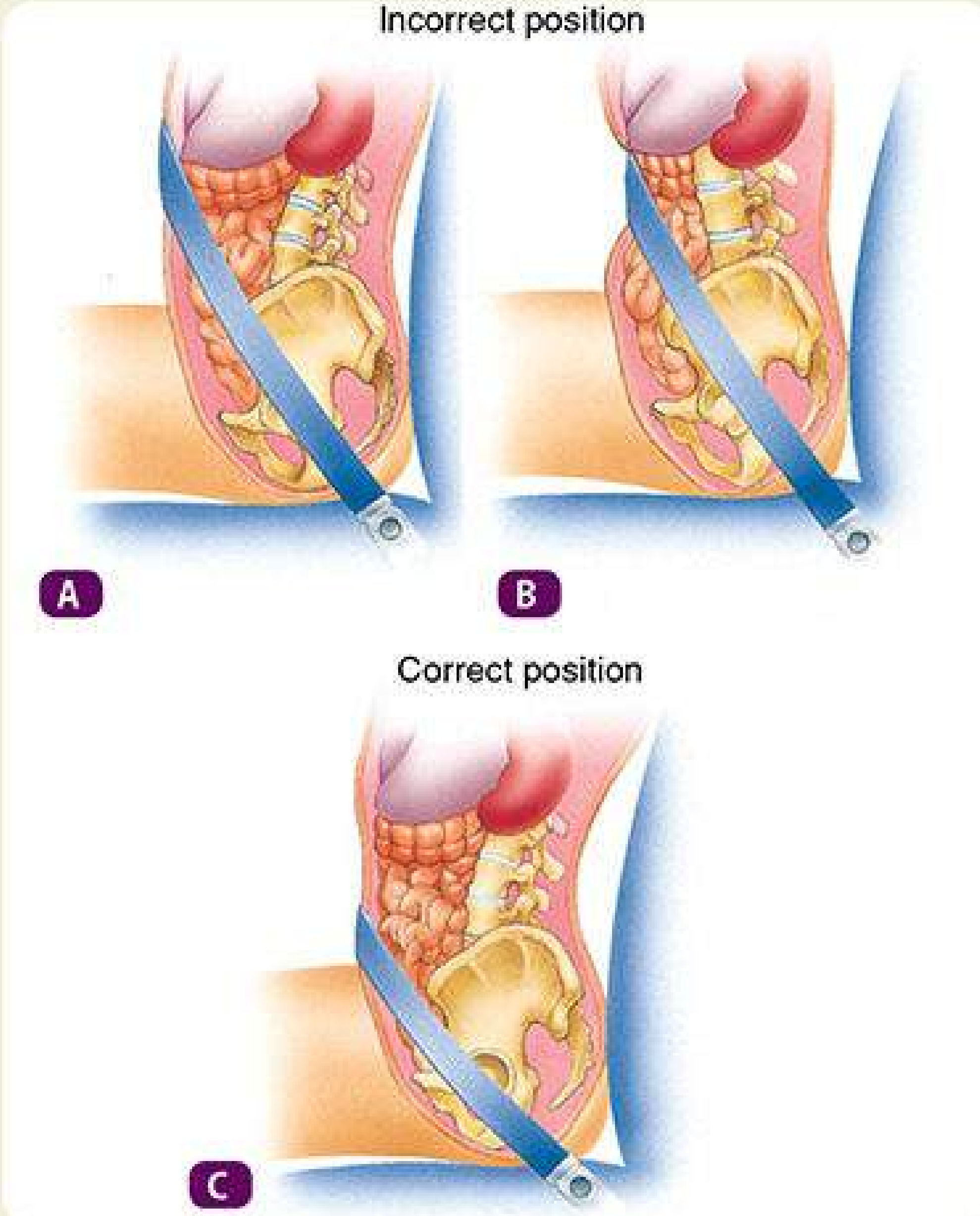


Figure 30-5 Diagrams **(A)** and **(B)** show improper positioning of lap seat belts. The proper position for a seat belt is below the anterior superior iliac spines of the pelvis and against the hip joints, as shown in diagram **(C)**.

Open Abdominal Injuries

Open abdominal injuries are those in which a foreign object enters the abdomen and opens the peritoneal cavity to the outside; these are also known as penetrating injuries **Figure 30-6**. Stab wounds and gunshot wounds are examples of open injuries, or penetrating trauma. Open wounds may not be deeper than the muscular wall of the abdomen; however, this cannot be determined in the prehospital setting. Therefore, you should maintain a high index of suspicion for unseen injuries, internal damage to organs, and potential life-threatening injuries and provide rapid transport. Patients with open abdominal injuries must be assessed and evaluated at the hospital.

Figure 30-6 Because it is difficult to know how deep a penetrating injury is, assume organ damage and transport promptly.

When a patient has sustained a penetrating injury to the abdomen, it is important to attempt to determine the velocity of the object that penetrated the abdominal wall because this can predict the amount of damage to tissue that has occurred. There are three levels of velocity that are commonly discussed in traumatic injuries.

- Low-velocity injuries. Caused by hand-held or handpowered objects such as knives and other edged weapons
- Medium-velocity penetrating wounds. Caused by smaller caliber handguns and shotguns
- High-velocity injuries. Caused by larger weapons such as high-powered rifles and the higher-powered handguns

High- and medium-velocity injuries have temporary wound channels in addition to the exit and entrance wounds. These temporary channels are caused by cavitation. A cavity forms as the pressure wave from the projectile is transferred to the tissues. This causes microscopic tears to the blood vessels and nerves, expanding the width and length of the wound beyond what you can see during physical examination. Cavitation can produce significant bleeding depending on the speed or velocity of the penetrating object. The higher the velocity of the projectile, the larger the cavity it produces, typically resulting in a larger amount of tissue damage.

Low-velocity penetrations also have the capacity to damage underlying organs. This internal injury may not be apparent during the physical examination. The bleeding entrance wound may hide the fact that the object went farther and deeper into the peritoneal cavity and injured other organs and tissues. This is especially important information to remember when an injury occurs in the region where the thoracic cavity and the peritoneal cavity are separated by the diaphragm. Any time your patient has an injury at or below the xiphoid process, it should be assumed that both cavities have been violated.

An open abdominal injury that goes through the skin and muscle layer and through the fascia or the interior covering of the abdomen, such that organs now protrude from the peritoneum, is an evisceration. This visually shocking injury can be extremely painful. Do not push down on the patient's abdomen, and perform only a visual assessment when there is any suspicion of this type of injury. If there is clothing close to the wound, carefully cut the clothing around the wound, leaving a border of intact cloth outside the injured area. Never pull, even gently, on any clothing stuck to or inside the wound channel because this may remove even more of the abdominal contents.

Signs and Symptoms of an Open Injury

Patients with any type of abdominal injury generally have one concern: pain. But other significant distracting injuries may at first mask the pain, and some patients may not be able to tell you about pain because they are unconscious or unresponsive, such as after a head injury or a drug or alcohol overdose. A very common early sign of a significant abdominal injury is tachycardia because the heart is increasing its pumping action to compensate for blood loss. Later signs include evidence of shock, such as decreased blood pressure and pale, cool, moist skin, or changes in the patient's mental status, combined with trauma to the abdomen. In some cases, the abdomen may become distended from the accumulation of blood and fluid.

As an EMT, you must look for other signs and symptoms of potential trauma and injuries to the abdomen. A patient may have both closed and open injuries. Blunt injuries include bruises (often indicated by red areas of skin at this early stage) or other visible marks, whose location should guide your attention to underlying structures **Figure 30-7**. For example, bruises in the right upper quadrant, left upper quadrant, or **flank** (the region below the rib cage and above the hip) might suggest an injury to the liver, spleen, or kidney, respectively **Figure 30-8**. Bruises around the umbilicus can predict significant internal abdominal bleeding **Figure 30-9**.

Figure 30-7 Bruising on the abdomen can provide clues to the possible injury of underlying organs.

Figure 30-8 Bruises in the right upper quadrant, left upper quadrant, or flank suggest an injury to the liver, spleen, or kidney, respectively.

Hollow Organ Injuries

Injuries that involve the hollow organs often have delayed signs and symptoms. The hollow organs commonly spill their contents into the abdomen and then an infection develops, which can take a few hours to days to develop. When the stomach and the intestines are injured, they can spill gastrointestinal contents such as food, waste, and digestive liquids that are highly toxic and acidic. These substances cause significant tissue damage to the entire peritoneum.

Words of Wisdom

The signs of abdominal injury are usually more definite than the symptoms, including firmness on palpation of the abdomen, obvious penetrating wounds, bruises, and altered vital signs, such as increased pulse rate, increased respiratory rate, decreased blood pressure, and shallow respirations (although these signs might not appear until later). Common symptoms include abdominal tenderness, particularly localized tenderness and difficulty moving because of pain.

Figure 30-9 Bruising around the umbilicus indicates the possibility of significant bleeding inside the abdomen.

Both blunt and penetrating trauma can cause injuries to the hollow organs. Blunt trauma causes the organ to "pop," thus releasing fluids or air. Penetrating trauma causes direct injury such as laceration and punctures. In open wounds, patients typically report an intense pain that can be out of character for the size of the injury. Patients may also report intense pain with open wounds of the stomach or small bowel.

The gallbladder and the urinary bladder, which are filled with bile and urine, are two additional hollow organs whose contents are potentially irritating and damaging to the tissues of the abdomen if ruptured by injury. These fluids move via gravity into the loose spaces and voids in the peritoneal cavity, eventually leading to infection.

Free air in the peritoneal cavity is abnormal and usually indicates that a hollow organ or loop of bowel has perforated. Perforation with free air is usually very painful. If the site of perforation is not rapidly identified and repaired, severe infection and septic shock may develop. Any air in the peritoneal cavity seeks the most superior space or void; thus the location of the air can change with positioning of the patient.

Solid Organ Injuries

Solid organs (liver, spleen, diaphragm, kidneys, and pancreas) can bleed significantly and cause rapid blood loss that can be hard to identify from a physical examination because the patient is not experiencing significant pain. Conversely, solid organs can slowly ooze blood into the peritoneal cavity, causing pain to increase slowly over time and increasing the chance for toxicity to develop. Blood in the peritoneal cavity irritates tissue and fills any voids or spaces, which can make it difficult for you to determine the exact source of the bleeding. Because of the structures in the retroperitoneal space and the spaces in the abdominal cavity, the peritoneal cavity can hold a large volume of blood following traumatic injuries of solid organs and major blood vessels.

YOU are the Provider — PART 2

When you reach the patient, he is lying supine on the ground outside of the arena area. The scene is safe and the bull has been penned up. The patient is conscious, but restless. He reports pain over his entire abdomen, both flank areas, and the back of his head. Your partner manually stabilizes his head while you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	In obvious pain; restless
Level of consciousness	Conscious and alert; restless
Airway	Open, clear of secretions or foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, rapid and weak; skin is pale, cool, and moist; no obvious bleeding

3. How should you interpret your primary assessment findings?
4. What immediate treatment is indicated for this patient?

The liver is the largest organ in the abdomen. It is very vascular; therefore, it can contribute to hypoperfusion if it is injured. It is often injured by a fractured lower right rib or a penetrating trauma, such as a stab wound. A common finding during assessment of patients with an injured liver is referred pain to the right shoulder.

Like the liver, the pancreas and spleen are organs responsible for filtering blood and are therefore very vascular. Both organs are prone to heavy bleeding when fractured by blunt force or lacerated or punctured by penetrating injury. The spleen is often injured during motor vehicle crashes, especially in the cases of improperly placed seat belts or impact from the steering wheel, falls from heights or onto sharp objects, and bicycle and motorcycle crashes where the patient hits the handlebars on impact. Referred left shoulder pain also occurs in some cases of splenic injury.

If the diaphragm is penetrated or ruptured, loops of bowel may herniate into the thoracic cavity. Because the bowel will now be displacing lung tissue and vital capacity, patients will exhibit dyspnea or feel short of breath. Patients with a ruptured diaphragm after a motor vehicle crash may become very anxious and short of breath if placed in the supine position on a backboard. Change in position from upright to supine results in more abdominal contents spilling into the thoracic cavity and compressing the lungs, prohibiting the lungs from fully expanding.

In the retroperitoneal space, the kidneys can be impacted or penetrated by trauma. The kidneys are filtration organs; therefore, they are supplied with large quantities of blood. They can be sheared from their base, crushed, or fractured—causing significant blood loss. If the kidney is injured, a common finding is **hematuria**, or blood in the urine. This may be obvious to the naked eye or impossible to detect in the field. You may find drops of blood or blood-tinged urine on the patient's underwear, leading you to inspect the exterior of the genitals. Blood visible on inspection of the urinary meatus (opening of the urethra situated on the glans penis in men and in the vulva in women) indicates significant trauma to the genitourinary system. If blood is not present, do not take this as a sign that the patient is free from injury; the blood may not be visible yet.

Patient Assessment of Abdominal Injuries

The assessment of abdominal injuries is one of the more difficult assessments that you will perform. The causes of the injury may be readily apparent as a result of the MOI or the visibility of a penetrating wound, but the resulting tissue damage may not be so apparent. Often other injuries, such as a fractured bone, may be painful and distracting for the patient. The patient may not tell you about more subtle pain that could indicate an abdominal injury. Additionally, some abdominal injuries develop and worsen over time, making reassessment critical.

Scene Size-up

Your scene size-up begins with the information reported from dispatch. This information may be vague or incomplete, but can still provide information to consider as you prepare to respond. For example, is the patient injured or ill? Could one have led to the other? What equipment might you need to assess and treat the patient? Standard precautions should be taken prior to arrival at the scene; gloves and eye protection should be a minimum.

When you arrive at the scene, you will continue to gather information that will help manage the incident. Observe the scene for hazards and threats to your safety. Make sure the scene is safe and that law enforcement personnel have controlled the scene if necessary. If additional resources are needed, call for them early, and consider early ALS intercept for patients who may become unstable.

As you observe the scene, look for indicators of the MOI, and consider early spinal stabilization. This helps you develop an early index of suspicion for underlying injuries in the patient who has sustained a significant MOI. As you put together information from dispatch and your observations of the scene, consider the possible injuries the MOI could have produced.

As you inspect a vehicle, look at the damage. Could this damage result in an abdominal injury? In the case of an assault, think about how many times the patient was struck, where the patient was struck, and with what object.

If the wound is penetrating, inspect the object of penetration if possible. Does the object have a serrated, smooth, or jagged edge? Is it clean or dirty? How long is it? The MOI may also provide indications of potential safety threats. For example, a stab wound may indicate the presence of a violent individual. Weapons can provide useful information for hospital staff; however, do not spend too much time searching for a weapon, and be careful not to contaminate evidence in the process.

Special Populations

In pediatric patients, a common mechanism of injury is a motor vehicle versus pedestrian or motor vehicle versus bicycle crash. In the pediatric patient, the chest and abdomen are less protected by bony structures than in the adult. The pediatric patient may experience significant transfer of energy on impact. In the pediatric patient, the rib cage is so flexible that the chest can be flattened almost to the spine before rib fractures occur. This extensive compression can involve not only the organs of the chest, but also the abdomen. The ribs then recoil to their normal position, and the patient is left with very few outward signs that an injury has occurred.

Primary Assessment

Your goal in the primary assessment is to evaluate the patient's ABCs and then immediately care for any life threats. First perform a primary assessment.

The general impression, including an evaluation of the level of consciousness, will help you establish the seriousness of the patient's condition. Some abdominal injuries will be obvious and graphic; however, most will be very subtle and may go unnoticed. Considering the MOI together with the general impression will help you focus on the immediate problem. Remember, in some cases of trauma or blows to the abdomen, the injury may have occurred hours or even days earlier and the pain has now reached a point where it is severe enough for the patient to seek help.

As you approach the trauma patient with a suspected closed abdominal injury, important indicators will alert you to the seriousness of the patient's condition. Is the patient awake and interacting with his or her surroundings, or is he or she lying still, not making sounds? Does the patient have any apparent life threats? What color is the patient's skin? Is he or she appropriately or inappropriately responding to you? Your general impression will help you develop an index of suspicion for serious injuries and determine how urgently your patient needs care.

Trauma patients with closed abdominal injuries may have what appear to be minor injuries; however, you must not be distracted from looking for more serious hidden injuries. For example, an abrasion to the abdomen may appear to be a superficial injury when in actuality it may be the only outward clue that abdominal organs are injured.

Check for responsiveness using the AVPU scale. Ask the alert patient about his or her chief complaint. Unresponsiveness may indicate a life-threatening condition. You should administer high-flow oxygen via a nonrebreathing mask to trauma patients whose level of consciousness is less than alert and oriented and provide rapid transport to the emergency department (ED).

Trauma patients with open injuries may have obvious significant injuries that indicate a serious condition. However, other injuries may not be as obvious but may still indicate a very serious condition. Your general impression of how the patient is doing is based on information as simple as the MOI and the patient's level of consciousness. Observations such as bleeding from open injuries, skin color and condition, and gasping respirations also contribute to your general impression and help you determine your treatment priorities and the urgency of care needed. A good question to ask yourself is, "How sick is my patient based on what I know right now?"

In trauma patients, life-threatening external hemorrhage must be addressed before airway or breathing concerns. Next, ensure the patient has a clear and patent airway. If a spinal injury is suspected, prevent the patient from moving by having a team member hold the patient's head still and verbally remind the patient not to move. Patients may report feeling nauseous, and they may vomit. Remember to keep the airway clear of vomitus so that it is not aspirated into the lungs, especially in a patient who is unconscious or has an altered level of consciousness. Turn the patient on one side, stabilizing the spine if necessary, and try to clear any material from the throat and mouth. Note the nature of the vomitus: undigested food, blood, mucus, or bile.

You must also quickly assess the patient for adequate breathing. A distended abdomen or pain may prevent adequate inhalation. When these guarded respirations decrease the effectiveness of the patient's breathing, providing supplemental oxygen with a nonrebreathing mask will help improve oxygenation. If the patient's level of consciousness is decreased and respirations are shallow, consider supplementing respirations with a bag-valve mask (BVM). Use airway adjuncts as necessary to ensure a patent airway and assist with breathing.

Superficial abdominal injuries usually do not produce significant external bleeding. However, internal bleeding from open or closed abdominal injuries can be profound. Trauma to the kidneys, liver, and spleen can cause significant internal bleeding. If you suspect shock, evaluate the patient's pulse and skin color, temperature, and condition to determine the stage of shock. Treat the patient aggressively by providing oxygen, positioning the patient supine, and keeping the patient warm. Wounds should be covered and bleeding should be controlled as quickly as possible.

Because of the nature of abdominal injuries, a short on-scene time and rapid transport to the hospital are generally indicated. Abdominal pain together with an MOI that suggests injury to the abdomen or flank is a good indication for rapid transport. In the prehospital environment, it is difficult to determine whether the liver, spleen, or kidney has been injured. Hollow organs that have ruptured are also difficult to identify without more advanced diagnostic equipment. A delay in medical evaluation may result in an unnecessary and dangerous progression to shock. Patients who have visible significant bleeding or signs of significant internal bleeding may quickly become unstable. Treatment should be directed at quickly addressing life threats and providing rapid transport to the nearest appropriate hospital.

Patients with abdominal injuries should be evaluated at the highest level trauma center available because of the hidden or occult nature of most abdominal injuries. Transport to a trauma center is indicated for any patient who has an MOI that produces a high index of suspicion and who has any visible significant trauma, blunt or penetrating. Follow local protocols when considering a lower level care center such as acute care sites and clinics. Only the lowest levels of MOI should be considered eligible for these types of facilities.

History Taking

Once you have identified and treated life threats, you can then gather a history from the patient. You should clarify the chief complaint and MOI, as well as any associated symptoms. You can quickly assess the patient's chief complaint with a simple inspection, noting the position in which he or she is lying. Movement of the body or the abdominal organs irritates the inflamed peritoneum, causing additional pain. To minimize this pain, patients will lie still, usually with their knees drawn up, and their breathing will be rapid and shallow. For the same reason, they will contract their abdominal muscles, a sign called guarding. Ask about previous injuries associated with a chief complaint of abdominal pain.

Next, obtain a SAMPLE history from your patient. Using OPQRST to help explain an abdominal injury may provide some helpful information such as the description of the pain and if the pain is radiating. Take this time to confirm that you have all the necessary history to inform the hospital staff. If the patient is not responsive, attempt to obtain the SAMPLE history from friends or family members.

Be sure to ask the patient if he or she has experienced any nausea, vomiting, or diarrhea when you are investigating the details of the current injury. If the patient has experienced any of these symptoms, ask how many times and over what time period. Ask about the appearance of any bowel movements and urinary output to determine if there was any blood in the urine or black tarry stools (**melena**). This can help determine if the patient has gastrointestinal bleeding and if there is bleeding in the lower intestinal tract.

Secondary Assessment

In some instances, such as with a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

Usually, you will perform the physical examination on all patients with abdominal injuries in the same manner, as follows:

- Remove or loosen clothes to expose the injured regions of the body. Inspect the patient for bleeding before removing clothing to prevent damaging any exposed tissues, such as in the case of an evisceration.
- Provide privacy as needed or wait until you are in the back of the ambulance.
- The patient without suspected spinal injury should be allowed to stay in the position of comfort—with the legs pulled up toward the abdomen. This position will relieve some of the tension on the abdomen and thus provide pain relief.
- For a patient with spinal injury, place padding such as blankets or pillows under the his or her knees to help alleviate tension on the abdominal wall. Keep in mind that you can worsen the spinal injury if you are too aggressive when placing these items.

The patient without suspected spinal injury should not be forced to lie flat for the physical examination or transport. The fetal position may provide the patient with the most comfort during the physical examination or transport.

Examine the entire abdomen including all posterior, anterior, and lateral surfaces. This is a critical step when patients have an injury with an entrance wound. Examine the axillae (armpits) for entrance wounds.

Words of Wisdom

It is not typical for EMTs to auscultate bowel sounds, but if you are trained to do this, note that bowel sounds can be difficult to hear in the prehospital setting. Even in a quiet environment, you may not have enough time to wait to hear them. If you hear nothing, do not state that bowel sounds are absent; use the term decreased. If you hear a lot of gurgling and the sounds of gas moving about frequently, the term increased may be used. Most bowel sounds can be difficult to interpret and diverse in cause, so they are considered to be of limited value to you in your assessment.

Use DCAP-BTLS to help identify specific signs and symptoms of injury. Inspect and palpate the abdomen for the presence of deformity, which may be subtle in abdominal injuries. Look for the presence of contusions and abrasions, which can help localize focal points of impact and may indicate significant internal injury. Puncture wounds and other penetrating injuries must not be overlooked because the intra-abdominal extent of these injuries may be life threatening. The presence of burns, as in the case of flash burns or scalding fluids spilled onto the abdomen, must be noted and managed appropriately. Palpate for tenderness and attempt to localize to a specific quadrant of the abdomen. Identify and treat any lacerations with appropriate dressings. Swelling may involve the entire abdomen and indicates significant intra-abdominal injury.

Remember to palpate the abdomen when examining the region. Palpation is typically performed first with a light touch, progressing to applying gentle increasing pressure deeper into the tissues to draw out a pain response for injuries. The object is not to cause the patient further pain but to identify the location of the pain. Start by palpating the quadrant farthest away from the quadrant that is exhibiting signs and symptoms of injury and pain. This technique allows you to investigate the possibility of radiation and extension of the pain into other quadrants without causing the patient to guard the rest of the abdomen. If a light touch causes pain, deep palpation is not required or recommended.

YOU are the Provider — PART 3

After applying high-flow oxygen to the patient, you perform a secondary assessment. Your partner continues to manually stabilize the patient's head in a neutral position. During your physical examination, you find numerous abrasions to his anterior abdomen and flanks, and he has pain to palpation of his right upper abdominal quadrant. The rest of your secondary assessment is unremarkable for gross injuries. An off-duty EMT from your agency, who was a spectator at the rodeo, provides assistance and obtains a set of vital signs.

Recording Time: 6 Minutes	
Respirations	24 breaths/min; adequate depth
Pulse	120 beats/min; weak and regular
Skin	Pale, cool, and clammy
Blood pressure	104/54 mm Hg
Oxygen saturation (Spo_2)	97% (on oxygen)

The patient's spine is fully immobilized and he is loaded into the ambulance. He is still, conscious, and alert, but is restless and reports being very thirsty. You begin transport to the hospital while continuing to assess and treat the patient en route.

5. What are some common bruising patterns and clinical signs associated with intra-abdominal bleeding?

If the patient has been subjected to a significant MOI, an exam of the entire body will help you quickly identify any injuries your patient may have, not just abdominal injuries. Begin with the head and finish with the lower extremities, moving in a systematic manner. Your goal is not to identify the extent of all the injuries but to determine whether other injuries are present. This requires you to work quickly but thoroughly. If you find a life-threatening injury, stop and treat it immediately; otherwise move on. The injuries you find will guide your decisions in packaging your patient for transport. Assess the patient's need for spinal immobilization and apply per local protocol. In some EMS systems, full spinal immobilization of the patient with penetrating trauma is not performed in the interest of rapid transport for surgical intervention. Up to this point in the patient assessment process you may have been stabilizing the patient's spine by simply holding the head still and asking the patient not to move. If a cervical collar has not been applied, place one on the patient now before you log roll the patient to inspect the posterior part of the body and place the patient on a backboard.

The kidneys are located in the flank region of the back. Inspect and palpate this area for tenderness, bruising, swelling, or other signs of trauma. Remember, you may not be able to trigger pain from the specific organ, but the tissues around it may exhibit symptoms of pain. Hollow organs will spill their contents into the peritoneal cavity and will typically produce a significant peritonitis, which may be seen as diffuse pain with guarding and reaction to sudden jarring movements. Bowel sounds may help confirm these findings, but you should not depend on these sounds to rule out a specific injury.

Quickly obtain the patient's vital signs. Many abdominal emergencies, in addition to injuries or illnesses that result in severe bleeding, can cause a rapid pulse and low blood pressure. Record vital signs as early as possible and periodically thereafter (every 5 minutes in the patient whom you suspect has a serious injury). This will help you identify changes in the patient's condition and be alert to signs of decompensation from blood loss. If the patient is experiencing external or internal hemorrhaging, as in the case of a stab wound or a direct blow to the abdomen, closely monitor the vital signs with a degree of suspicion and pay close attention to changes in the vital signs.

Use pulse oximetry and noninvasive blood pressure devices when these monitoring devices are available. It is recommended you always assess the patient's first blood pressure manually with a sphygmomanometer (blood pressure cuff) and stethoscope.

Assessment of an Isolated Abdominal Injury

If the MOI suggests an isolated injury to the abdomen, focus your physical examination only on the injured area. Inspect the skin of the abdomen for wounds through which bullets, knives, or other missile-type foreign bodies may have passed. Keep in mind that the size of the wound does not necessarily indicate the extent of the underlying injuries. If you find an entry wound, you must always check for a corresponding exit wound in the patient's back or sides. If the injury was caused by a very high–velocity missile from a rifle, you may see a small, harmless-looking entrance wound with a large, gaping exit wound. Do not attempt to remove a knife or other object that is impaled in the patient. Instead, stabilize the object with supportive bandaging. Bruises or other visible marks are important clues to the cause and severity of any blunt injury. Steering wheels and seat belts produce characteristic patterns of bruising on the abdomen or chest.

Words of Wisdom

Occasionally you will have a patient who is extremely sensitive to palpation or is ticklish. This can make the physical examination process more difficult. Because it is difficult for a patient to tickle himself or herself, use the technique of placing the patient's hand on the surface of his or her abdomen and then palpate and compress the abdomen with the patient's hand between your hand and the patient's skin.

Words of Wisdom

Log rolling the patient onto a backboard always provides a valuable chance to examine the back for signs of injury. Instruct and position helpers to ensure your ability to inspect and palpate the back briefly while the patient is rolled onto his or her side. If possible, pad the long backboard before returning the patient to a supine position. This action helps reduce discomfort and prevents soft-tissue injury. Avoid log rolling patients with an evisceration because this can cause more of the abdominal organs to protrude from the wound. Instead, keep the patient in the supine position and allow him or her to flex the knees when possible to help relieve tension on the abdomen.

Reassessment

Repeat the patient's primary assessment and vital signs. Reassess the interventions and treatment you have provided to the patient. Identify trends in pain, vital signs, and the progress of treatments to determine whether the patient's condition is improving or getting worse. Adjustments in care can be based on these objective findings.

Manage airway and breathing conditions based on signs and symptoms found during the primary assessment. Provide spinal immobilization to the patient with suspected spinal injuries. If the patient has signs of hypoperfusion, provide aggressive treatment of shock and rapid transport to the appropriate hospital. If an evisceration is discovered, place a sterile dressing moistened with normal saline over the wound, apply a bandage, and transport. Never attempt to push eviscerated tissue or organs back into the abdominal cavity. A patient who has a ruptured diaphragm may have an abdomen with a sunken anterior wall and difficulty breathing because of bowel contents in the chest cavity. These patients should receive positive-pressure ventilation with a BVM, which may be more difficult to perform without a patent diaphragm and with bowel contents impairing lung expansion. Do not delay transport of the seriously injured trauma patient to complete nonlifesaving treatments such as splinting extremity fractures. Instead, complete these types of treatments en route to the hospital.

Communicate to the hospital the MOI and injuries found during your assessment. It is important to use appropriate medical and anatomic terminology; however, when in doubt just describe what you see. The content of your radio report will depend on your local protocols. The information you provide helps the hospital staff prepare for the patient.

Documentation of your assessment and trends in vital signs is a tremendous help to physicians in evaluating the problem when the patient arrives in the ED. Document the results of the physical examination and any pertinent negatives such as no blood loss noted in bowel movements. Also document if you passed over any step of the physical examination such as with a patient with acute abdominal pain in whom you opted to not perform palpation. Continuity of care is maintained when the ED has an accurate record of your findings at the scene as well as the treatments you have provided. It is imperative that you be able to describe the scene in enough detail so the trauma team has a clear idea of the circumstances. Some services and departments now carry digital or other instant cameras to be able to show the trauma team the MOI that the patient was exposed to. Remember, your written report is also a legal record of your care. If assault is suspected, you may have a legal requirement to inform the hospital staff of your suspicions; however, this information can wait until you have transported the patient to the hospital and had a chance to discuss it privately with appropriate hospital personnel.

Be cautious and diligent when dealing with patients who refuse transport to the hospital after sustaining an injury to the abdomen or genitourinary system. These patients are at high risk for complications; therefore, that information should be explained to them in great detail. Contacting medical control for assistance to convince the patient of the need for transport can be very useful. Always document in detail the information you provide to the patient and, if the patient continues to refuse transport, have the patient sign a document of refusal or an “against medical advice” form.

Emergency Medical Care of Abdominal Injuries

Closed Abdominal Injuries

An urgent concern in patients with closed abdominal injuries is that you do not know the true extent of the injury. Because of this, the patient requires rapid transport to the nearest and highest level of care available, primarily a trauma center with a surgeon. If possible, position the patient for optimal comfort and apply high-flow oxygen if the patient has signs of hypoxia or shock. Treat for shock.

Blunt Abdominal Injuries

A patient with a blunt abdominal injury may have one or more of the following injuries:

- Severe bruising of the abdominal wall
- Laceration of the liver and spleen
- Rupture of the intestine
- Tears in the mesentery, the membranous folds that attach the intestines to the walls of the body, and injury to blood vessels within them
- Rupture of the kidneys or avulsion of the kidneys from their arteries and veins
- Rupture of the urinary bladder, especially in a patient who had a full and distended bladder at the time of the injury
- Severe intra-abdominal hemorrhage
- Peritoneal irritation and inflammation in response to the rupture of hollow organs

A patient who has sustained a blunt abdominal injury should be log rolled to a supine position onto a backboard. Ensure you protect the spine while you roll him or her. If the patient vomits, turn him or her to one side and clear the mouth and throat of vomitus. Monitor the patient’s vital signs for any indication of shock such as pallor; cold sweat; rapid, thready pulse; or low blood pressure. If you see any of these signs, administer high-flow supplemental oxygen via a nonrebreathing mask, or a BVM if needed, and take all the appropriate measures to treat for shock. Patients with dyspnea due to a diaphragmatic rupture may require assistance with a BVM. Keep the patient warm with blankets, and provide rapid transport to the ED.

Open Abdominal Injuries

Penetrating Abdominal Injuries

Patients with penetrating injuries generally have obvious wounds and external bleeding **Figure 30-10A**; however, significant external bleeding is not always present. As an EMT, you should have a high index of suspicion that the patient has serious unseen blood loss occurring inside the body. A large wound may have protrusions of bowel, fat, or other structures. In addition to pain, these patients often report nausea and vomiting. Patients with peritonitis generally prefer to lie very still with their legs drawn up because it hurts to move or straighten their legs. They may express grief or pain after every bump in the road during transport.

In caring for a patient with a penetrating wound to the abdomen, follow the general procedures previously described for care of a blunt abdominal injury as well as following the specific steps for the penetrating wound. Inspect the patient's back and sides for exit wounds, and apply a dry, sterile dressing to all open wounds. If the penetrating object is still in place, apply a stabilizing bandage around it to control external bleeding and to minimize movement of the object **Figure 30-10B**.

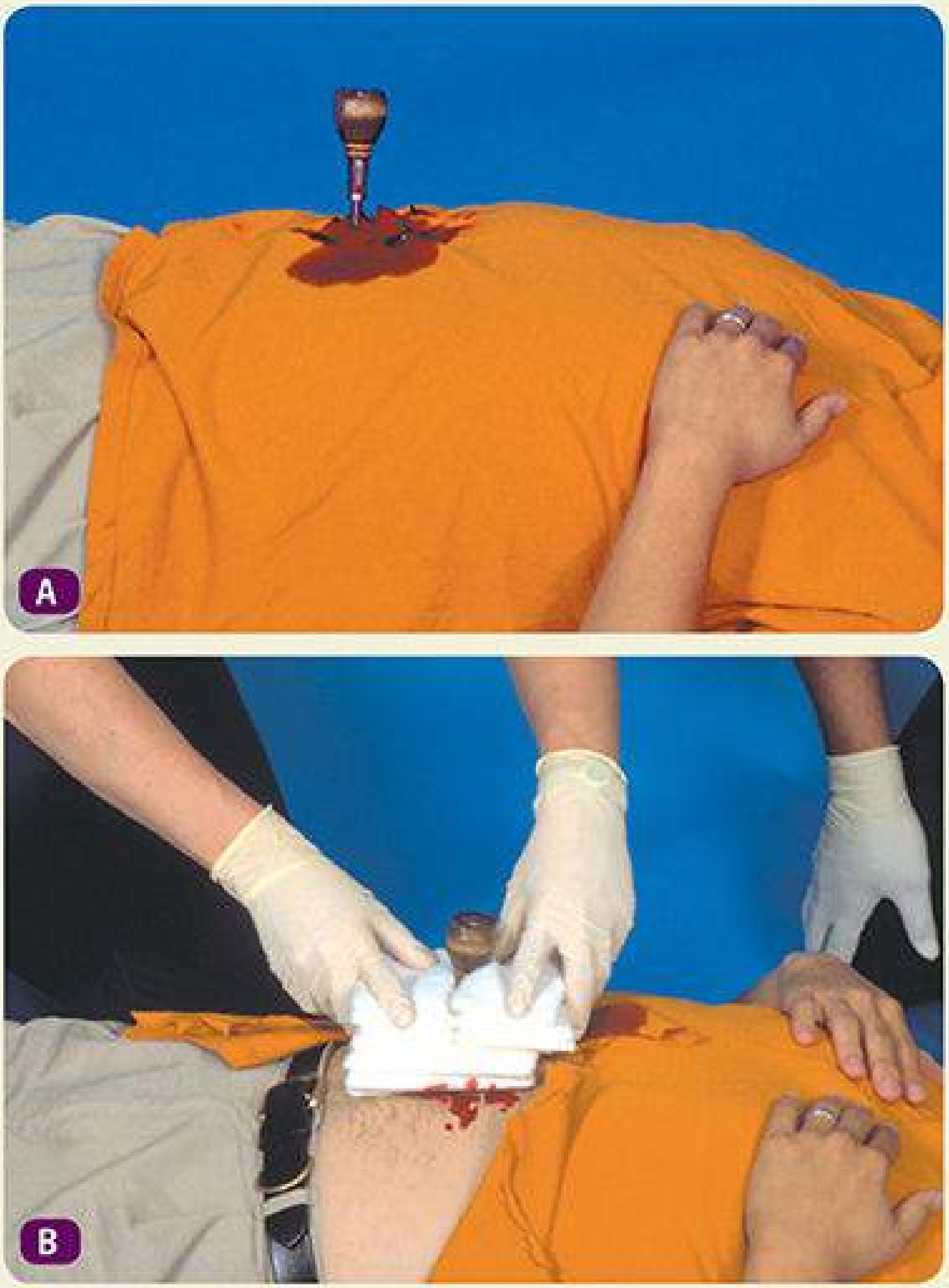


Figure 30-10 **A.** Penetrating injuries have obvious wounds and may also have external bleeding. **B.** If the penetrating object is still in place, use a roller bandage to stabilize the object and to control bleeding.

YOU are the Provider — PART 4

You reassess the patient en route and note that his clinical status has deteriorated. You ask your driver to notify the receiving facility as you continue to treat the patient. There are no ALS units available to rendezvous with and assist you.

Recording Time: 12 Minutes	
Level of consciousness	Responsive to pain only
Respirations	28 breaths/min; shallow
Pulse	134 beats/min; absent radial pulses
Skin	Cool, pale, and clammy
Blood pressure	82/54 mm Hg
Spo_2	88% (on oxygen)

6. Why is your patient's condition deteriorating? How should you modify your treatment?

Abdominal Evisceration

Severe lacerations of the abdominal wall may result in an evisceration, in which internal organs or fat protrude through the wound **Figure 30-11**. Never try to replace an organ that is protruding from an abdominal laceration, whether it is a small fold of peritoneum or nearly all of the intestines. Instead, cover it with sterile dressings moistened with sterile saline solution and secure with a bandage and tape. (Protocols in some EMS systems call for an occlusive dressing over the dressings.) Because the open abdomen radiates body heat very effectively, and because exposed organs lose fluid rapidly, you must keep the organs moist and warm **Figure 30-12**. Do not use any material that is adherent or loses its substance when wet, such as toilet paper, facial tissue, paper towels, or absorbent cotton.

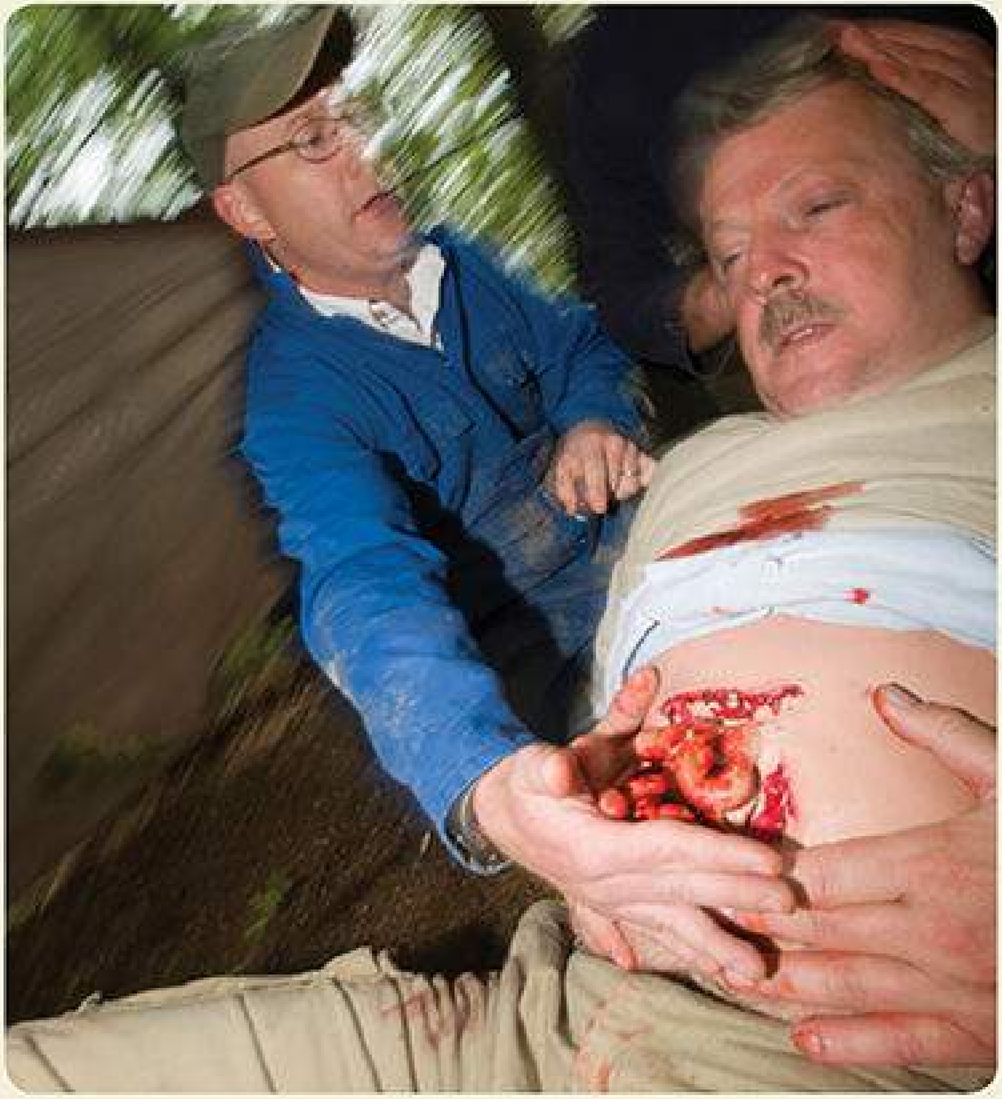


Figure 30-11 An abdominal evisceration is an open abdominal wound from which internal organs or fat protrude.

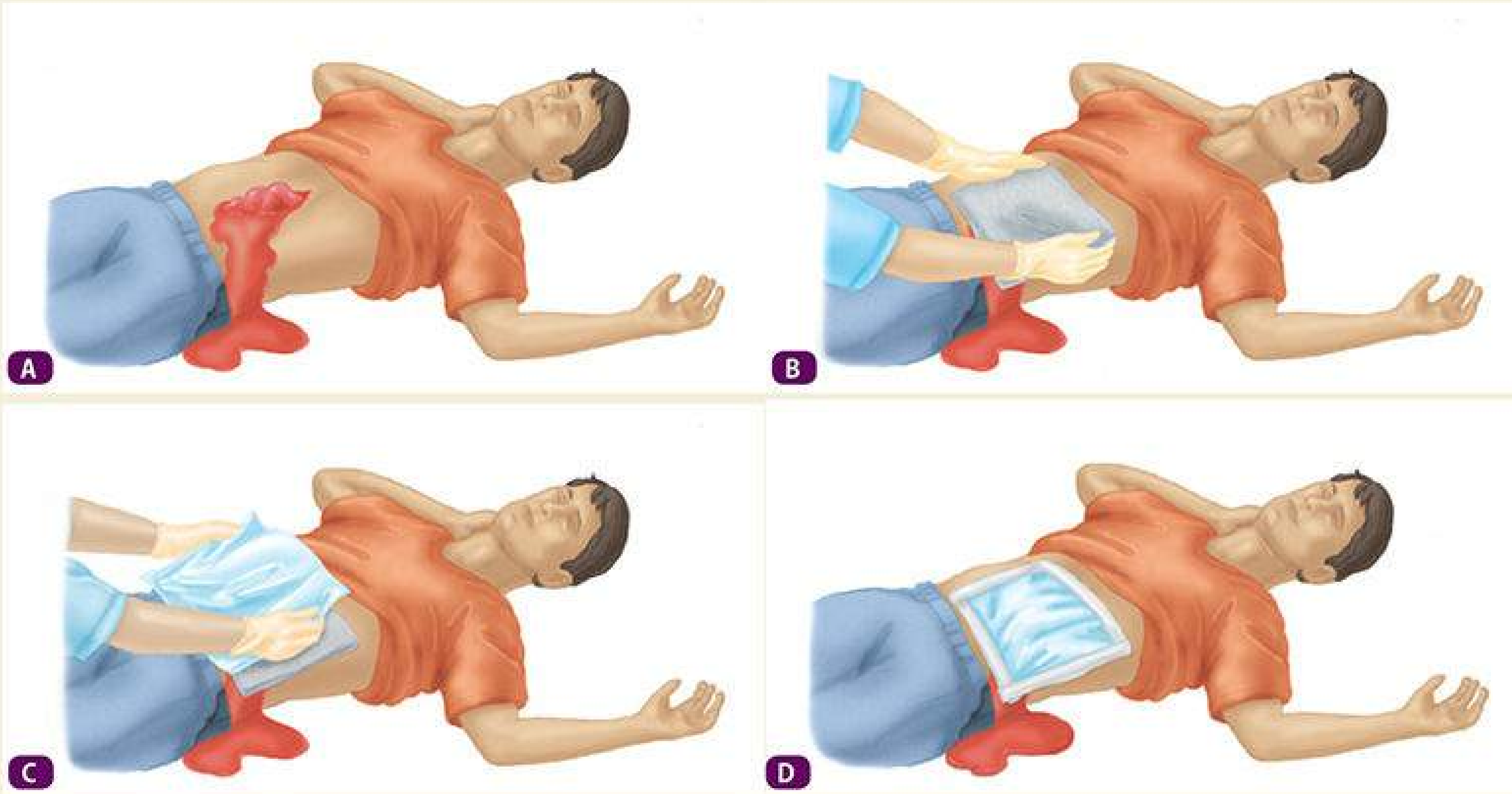


Figure 30-12 **A.** The open abdomen radiates body heat rapidly and must be covered. **B.** Cover the wound with moistened, sterile dressings and with an occlusive dressing, depending on local protocol. **C.** Secure the dressing with a bandage. **D.** Secure the bandage with tape.

Treat the patient for shock by keeping the patient warm and placing the patient in the supine position. Provide high-flow oxygen and transport according to local protocols and destination policy. Transport the patient to the highest level trauma center available.

Anatomy of the Genitourinary System

The genitourinary system controls both the reproductive functions and the waste discharge system, which are generally considered together. The organs of the genitourinary system, such as the kidneys and urinary bladder, are located in the abdomen.

The urinary system controls the discharge of certain waste materials filtered from the blood by the kidneys. In the urinary system, the kidneys are solid organs; the ureters, urinary bladder, and urethra are hollow organs Figure 30-13.

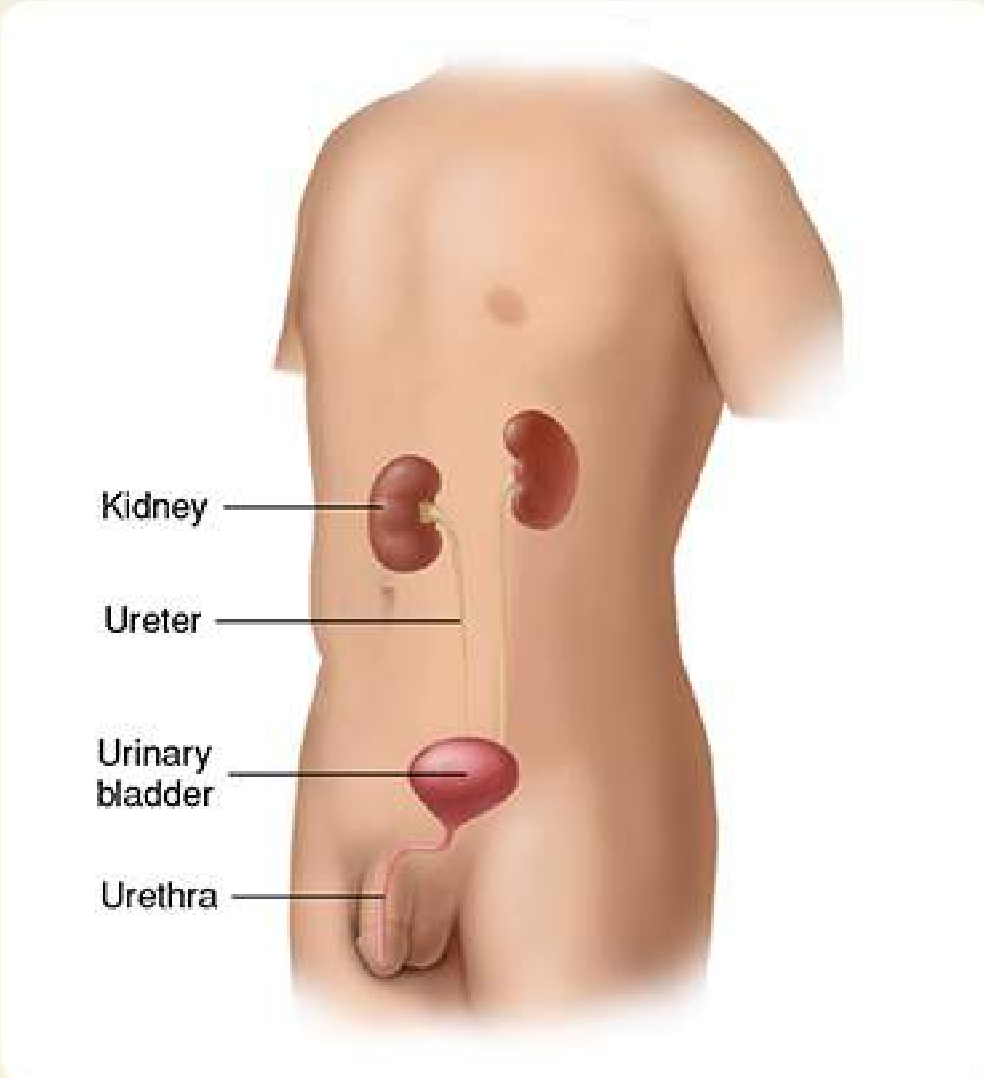


Figure 30-13 The urinary system lies behind the digestive tract. The kidneys are solid organs; the ureter, urinary bladder, and urethra are hollow organs.

The genital system is also important to the reproductive processes. The male genitalia, except for the prostate gland and the seminal vesicles, lie outside the pelvic cavity **Figure 30-14**. The female genitalia, except for the vulva, clitoris, and labia, are contained entirely within the pelvis **Figure 30-15**. The male and female reproductive organs have certain similarities and, of course, basic differences. They allow for the production of sperm and egg cells and appropriate hormones, the act of sexual intercourse, and, ultimately, reproduction.

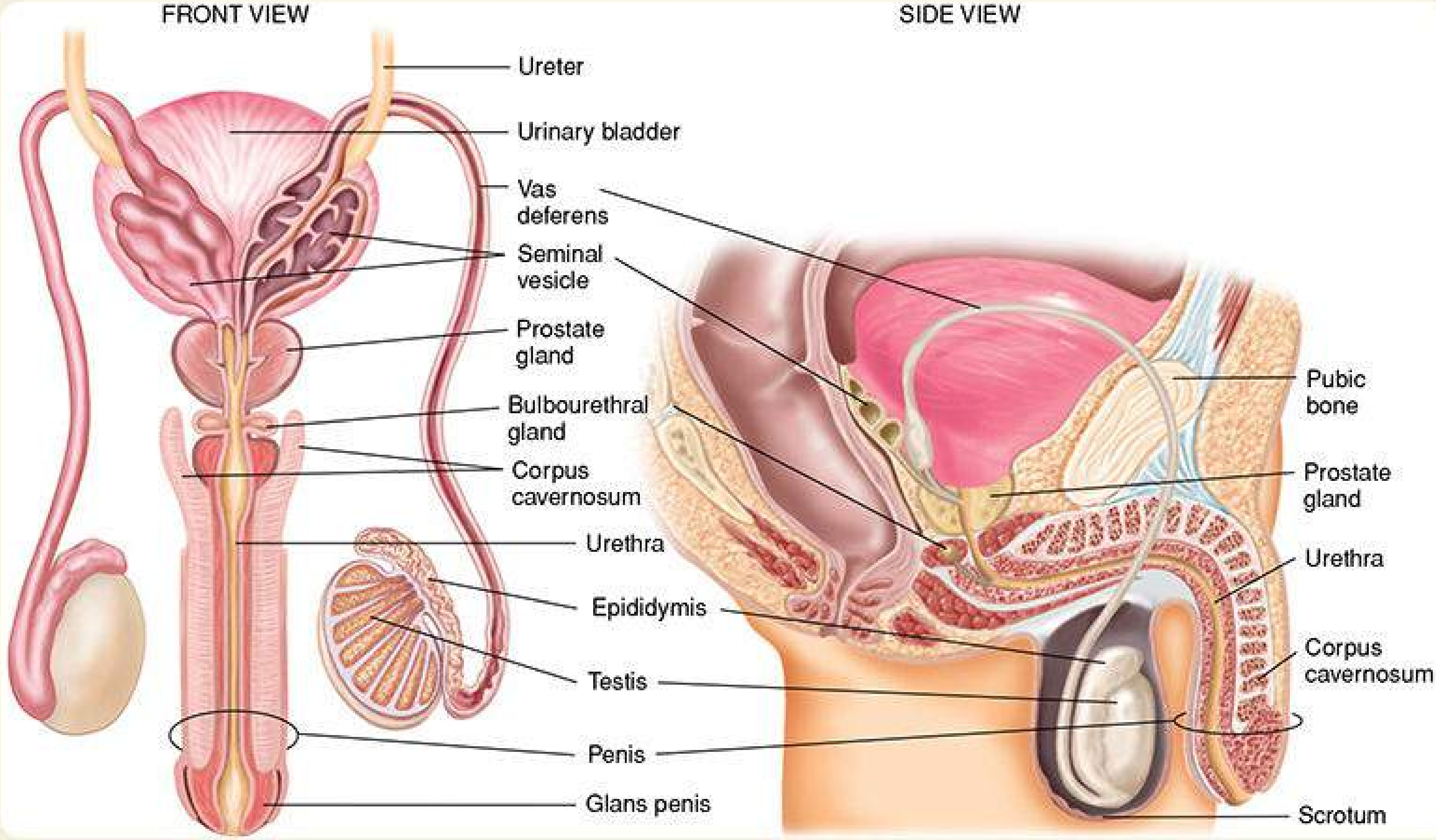


Figure 30-14 The male reproductive system includes the testicles, vas deferens, seminal vesicles, prostate gland, urethra, and penis.

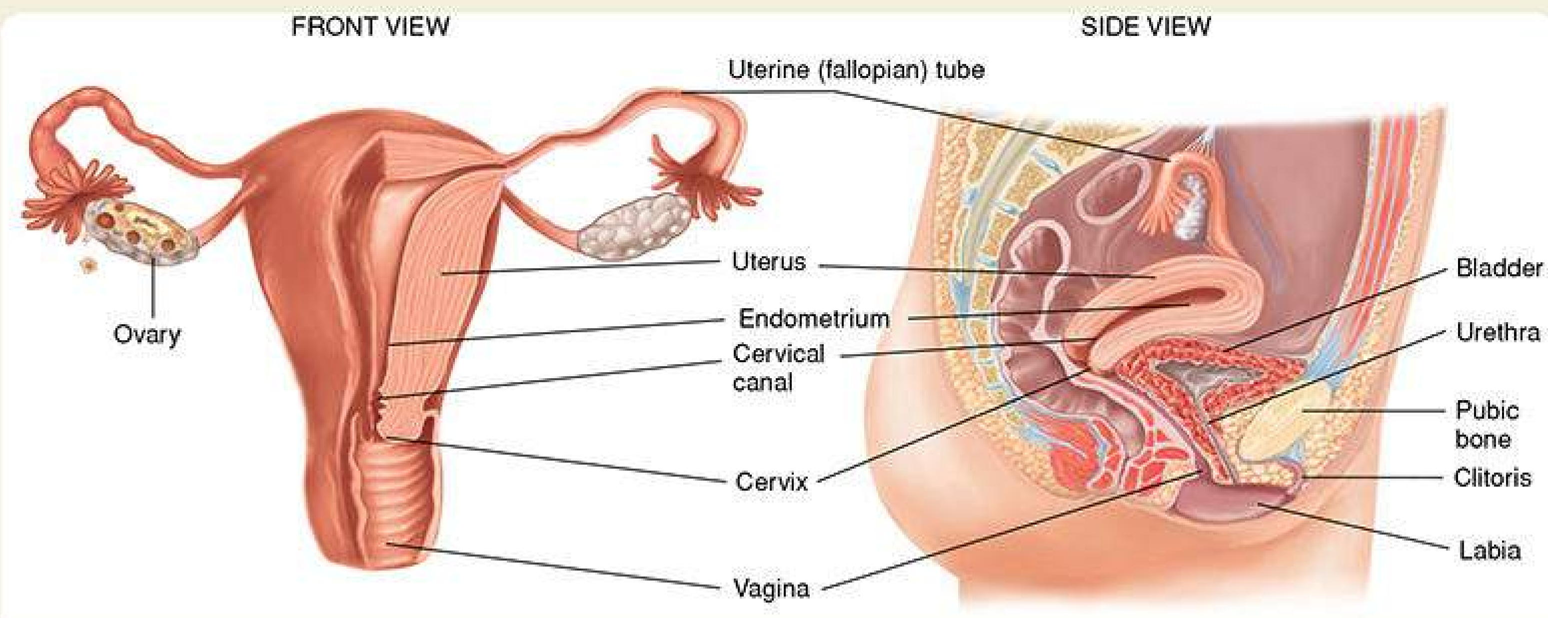


Figure 30-15 The female reproductive system includes the ovaries, fallopian tubes, uterus, cervix, and vagina.

Injuries of the Genitourinary System

Injuries of the Kidneys

Injuries of the kidneys are not unusual and rarely occur in isolation. This is because the kidneys lie in such a well-protected area of the body. A penetrating wound that reaches the kidneys almost always involves other organs. The same is true with blunt injuries. A blow that is forceful enough to cause significant kidney damage often results in damage to other intra-abdominal organs. Less significant injuries to the kidneys may result from a direct blow or even from a tackle in football **Figure 30-16**. Suspect kidney damage if the patient has a history or physical evidence of any of the following:

- An abrasion, laceration, or contusion in the flank
- A penetrating wound in the flank (the region below the rib cage and above the hip) or the upper abdomen
- Fractures on either side of the lower rib cage or of the lower thoracic or upper lumbar vertebrae
- A hematoma in the flank region

Figure 30-16 A tackle in football that results in blunt trauma to the lower rib cage or the flank can cause kidney injury.

Injuries to the Urinary Bladder

Injury to the urinary bladder, either blunt or penetrating, may result in its rupture. When this happens, urine spills into the surrounding tissues, and any urine that passes through the urethra is likely to be bloody. Blunt injuries of the lower abdomen or pelvis often cause rupture of the urinary bladder, particularly when the bladder is full and distended. Sharp, bony fragments from a fracture of the pelvis often perforate the urinary bladder **Figure 30-17**. Penetrating wounds of the lower midabdomen or the perineum (the pelvic floor and associated structures that occupy the pelvic outlet) can directly involve the urinary bladder. In men, sudden deceleration from a motor vehicle or motorcycle crash can literally shear the bladder from the urethra. Remember, in the second and third trimesters of pregnancy, the incidence of injury to the urinary bladder is increased by displacement of the uterus.

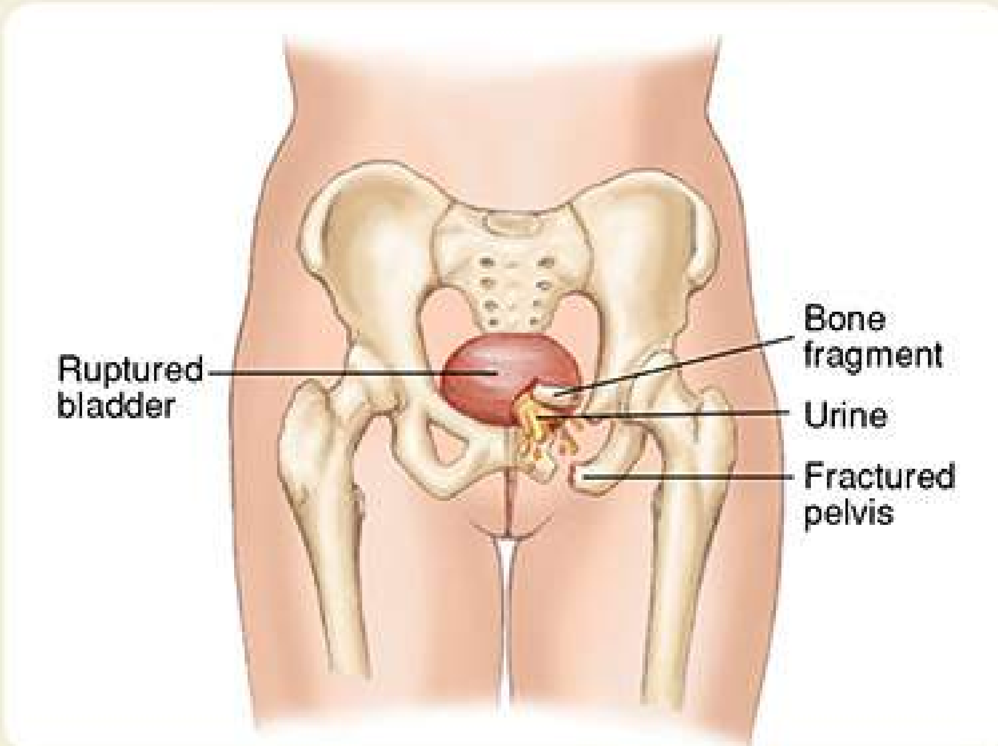


Figure 30-17 Fracture of the pelvis can result in perforation of the bladder by the bony fragments. Urine then leaks into the pelvis.

▶ Injuries of the External Male Genitalia

Injuries of the external male genitalia include all types of soft-tissue wounds. Although these injuries are uniformly painful and generally a source of great concern to the patient, they are rarely considered life threatening. They should not be given priority over other, more severe wounds, unless the rich blood supply causes significant bleeding. It is important to know that pain from an injury to the testicles or another cause, such as infection or cancer, may be referred to the lower abdomen. As a result, when assessing men with lower abdominal pain you should also consider injury or other causes of pain to the testicles.

▶ Injuries of the Female Genitalia

Internal Female Genitalia

The uterus, ovaries, and fallopian tubes are subject to the same kinds of injuries as any other internal organ. However, they are rarely damaged because they are small, deep in the pelvis, and well protected by the pelvic bones. Unlike the urinary bladder, which lies adjacent to the bony pelvis, they are usually not injured as a result of a pelvic fracture.

An exception is the pregnant uterus. As pregnancy progresses, the uterus enlarges substantially and rises out of the pelvis, becoming vulnerable to both penetrating and blunt injuries. These injuries can be particularly severe because the uterus has a rich blood supply during pregnancy. You must also keep in mind that the fetus is at risk. You can expect to see the signs and symptoms of shock with these patients; be prepared to provide all necessary support and prompt transport. Note also that contractions may begin. If possible, ask the patient when she is due to deliver, and report this information to the hospital staff.

In the third trimester of pregnancy, the uterus is large and may obstruct the vena cava, leading to a decrease in the amount of blood returning to the heart if the patient is placed in a supine position (supine hypotensive syndrome). As a result, blood pressure may decrease. The patient should be carefully placed on her left side so that the uterus will not lie on the vena cava. If the patient is secured to a backboard, tilt the board to the left. Chapter 23, *Gynecologic Emergencies,* and Chapter 33, *Obstetrics and Neonatal Care,* cover gynecologic emergencies and the special considerations for pregnant trauma patients in detail.

External Female Genitalia

The external female genitalia include the vulva, the clitoris, and the major and minor labia (lips) at the entrance of the vagina. Injuries of the external female genitalia can include all types of soft-tissue injuries. Because these genital parts have a rich nerve supply, injuries are very painful. Vaginal bleeding may occur because of penetrating or blunt trauma. These injuries can be accidental, as in the case of straddle injuries from bicycles or motorcycles; or they can be intentional as in the case of assaults. Determining the MOI will assist you in deciding if you need to call for additional resources, as in the case of sexual assault.

In any case of trauma, it is important to determine the possibility of pregnancy. Ask the patient for the date of her last known menstrual period or if she has been sexually active. Assume all women of childbearing age are possibly pregnant. This information is medically relevant because there are medications and tests that are harmful for a fetus and there is the potential for another source of blood loss in the gravid uterus.

In cases of external bleeding and trauma, a sterile absorbent sanitary napkin or pad may be applied to the labia. Do not insert instruments, gloved fingers, or a tampon into the vagina because this can cause further damage.

Patient Assessment of the Genitourinary System

When assessing a genitourinary injury, there is a potential for the patient to become embarrassed, so it is very important for you to maintain a professional presence at all times when dealing with these injuries. Remember to provide privacy for the patient during the assessment process. Whenever possible, have a provider perform the assessment who is the same gender as the patient. First look for blood on the patient's underwear and inspect only the external genitalia when there are concerns of pain or external signs of injury.

Scene Size-up

As you arrive at the scene, observe it for hazards and threats to the safety of the crew, bystanders, and the patient. Assess the impact the hazards have on patient care and address those hazards. Assess the potential for violence and assess for environmental hazards.

Ensure that you and your crew have taken standard precautions—a minimum of gloves and eye protection. Control of blood and bloody contaminants can be difficult unless you are careful about what you touch and where. Apply standard precautions before you approach the scene to minimize your direct exposure to body fluids. Because of the color of blood and how well it soaks through clothing, you can often identify patients with an open injury as you approach the scene. However, blood can be hidden under thick clothing such as denim and leather. Eye protection is required when managing open injuries. Determine the number of patients and consider if you need additional or specialized resources on the scene.

As you observe the scene, look for indicators of the MOI. Consider information from dispatch, your observations of the scene, and the MOI to help develop your list of expected injuries. Be aware that the patient may avoid discussing the injury to avoid undergoing a physical examination. Also, the patient may provide an MOI that seems "less embarrassing" than the actual MOI. By maintaining a professional demeanor, respecting the patient's privacy, and maintaining the patient's dignity, you will earn the patient's trust. If the patient trusts you, you are more likely to discover the true facts behind the injury.

YOU are the Provider **PART 5**

The patient is becoming combative and resists your attempts to assist his ventilations, but he will tolerate oxygen via a nonrebreathing mask. During your reassessment, you note blood on the front of the patient's underwear, which was not there during previous assessments. You examine the area more carefully but do not see any open injuries to the genitalia or adjacent areas. You call your radio report in to the receiving facility.

Recording Time: 17 Minutes	
Level of consciousness	Responsive to pain only
Respirations	28 breaths/min; shallow
Pulse	128 beats/min; weak and regular
Skin	Cool, pale, and clammy
Blood pressure	90/58 mm Hg
Spo_2	93% (on oxygen)

The patient begins vomiting bright red blood. You quickly turn the backboard to the side to allow the vomitus to drain and then suction his mouth to ensure that his airway remains clear.

7. On the basis of your reassessment, what additional injuries should you suspect?
8. How will your reassessment findings change your current treatment plan?

Primary Assessment

During the primary assessment, you must quickly scan the patient to identify and treat potential life threats and determine the priority of patient care and transport. The genitourinary system is very vascular, and injuries to it can produce a significant volume of blood loss. Do not avoid this area during the primary assessment. In fact, life-threatening hemorrhage must be addressed immediately, even before airway or breathing concerns. Look externally at the patient's undergarments for signs of bleeding and injury. If bleeding is present, maintain privacy for the patient and inspect the exterior genitals for visible injury.

As you approach the trauma patient, important indicators will alert you to the seriousness of the patient's condition. Is the patient awake and interacting with his or her surroundings, or lying still, not making sounds? Does the patient have any apparent life threats? What color is the patient's skin? Is he or she appropriately or inappropriately responding to you? Your general impression will help you develop an index of suspicion for serious injuries and determine how urgently your patient needs care.

As stated, the genitourinary system is very vascular and can be a significant source of bleeding.

If visible significant bleeding is seen, you must begin the steps necessary to control bleeding. Significant bleeding is an immediate life threat and must be controlled quickly using appropriate methods. In dark environments, bleeding can be hard to see because of its color. Thick clothing may also hide bleeding. After you consider the MOI and form suspicions as to where bleeding may occur, expose that part of the body.

Ensure the patient has a clear and patent airway. Because trauma was involved, protect the patient from further spinal injury as you manage the airway. If the patient is unresponsive or has a significant altered level of consciousness, consider inserting an oropharyngeal airway or nasopharyngeal airway. Quickly assess the patient for adequate breathing. Provide assisted ventilations using a BVM as needed, depending on the level of consciousness and if your patient is breathing inadequately.

Quickly assess the patient's pulse rate and quality; determine the skin condition, color, and temperature; and check the capillary refill time. These assessments will help you determine the presence of circulatory conditions or shock. Closed injuries do not always have visible signs of bleeding. Because the bleeding is occurring inside the body, shock may be present. Your assessment of the pulse and skin will indicate to you how aggressively you need to treat your patient for shock.

A patient with a genitourinary system injury should be taken to a trauma center for evaluation and treatment. Any injury to this system can prove to be life altering and often requires specialized care from a medical specialist. When possible and protocols allow, transport the patient to a facility capable of treating this subset of injuries.

History Taking

When determining the chief complaint, you are seeking the primary reason that the patient called for assistance. Begin your interview by establishing why the patient called 9-1-1. Ask about associated complaints, but be cautious not to put words in the patient's mouth, such as when describing pain. This can be avoided by asking, "What else is wrong?" or "Is anything else bothering you?" Common associated complaints with genitourinary injuries are nausea, vomiting, diarrhea, blood in urine (hematuria), vomiting blood (hematemesis), or abnormal bowel and bladder habits such as an increase in frequency or the absence of the need to void. You can use the SAMPLE history to further gather more facts and specifics about the chief complaint.

Use the SAMPLE mnemonic device to help determine the patient's baseline. Establish the signs and symptoms of the injury. Use OPQRST to learn more about any pain the patient reports. Ask the patient about output from the genitourinary system, specifically the presence of blood in the urine. This may or may not be visible, and the simple lack of it does not preclude your patient from having internal genitourinary injuries. Ask your patient about any allergies to medications or environmental triggers. Medications mask the signs and symptoms of injuries or make them more severe, so it is important to determine what your patient is prescribed and what over-the-counter or herbal remedies the patient may have taken. The importance of past medical history cannot be overstated. Incidence of repeated or previous injury or illness involving the genitourinary system can help determine the extent of the current injury and possibly the MOI. The last intake of both food and fluids is important because it can predict what is contained in the genitourinary system and if the symptoms are related to the ingestion of those foods and fluids. Finally, addressing the events that led to the injury help determine the MOI and help you draw conclusions and develop an index of suspicion.

Secondary Assessment

The secondary assessment is a more detailed, comprehensive examination of the patient that is used to uncover injuries that may have been missed during the primary assessment. In some instances, such as with a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

Genitourinary system injuries can be awkward to evaluate and can be even more awkward to treat. Privacy is a genuine concern. When examining the patient, expose only what is needed. If an area must be exposed, cover it after it has been examined. Being professional helps reduce anxiety for both you and your patient. If possible, a provider who is the same gender as the patient should perform direct assessment of the genitalia. However, never delay treatment of any reason if hemorrhage is significant and potentially life threatening.

When your patient has an isolated injury to the genitourinary system with a limited MOI, focus your assessment on the isolated injury, the patient's concern, and the body region affected. Look for DCAPBTLS. Ensure that wounds are identified and the bleeding is controlled. Note the location and extent of the injury.

If there is significant trauma (such as a blunt trauma) likely affecting multiple systems, start with an exam of the entire body looking for DCAP-BTLS to determine the nature and extent of genitourinary injury. This examination will help determine all the injuries and the extent of those injuries. Inspect or visualize the region looking for deformities that may reveal the presence of multiple rib fractures (that could injure the kidneys). Identify small areas of contusions or abrasions that may pinpoint a specific point of impact. The presence of penetrating injuries indicates a possible internal injury that should be managed accordingly. The presence of burns must be noted and managed appropriately. Palpate for tenderness to localize the injury and the presence of fractures. Look for lacerations and local swelling. Applying this systematic approach to patient assessment minimizes the chance of missing a significant injury.

With genitourinary injuries, it is important to not focus only on one area of the body. With significant trauma, you should quickly assess the entire patient from head to toe.

Obtain the patient's vital signs. Patients who have hidden injuries may have internal bleeding and their condition may rapidly become unstable. It is important to reassess the vital signs to identify how quickly the patient's condition is changing. Signs such as tachycardia, tachypnea, low blood pressure, weak pulse, and cool, moist, and pale skin indicate hypoperfusion and imply the need for rapid treatment at the hospital. The reassessment of your patient's vital signs will give you a good understanding of how well or how poorly your patient is tolerating the injury.

Reassessment

Repeat the patient's primary assessment and vital signs. Reassess the interventions and treatment you have provided to the patient. Identify trends in pain, vital signs, and the progress of treatments to determine whether the patient's condition is improving or getting worse. Adjustments in care should be based on these objective findings.

When treating patients with trauma to the genitourinary system, the concerns are similar to those for other injuries to other body systems. Provide oxygen if there are signs of dyspnea or shock and maintain a patent airway. Attempt to control bleeding and treat for shock. Place the patient in a position of comfort and transport to the appropriate facility.

Communicate your suspicions and concerns early with the receiving facility staff so they can be adequately prepared and, if required, have a specialist en route to evaluate and treat the patient. Your documentation should be complete and thorough. Describe all injuries and the treatment given. Remember, your documentation is your legal record of what happened.

Emergency Medical Care of Genitourinary Injuries

Kidneys

Damage to the kidneys may not be obvious on inspection of the patient. You may or may not see bruises or lacerations on the overlying skin. However, you will see signs of shock if the injury is associated with significant blood loss. Because one of the functions of the kidneys is the formation of urine, another sign of kidney damage is blood in the urine (hematuria). Treat shock and associated injuries in the appropriate manner. Provide rapid transport to the hospital, carefully monitoring the patient's vital signs en route.

Urinary Bladder

Suspect a possible injury of the urinary bladder if you see blood at the urethral opening or physical signs of trauma on the lower abdomen, pelvis, or perineum. There may be blood at the tip of the penis or a stain on the patient's underwear.

The presence of associated injuries or of shock will dictate the urgency of transport. In most instances, provide rapid transport, and monitor the patient's vital signs en route.

External Male Genitalia

A few general rules apply to the treatment of injuries involving the external male genitalia:

- These injuries are very painful. Make the patient as comfortable as possible.
- Use sterile, moist compresses to cover areas that have been stripped of skin.
- Apply direct pressure with dry, sterile gauze dressings to control bleeding.
- Never move or manipulate impaled instruments or foreign bodies in the urethra.
- If possible, always identify and take avulsed parts to the hospital with the patient. Label the bag with the patient's name.

If you encounter a patient with an avulsion (tearing away) of skin of the penis, wrap the penis in a soft, sterile dressing moistened with sterile saline solution, and rapidly transport the patient. Use direct pressure to control any bleeding. You should try to save and preserve the avulsed skin, but do not delay treatment or transport for more than a few minutes to do so.

Managing blood loss is your top priority in amputation of the penile shaft, whether partial or complete. You should use local pressure with a sterile dressing on the remaining stump. Never apply a constricting device to the penis to control bleeding. Surgical reconstruction of even a completely amputated penis is possible if you can locate the amputated part. Wrap it in a moist, sterile dressing; place it in a plastic bag; and transport it in a cooled container; do not allow it to come in direct contact with ice.

If the connective tissue surrounding the erectile tissue in the penis is severely damaged, the shaft of the penis can be fractured or severely angled, sometimes requiring surgical repair. The injury may occur during particularly active sexual intercourse. It is associated with intense pain, bleeding into the tissues, and fear. Provide rapid transport to the ED.

Accidental laceration of the skin about the head of the penis usually occurs when the penis is erect and is associated with heavy bleeding. Local pressure with a sterile dressing is usually sufficient to stop the hemorrhage.

It is not uncommon for the skin of the shaft of the penis or the foreskin to get caught in the zipper of pants. If a small segment of the zipper is involved (one or two teeth), you can try to unzip the pants. If a longer segment is involved or the patient is agitated, use heavy scissors to cut the zipper out of the pants to make the patient more comfortable during transport. Explain to the patient how you are going to use the scissors before you begin cutting. Be particularly careful not to cause injury to the scrotum while cutting the zipper away from the penis.

Urethral injuries in men are not uncommon. Lacerations of the urethra can result from straddle injuries, pelvic fractures, or penetrating wounds of the perineum. These injuries may bleed profusely, although bleeding may not be evident externally. Direct pressure with a dry, sterile dressing usually controls any external hemorrhage. Because the urethra is the channel for urine, it is very important to know whether the patient can urinate and whether hematuria is present. For this reason, you should save any voided urine for later examination at the hospital. Any foreign bodies that may be protruding from the urethra will have to be removed in a surgical setting.

Avulsion of the skin of the scrotum may damage the scrotal contents. If possible, preserve the avulsed skin in a moist, sterile dressing for possible use in reconstruction. Wrap the scrotal contents or the perineal area with a sterile, moist compress, and use a local pressure dressing to control bleeding. Promptly transport the patient to the ED.

Direct blows to the scrotum can result in the rupture of a testicle or significant accumulation of blood around the testes. In either case, you should apply an ice pack to the scrotal area while transporting the patient.

Female Genitalia

Lacerations, abrasions, and avulsions should be treated with moist, sterile compresses. Use local pressure to control bleeding and a diaper-type bandage to hold dressings in place. Under no circumstances should you pack or place dressings into the vagina. Leave any foreign bodies in place after you stabilize them with bandages.

In general, although these injuries are painful, they are not life threatening. Bleeding may be heavy, but it can usually be controlled by local compression. Contusions and other blunt injuries all require careful in-hospital evaluation. However, the urgency for transport will be determined by associated injuries, the amount of hemorrhage, and the presence of shock.

Rectal Bleeding

Rectal bleeding is a common complaint and something that you may hear as a chief complaint or secondary to abdominal or pelvic complaints. Bleeding from the rectum may present as blood stains or blood soaking through underwear or patients may report blood in the toilet after a bowel movement or attempted bowel movement. Rectal bleeding can be caused by a sexual assault, rectal foreign bodies, hemorrhoids, colitis, or ulcers of the digestive track. Significant rectal bleeding can occur after hemorrhoid surgery and can lead to significant blood loss and shock.

Sexual Assault and Rape

Sexual assault and rape are all too common. According to the US Department of Justice's National Crime Victimization Survey, there are 293,066 victims (age 12 or older) of rape and sexual assault each year. The definition of rape, sexual assault, and similar terms differs by state. Although most victims are women, men and children are also victimized. Often, you can do little beyond providing compassion and transportation to the ED. On some occasions, patients will have sustained multiple-system trauma and will also need treatment of shock.

Do not examine the genitalia of a victim of sexual assault unless obvious bleeding requires you to apply a dressing. Treat all other injuries according to appropriate procedures and protocols for your EMS system. Observe standard precautions. Take care to shield the patient from curious onlookers. Because you may have to appear in court as much as 2 or 3 years later, you must document in detail the patient's history, assessment, treatment, and response to treatment. Do not speculate. Record only the facts.

Follow any crime scene policy established by your system to protect the scene and any potential evidence for police. Advise the patient not to wash, bathe, shower, douche (if female), urinate, or defecate until after a physician has examined him or her; this will help preserve any evidence of a crime. If oral penetration has occurred, advise the patient not to eat, drink, brush teeth, or use mouthwash until he or she has been examined. If the patient will tolerate being wrapped in a sterile burn sheet, this may help investigators find any hair, fluid, or fiber from the alleged offender. Handle the patient's clothes as little as possible, placing articles and any other evidence in paper bags. Do not use plastic bags. If a female patient insists on urinating, have her do so in a sterile urine container (if available). Also, have her deposit the toilet paper in a paper bag. Seal and label the bag for the police because these items can be critical evidence.

To reduce the patient's anxiety, whenever possible the EMT who is caring for the patient should be the same gender as the patient. Remember, a victim of rape or sexual assault, whether a man or a woman, may need medical assistance. In these cases, you must treat the medical injuries but also provide privacy, support, and reassurance. Chapter 23, *Gynecologic Emergencies*, covers this topic in detail.

YOU are the Provider — SUMMARY

1. How do hollow organ injuries differ from solid organ injuries?

Hollow organs—the stomach, intestines, and urinary bladder—are structures through which materials pass. When hollow organs are ruptured or lacerated, they release their contents into the pelvis or peritoneal (abdominal) cavity. The release of hollow organ contents into the peritoneal cavity causes an intense inflammatory response (peritonitis), which can result in a life-threatening infection. Hollow organ injury may be associated with some internal bleeding; however, the major cause of death is sepsis, which typically occurs later in the hospital.

Solid organs—the liver, spleen, pancreas, and kidneys—are highly vascular and tend to bleed profusely when injured by blunt or penetrating trauma. Unlike hollow organ injury, the major cause of death following injury to the solid organs is internal hemorrhage, which can very quickly lead to death.

2. How should you focus your assessment of a patient with potential intra-abdominal bleeding?

When you are caring for a patient with blunt or penetrating abdominal trauma, you should focus on recognizing signs and symptoms of shock, initiating treatment without delay, and providing rapid transport to the hospital.

If your patient sustained blunt abdominal trauma, has external evidence of injury (eg, bruising, distention, rigidity), and signs of shock—all signs that clearly suggest intra-abdominal bleeding—does the origin of the hemorrhage affect the treatment that you provide in the field? The answer, of course, is no. What *does* matter is that *the patient is bleeding from a source that you cannot control*, and that his or her outcome depends on you recognizing the situation, initiating prompt treatment, and providing rapid transport.

3. How should you interpret your primary assessment findings?

Rarely do EMS providers actually witness the injury when it occurs; this is why it is so important for you to pay attention to clues that suggest a particular mechanism of injury (MOI). However, in this situation you did witness the patient being trampled by a bull and were able to see that his injuries appear to be to the abdomen and flanks.

On the basis of the MOI and your primary assessment findings, your initial impression should be that your patient is in shock, which is likely the result of intra-abdominal bleeding. Although you will need to perform a head-to-toe secondary assessment to identify any other injuries, intra-abdominal bleeding is the most plausible field impression given the information that you have. You should quickly identify this patient as a "load and go," begin immediate treatment, and arrange for rapid transport to the hospital.

4. What immediate treatment is indicated for this patient?

Apply high-flow oxygen via a nonrebreathing mask. Oxygen is a critical treatment for any patient with signs and symptoms of shock and should be administered as soon as possible. Carefully monitor the patient's breathing and be ready to assist his ventilations if signs of inadequate breathing (eg, shallow breaths [reduced tidal volume], decreased mental status) are observed.

Cover the patient with a blanket to keep him warm. Patients in shock are less able to maintain body temperature because heat production requires energy, and energy requires oxygen; shock is a problem caused by a lack of oxygen!

5. What are some common bruising patterns and clinical signs associated with intra-abdominal bleeding?

As blood accumulates in the abdominal cavity, the abdomen typically becomes distended and rigid. Palpation of the patient's abdomen can be challenging in the presence of abdominal guarding. Guarding is a conscious (voluntary) or unintentional (involuntary) response to abdominal trauma and it is characterized by stiffening of the rectus abdominis muscles in an attempt to minimize the pain. Although guarding may be seen in patients who do not have significant intra-abdominal injury, *any abdominal rigidity following trauma should be assumed to be the result of internal bleeding*.

If bruising is observed following abdominal trauma, there are several patterns that you should look for during your assessment of the abdomen. Periumbilical (around the umbilicus) bruising is an indicator of blood in the peritoneal cavity. Bruising to the flank area is also an indicator of blood behind the peritoneal cavity and suggests injury to the kidneys, pelvis, or bladder.

Injury to the liver or spleen may present with referred pain to the shoulders. Unlike radiating pain, which is characterized by pain that "moves" from one area of the body to another, referred pain is characterized by pain in two separate locations.

It is important to note that some patients with intra-abdominal bleeding may not present with external signs of injury. The retroperitoneal space is a common location for hidden bleeding and can accommodate a large volume of blood.

6. Why is your patient's condition deteriorating? How should you modify your treatment?

Your patient was exhibiting signs of shock on initial contact with him. His level of consciousness has decreased, he is hypotensive, his breathing is inadequate, and his oxygen saturation is falling despite the use of high-flow oxygen. This indicates that he is now in decompensated shock; the compensatory mechanisms that help maintain adequate perfusion to the tissues and cells of the body are failing.

Any deterioration in a patient's clinical status should prompt you to immediately repeat the primary assessment. His oxygen saturation is falling, which is likely the result of the combined effects of internal bleeding and inadequate breathing. At this point, you should begin assisting his ventilations with a BVM attached to high-flow oxygen. Consider inserting a nasopharyngeal airway; his level of consciousness has decreased to the point that he may not be able to completely maintain his own airway.

Patients who have experienced trauma and who are in shock should be transported in the supine position.

As you continue to treat the patient, you must continuously monitor his ABCs. His condition is critical, and he is at high risk for cardiac arrest. If he becomes apneic and pulseless, begin cardiopulmonary resuscitation and ask your partner to update the receiving facility.

7. On the basis of your reassessment, what additional injuries should you suspect?

Blood stains on the front of the patient’s underwear without evidence of any open genitalia injuries indicates that he has blood in his urine (hematuria) and suggests injury to his kidneys, urinary bladder, or both.

Remember, the patient had diffuse abdominal pain and abrasions to both the anterior part of his abdomen and flanks. In addition to injury to his liver or spleen, which is likely what is causing his shock, it is clearly possible that he experienced injury to his genitourinary organs as well.

If you will recall from your evaluation of the patient, he had pain and abrasions of his flanks; this indicates direct trauma to that area, which overlies the kidneys. Injury to the kidneys may not be obvious during your assessment. If anything, you may see only abrasions or redness over the flanks; flank bruising typically does not manifest until later. Because one of the functions of the kidney is the formation of urine, another sign of kidney injury is hematuria.

Hematuria can also indicate rupture of the urinary bladder. Blood at the urethral opening should also make you suspicious for urinary bladder rupture.

Hematemesis, the vomiting of blood, indicates bleeding within the gastrointestinal tract. More specifically, vomiting bright red blood indicates injury to some part of the upper gastrointestinal tract. You should suspect injury to the patient’s stomach.

8. How will your reassessment findings change your current treatment plan?

Despite the presence of indicators that suggest injury to both solid and hollow abdominal and genitourinary organs, you should maintain the patient’s airway, ensure adequate oxygenation and ventilation, and treat for shock. Rapid transport to a trauma center is critical!

Blunt trauma with internal bleeding is often more fatal than penetrating abdominal trauma with external bleeding. Open injuries are obvious, whereas internal injuries are often hidden and may be missed. In the absence of obvious external injury, a trauma patient with signs of shock should be assumed to be bleeding into his or her abdomen.

EMS Patient Care Report (PCR)

Date: 12-16-16	**Incident No.:** 012809	**Nature of Call:** Traumatic injury		**Location:** 1333 Rodeo Blvd.	
Dispatched: 1904	**En Route:** 1904	**At Scene:** 1904	**Transport:** 1914	**At Hospital:** 1925	**In Service:** 1934

Patient Information

Age: 20 **Sex:** M **Weight (in kg [lb]):** 61 kg (135 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** None **Chief Complaint:** Pain in abdomen, flanks, and back of head

Vital Signs

Time: 1910	**BP:** 104/54	**Pulse:** 120	**Respirations:** 24	**Spo_2:** 97%
Time: 1916	**BP:** 82/54	**Pulse:** 134	**Respirations:** 28	**Spo_2:** 88%
Time: 1921	**BP:** 90/58	**Pulse:** 128	**Respirations:** 28	**Spo_2:** 93%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Thermal management, shock treatment, spinal immobilization, suctioning

Narrative

Medic 4 was standing by at a rodeo event when a bull rider was thrown from a bull and trampled. On contact with the patient, a 20-year-old man, he was found to be conscious, but restless, and in severe pain. His airway was patent and his breathing was adequate; radial pulses were rapid and weak. Manual c-spine stabilization was initiated immediately. Patient reports pain in the RUQ of his abdomen, his flank areas, and the back of his head. Administered high-flow oxygen via nonrebreathing mask and performed secondary assessment. Assessment revealed abrasions of the anterior part of the abdomen and both flanks and palpable tenderness in the RUQ. Breath sounds were clear to auscultation bilaterally, and the remainder of the assessment was unremarkable. Applied full spinal immobilizaion, covered patient with a blanket, loaded him into the ambulance, obtained vital signs, and began transport to the hospital. En route, patient's mental status and vital signs deteriorated; he was now responsive only to pain; his respirations increased in rate, but decreased in depth; a marked decrease in his blood pressure was observed; and his oxygen saturation decreased. Began assisting the patient's ventilations with a BVM attached to high-flow oxygen. Patient became somewhat combative and would no longer tolerate assisted ventilation. However, he would tolerate oxygen via nonrebreathing mask. Reassessment of patient revealed little improvement in his vital signs. Noted blood on patient's underwear, which was previously not present. Assessment of genitalia and adjacent areas revealed no signs of open injury. Continued to monitor patient and contacted receiving facility. Patient then began vomiting bright red blood, so the backboard was immediately turned to the side and the patient's mouth was suctioned to ensure airway patency. Suctioned remaining vomitus from the patient's mouth and returned the backboard to a supine position. Called radio report to receiving facility to provide update on patient's status, and closely monitored his condition throughout the duration of the transport. Patient was delivered to emergency department staff without further incident, and verbal report was given to attending physician. Medic 4 cleared the hospital and returned to service at 1934.**End of report**

Prep Kit

Ready for Review

- Abdominal injuries are categorized as either open (penetrating trauma) or closed (blunt force trauma).
- Either classification of injury can result in injury to the hollow or solid organs of the abdomen and cause significant life-threatening bleeding.
- Blunt force trauma that causes closed injuries results from an object striking the body without breaking the skin, such as being hit with a baseball bat or when the patient's body strikes the steering wheel during a motor vehicle crash.
- Penetrating trauma is often a result of a gunshot wound or stab wound. Other mechanisms of injury such as a fall on an object can also cause penetrating trauma to the abdomen.
- Injury to the solid organs often causes significant internal bleeding that can be life threatening.
- Injury to the hollow organs of the abdomen may cause irritation and inflammation to the peritoneum as caustic digestive juices leak into the peritoneum. A serious infection may also occur over several hours.
- Always maintain a high index of suspicion for serious intra-abdominal injury in the trauma patient, particularly in the patient who exhibits signs of shock.
- Assess the abdomen for signs of bruising, rigidity, penetrating injuries, and reports of pain.
- Never remove an impaled object from the abdominal region. Secure it in place with a large bulky dressing and provide rapid transport. When a penetrating injury exists, spinal immobilization is usually not indicated (follow local protocol).
- Be prepared to treat the patient for shock. Place the patient supine, keep the patient warm, and provide high-flow oxygen.
- Never replace an organ that protrudes from an open injury to the abdomen (evisceration). Instead, keep the organ moist and warm. Cover the injury site with a large, sterile, moist, bulky dressing and an occlusive dressing, if specified by local protocol.
- Injuries to the kidneys may be difficult to detect because they are located in the well-protected region of the body. Be alert to bruising or a hematoma in the flank region.
- Injury to the solid organs often causes significant internal bleeding that can be life threatening.
- In the case of sexual assault or rape, treat for shock if necessary, and record all the facts in detail. Follow any crime scene policy established by your system to protect the scene and any potential evidence. Advise the patient not to wash, bathe, shower, douche (if female), or void until after a physician has examined him or her.

Vital Vocabulary

closed abdominal injury An injury in which there is soft-tissue damage inside the body but the skin remains intact.

evisceration The displacement of organs outside of the body.

flank The region below the rib cage and above the hip.

guarding Contracting the stomach muscles to minimize the pain of abdominal movement; a sign of peritonitis.

hematuria Blood in the urine.

hollow organs Structures through which materials pass, such as the stomach, small intestines, large intestines, ureters, and urinary bladder.

melena Black, tarry stools.

open abdominal injury An injury in which there is a break in the surface of the skin or mucous membrane, exposing deeper tissue to potential contamination.

peritoneal cavity The abdominal cavity.

peritoneum The membrane lining the abdominal cavity (parietal peritoneum) and covering the abdominal organs (visceral peritoneum).

solid organs Solid masses of tissue where much of the chemical work of the body takes place (eg, the liver, spleen, pancreas, and kidneys).

Assessment *in Action*

You are dispatched to a private residence for a person reporting abdominal pain. You arrive to find a 25-year-old man lying on the couch in the fetal position. The patient states he was tackled while playing football 3 days ago and he now has pain that is becoming progressively worse. He is pale and diaphoretic. A physical examination of the abdomen shows bruising over the right and left upper quadrants, rebound tenderness, and guarding. The patient states the pain radiates to his right shoulder. Assessment of his vital signs shows a pulse rate of 130 beats/min, a blood pressure of 90/60 mm Hg, and respirations of 24 breaths/min.

1. Bruising over the right upper quadrant could indicate injury to which of the following?

   A. Liver
   B. Colon
   C. Kidney
   D. Appendix

2. Appropriate management of this patient would include:

   A. advanced life support intercept.
   B. semi-Fowler positioning.
   C. assisted ventilation.
   D. oxygen via Venturi mask.

3. On the basis of your findings, which of the following best describes the patient's condition?

   A. Respiratory distress
   B. Altered mental status

C. Multisystem trauma
D. Shock resulting from blunt trauma

4. The patient's pain radiating to the right shoulder is most likely referred from the:

   A. bladder.
   B. liver.
   C. kidney.
   D. intestine.

5. What potentially injured organs are found in the left upper quadrant?

   A. Spleen and liver
   B. Spleen and ascending colon
   C. Spleen and gallbladder
   D. Spleen and stomach

6. Bleeding from solid organs may be causing shock in this patient. Which of the following are considered solid organs?

   A. Liver and intestines
   B. Kidneys and bladder
   C. Spleen and stomach
   D. Pancreas and spleen

7. The most concerning assessment finding for the patient is:

   A. passage of time since injury.
   B. tachypnea and tachycardia.
   C. fetal position.
   D. progressive pain level.

8. Which of the following signs would indicate that an injury to the kidney has occurred?

   A. Hemoptysis
   B. Hematuria
   C. Hematoma
   D. Hematemesis

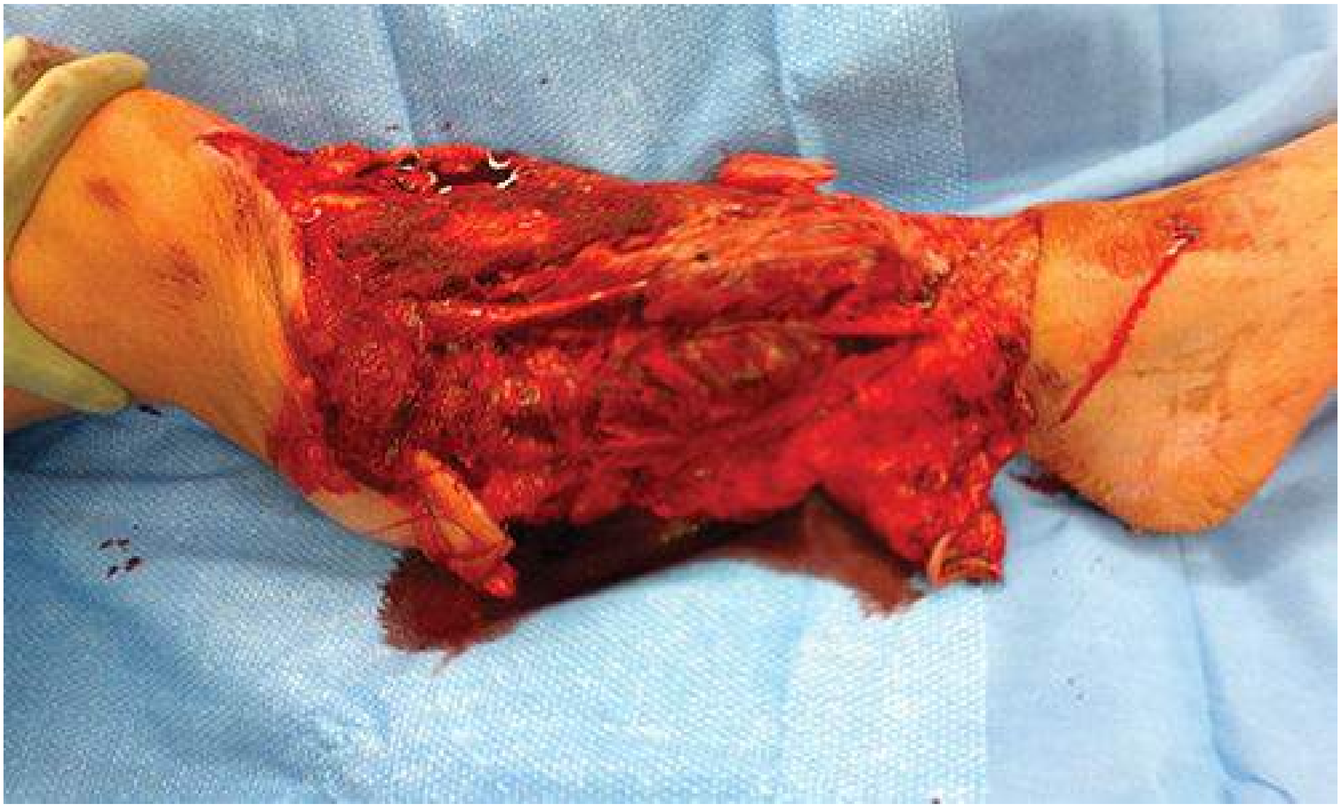
9. What is the cause of peritonitis?

10. What would guarding tell you about this patient's potential injuries?

CHAPTER

31

Orthopaedic Injuries



National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Orthopaedic Trauma

› Recognition and management of
- Open fractures (pp 1093–1096, 1103–1131)
- Closed fractures (pp 1093–1096, 1103–1131)
- Dislocations (pp 1096, 1103–1131)
- Amputations (pp 1097–1098, 1122–1123, 1132)

› Pathophysiology, assessment, and management of
- Upper and lower extremity orthopaedic trauma (pp 1092–1132)
- Open fractures (pp 1093–1096, 1099–1131)
- Closed fractures (pp 1093–1096, 1099–1131)
- Dislocations (pp 1096, 1099–1131)
- Sprains/strains (pp 1096–1097, 1099–1103, 1120–1121, 1130–1132)
- Pelvic fractures (pp 1093–1095, 1098–1103, 1114–1115, 1123–1125)
- Amputations/replantation (pp 1097–1103, 1122–1123, 1132)

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Nontraumatic Musculoskeletal Disorders

Anatomy, physiology, pathophysiology, assessment, and management of

› Nontraumatic fractures (pp 1093–1096, 1099–1131)

Knowledge Objectives

1. Describe the anatomy and physiology of the musculoskeletal system. (pp 1087–1091)
2. Name the four mechanisms of injury. (pp 1092–1093)
3. Describe the different types of musculoskeletal injuries, including fractures, dislocations, amputations, sprains, and strains. (pp 1092–1098)
4. Recognize the characteristics of specific types of musculoskeletal injuries. (pp 1092–1099, 1115–1132)
5. Differentiate between open and closed fractures. (p 1093)
6. Explain how to assess the severity of an injury. (pp 1098–1099)
7. Describe the emergency medical care of the patient with an orthopaedic injury. (pp 1103–1132)
8. Describe the emergency medical care of the patient with a swollen, painful, deformed extremity (fracture). (pp 1103–1130)
9. Discuss the need for, general rules of, and possible complications of splinting. (pp 1104–1105)
10. Explain the reasons for splinting fractures, dislocations, and sprains at the scene versus transporting the patient immediately. (pp 1104–1105)
11. Describe the emergency medical care of the patient with an amputation. (p 1132)

Skills Objectives

1. Demonstrate the care of musculoskeletal injuries. (pp 1103–1104, Skill Drill 31-1)
2. Demonstrate how to apply a rigid splint. (p 1106, Skill Drill 31-2)
3. Demonstrate how to apply a zippered air splint. (pp 1107–1108, Skill Drill 31-3)
4. Demonstrate how to apply an unzippered air splint. (p 1108, Skill Drill 31-4)
5. Demonstrate how to apply a vacuum splint. (p 1109, Skill Drill 31-5)
6. Demonstrate how to apply a Hare traction splint. (pp 1111–1113, Skill Drill 31-6)
7. Demonstrate how to apply a Sager traction splint. (pp 1113–1114, Skill Drill 31-7)
8. Demonstrate how to splint the clavicle, the scapula, the shoulder, the humerus, the elbow, and the forearm. (pp 1115–1121)
9. Demonstrate how to splint the hand and wrist. (p 1123, Skill Drill 31-8)
10. Demonstrate how to care for a patient with an amputation. (p 1132)

Introduction

The human body is a well-designed system in which form, upright posture, and movement are provided by the musculoskeletal system. This system also protects the vital internal organs of the body. The term musculoskeletal refers to the bones and voluntary muscles of the body. However, the bones and muscles are susceptible to external forces that can cause injury. Also at risk are the tendons, cartilage, and the ligaments.

Musculoskeletal injuries are among the most common reasons why patients seek medical attention. Complaints related to the musculoskeletal system result in almost 60 million visits to physicians annually in the United States. Approximately one in seven Americans will experience some type of musculoskeletal impairment, leading to millions of missed days of work or school and costing hundreds of billions of dollars yearly. An estimated 70% to 80% of all patients with multiple system trauma have one or more musculoskeletal injuries.

Musculoskeletal system injuries are often easily identified because of pain, swelling, and deformity. Although these injuries are rarely fatal, they often result in short- or long-term disability. By providing prompt assessment and treatment, such as splinting, EMTs may help reduce the disability period for patients. Despite the sometimes dramatic appearance of these injuries, do not focus solely on a musculoskeletal injury without first determining that no life-threatening injuries exist. Never forget the ABCs!

As an EMT, you must be familiar with the basic anatomy of the musculoskeletal system. Although muscles are technically soft tissue, they are discussed in this chapter because of their close relationship with the skeleton. Therefore, the chapter begins with a review of the musculoskeletal anatomy. Various types and causes of musculoskeletal injuries in general are identified, and the assessment and treatment process for each is explained, followed by a detailed discussion of splinting. The chapter then focuses on specific musculoskeletal injuries, beginning at the clavicle and ending at the feet.

Anatomy and Physiology of the Musculoskeletal System

Muscles

The muscular system includes three types of muscles: skeletal, smooth, and cardiac. Skeletal muscle, also called striated muscle because of its characteristic stripes, attaches to the bones and usually crosses at least one joint. This type of muscle is also called voluntary muscle because it is under direct voluntary control of the brain, responding to commands to move specific body parts **Figure 31-1**. Usually, movement is the result of several muscles contracting and relaxing simultaneously. Skeletal muscle makes up the largest portion of the body’s muscle mass. Its primary functions are movement and posture. Cardiac muscle contributes to the cardiovascular system, and smooth muscle is a component of other body systems, including the digestive system and the cardiovascular system.

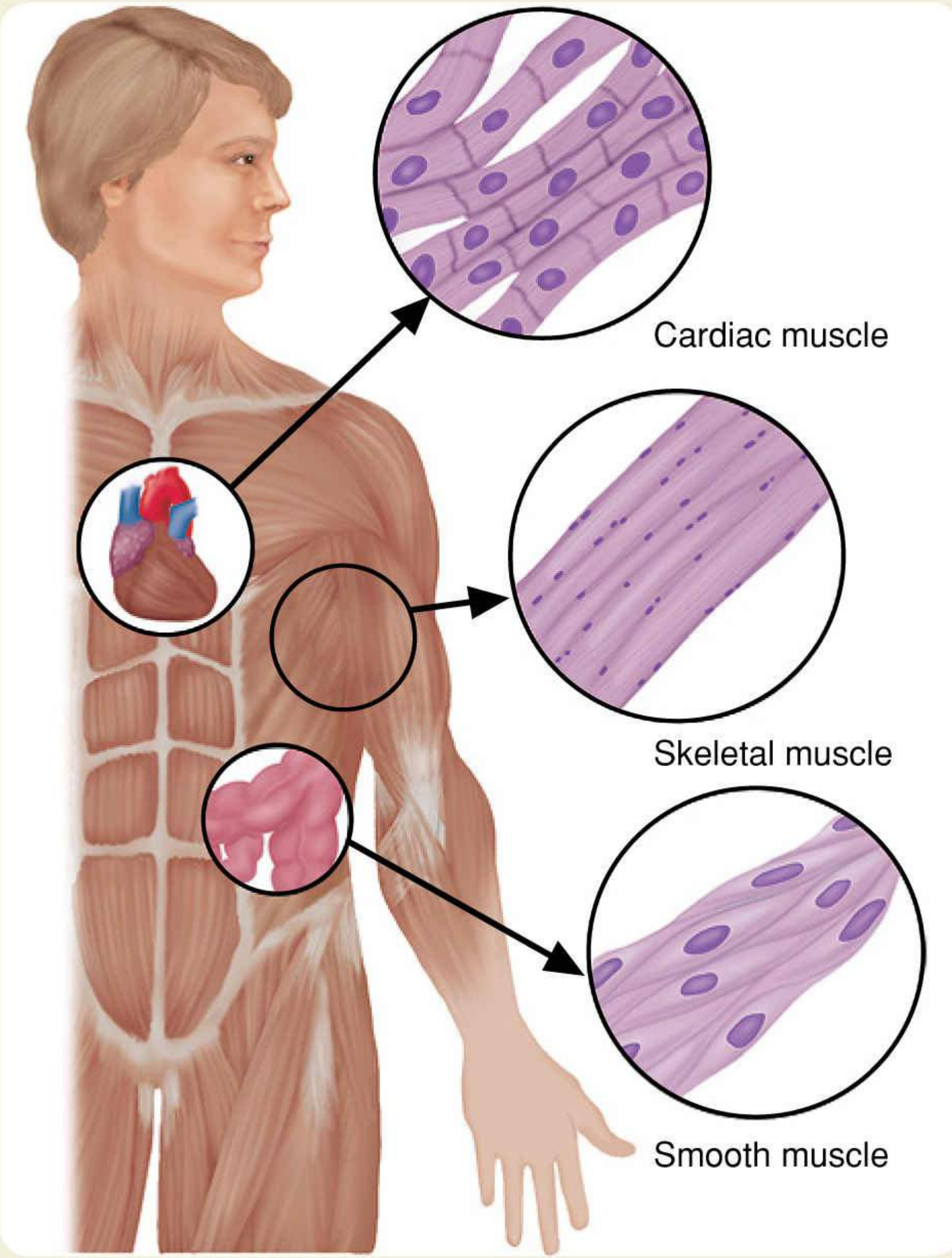


Figure 31-1 The major muscle type of concern for musculoskeletal injuries is skeletal muscle.

All skeletal muscles are supplied with arteries, veins, and nerves. Blood from the arteries brings oxygen, glucose, and nutrients to the muscles **Figure 31-2**. Waste products, including carbon dioxide and lactic acid, are carried away in the veins. Disease or trauma can result in the loss of a muscle's nervous supply; this, in turn, can lead to weakness and eventually atrophy, or a decrease in the size of the muscle and its inherent ability to function. Skeletal muscle tissue is directly attached to the bone by tough, ropelike structures known as tendons, which are extensions of the **fascia** (fibrous tissue) that covers all skeletal muscle. Fascia surrounds and supports the muscles and neurovascular structures.

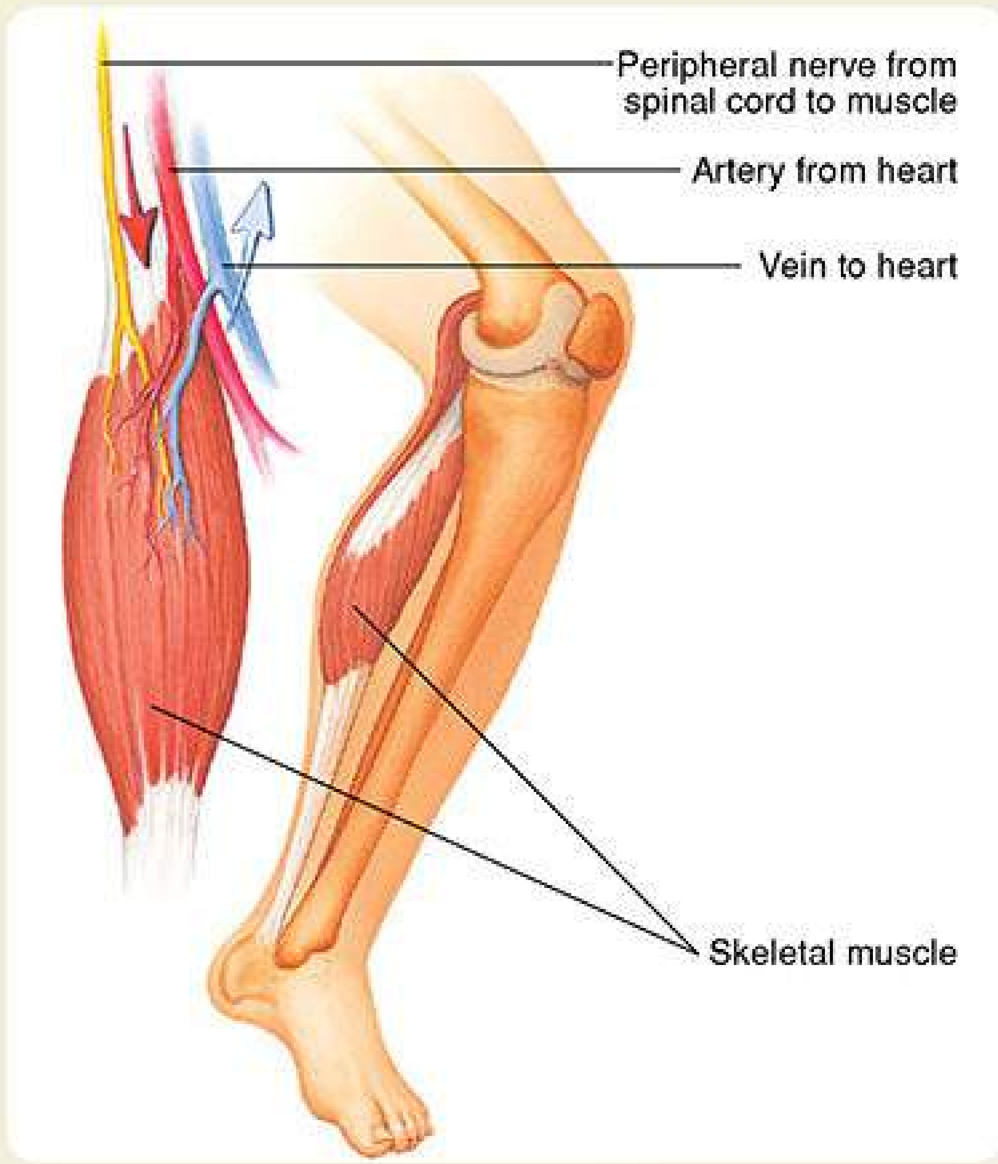


Figure 31-2 Skeletal muscles are supplied with arteries, veins, and nerves that bring oxygen and nutrients, carry away waste products, and supply nervous stimuli.

YOU are the Provider — PART 1

At 1620 hours, you are dispatched to a soccer field for a player with a possible broken leg. You and your partner proceed to the scene, with a response time of about 5 minutes. En route, dispatch advises you that the patient is conscious, alert, and breathing. The weather is overcast, the temperature is 88°F (31°C), and the traffic is moderate.

1. Under which circumstances can orthopaedic injuries pose a threat to a patient's life?
2. Given the information you have, can you rule out a critical injury?

Smooth muscle, also called involuntary muscle because it is not under voluntary control of the brain, performs much of the automatic work of the body. This type of muscle is found in the walls of most tubular structures of the body, such as the gastrointestinal tract and the blood vessels. Smooth muscle contracts and relaxes to control the movement of the contents within these structures **Figure 31-3**.

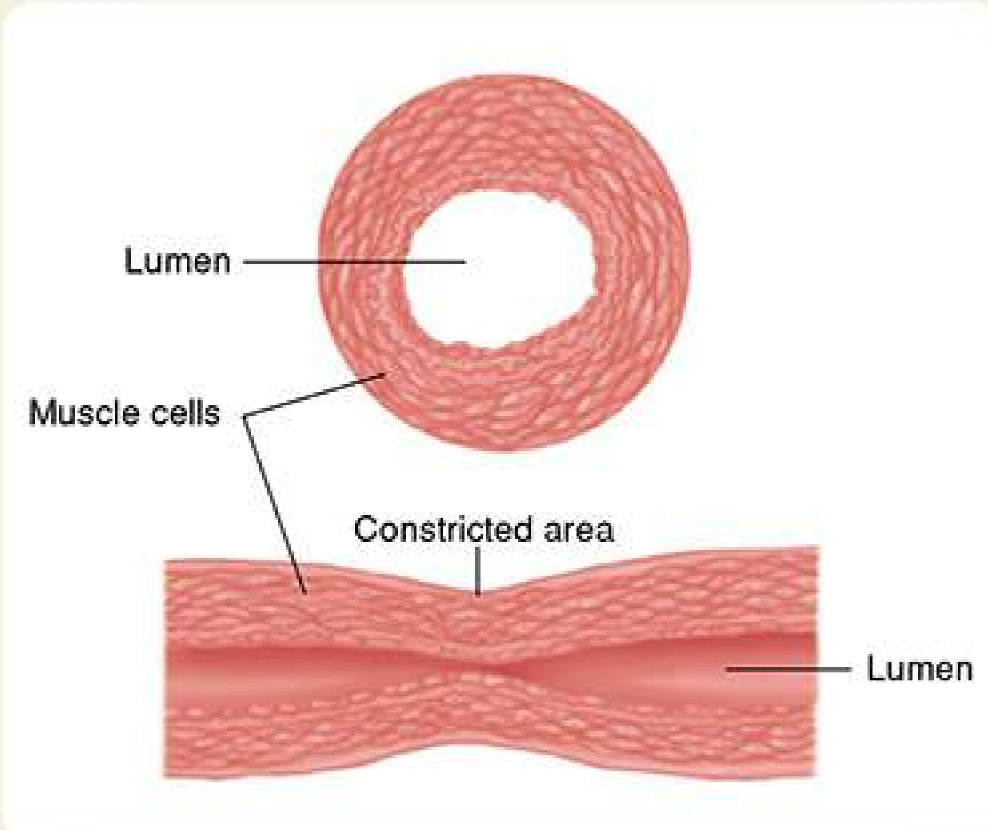


Figure 31-3 Smooth muscle is found in the walls of most tubular structures in the body. These muscles contract and relax to control the movement of the contents within these structures.

The heart neither looks nor acts like skeletal or smooth muscle. It is composed largely of cardiac muscle, a specially adapted involuntary muscle with its own regulatory system. The remainder of this chapter is concerned exclusively with skeletal muscle.

The Skeleton

The skeleton, which gives us our recognizable human form, protects our vital internal organs, and allows us to move, is made up of approximately 206 bones **Figure 31-4**. The bones in the skeleton also produce blood cells (in the bone marrow) and serve as a reservoir for important minerals and electrolytes.

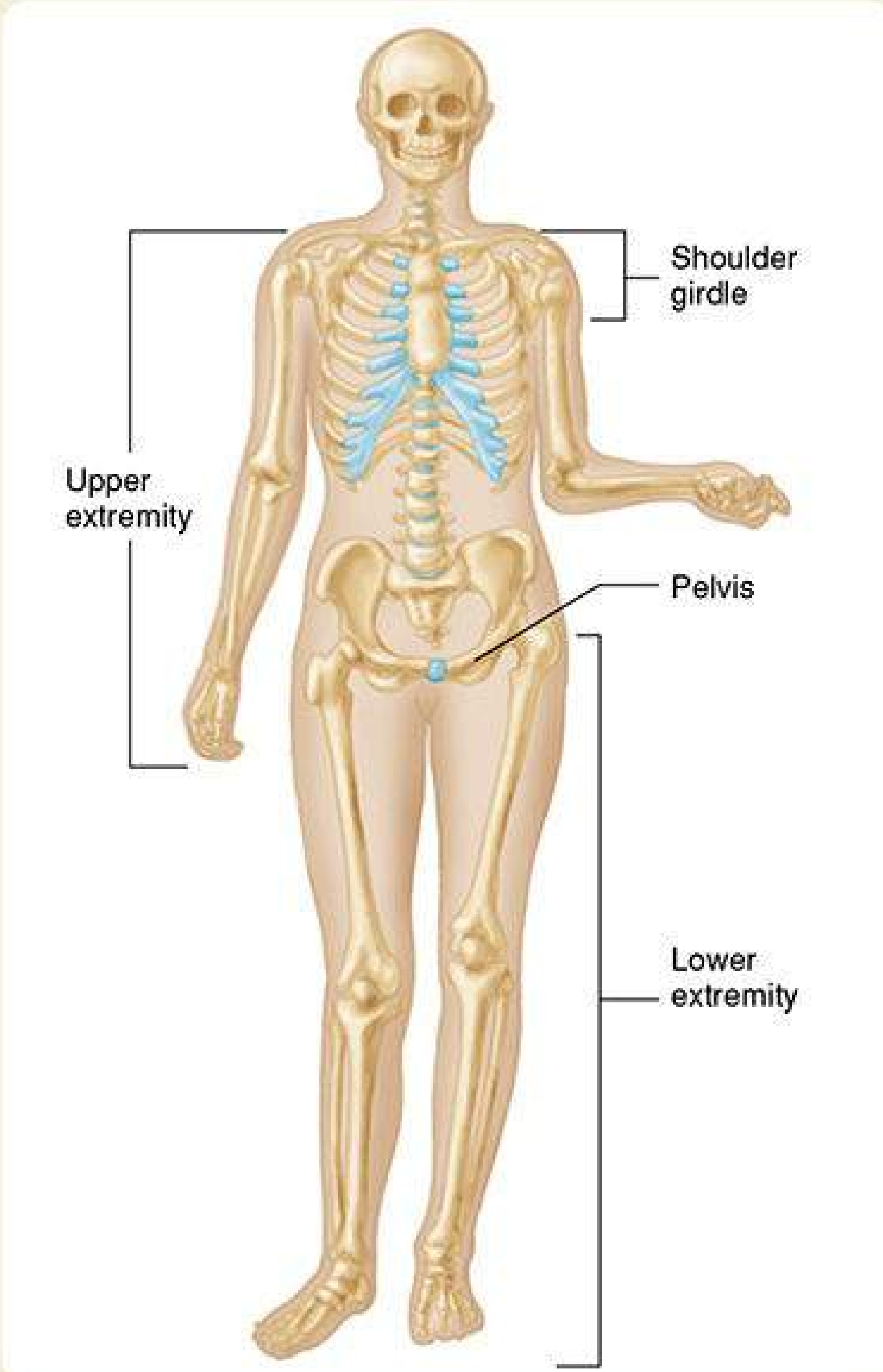


Figure 31-4 The human skeleton, consisting of approximately 206 bones, gives us our form and protects our vital organs.

The skull is a solid, vaultlike structure that surrounds and protects the brain. The thoracic cage protects the heart, lungs, and great vessels; the lower ribs protect the liver and spleen. The bony spinal canal encases and protects the spinal cord.

The pectoral girdle, also referred to as the shoulder girdle, consists of two scapulae and two clavicles **Figure 31-5**. The scapula (shoulder blade) is a flat, triangular bone held to the rib cage by powerful muscles that buffer it against injury. The clavicle (collarbone) is a slender, S-shaped bone attached by ligaments to the sternum on one end and to the acromion process on the other. The clavicle acts as a strut to keep the shoulder propped up; however, because it is slender and very exposed, this bone is vulnerable to injury.

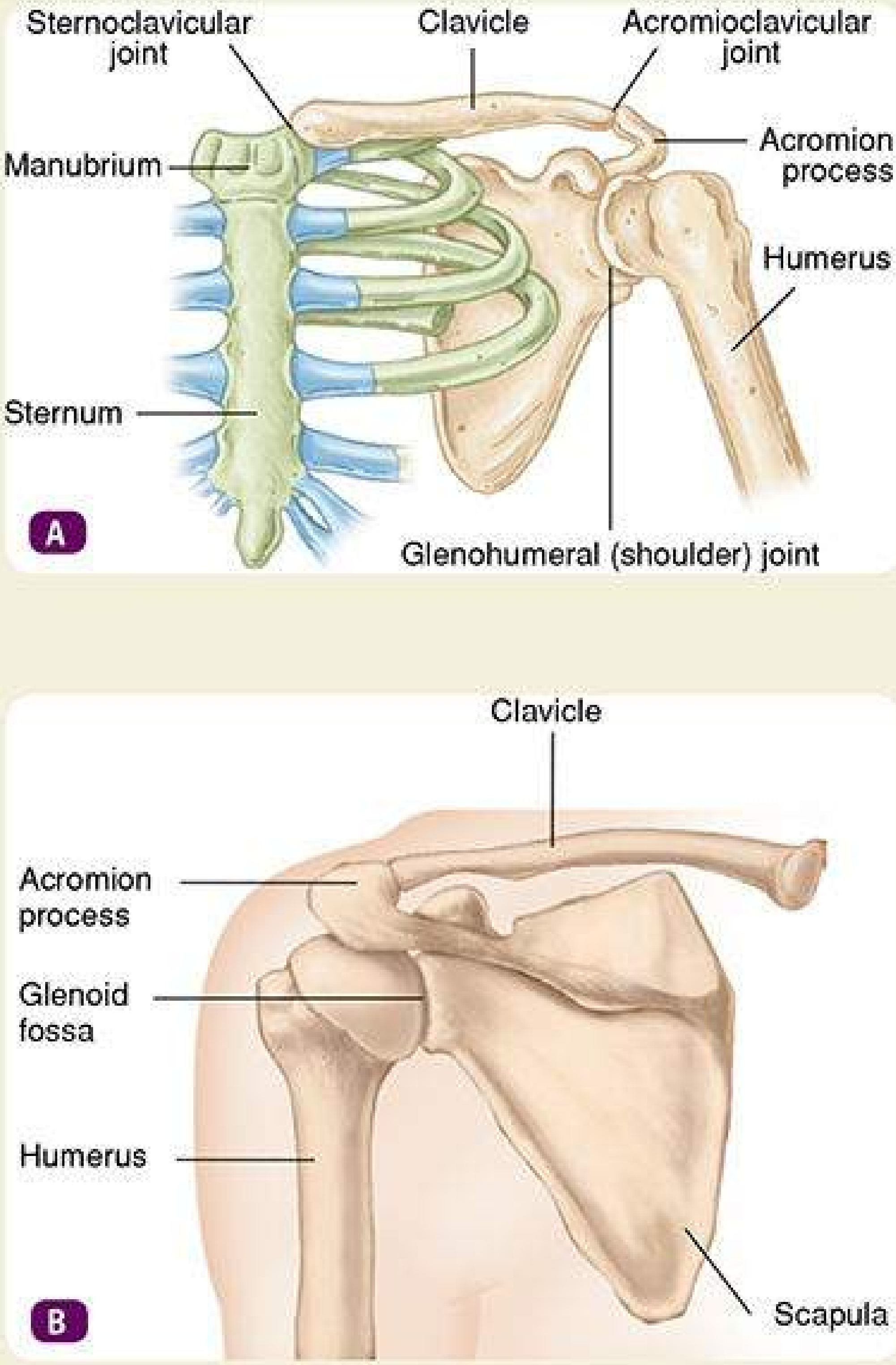


Figure 31-5 The pectoral girdle. **A.** Anterior view, including the clavicle. **B.** Posterior view, including the scapula.

A, B: © Jones & Bartlett Learning.

The upper extremity extends from the shoulder to the fingertips. The arm is composed of the upper arm (humerus), elbow, and forearm (radius and ulna) **Figure 31-6**. The upper extremity joins the shoulder girdle at the glenohumeral joint. The upper extremity begins with the humerus. The humerus connects with the bones of the forearm at the elbow—the radius and ulna—to form the hinged elbow joint.

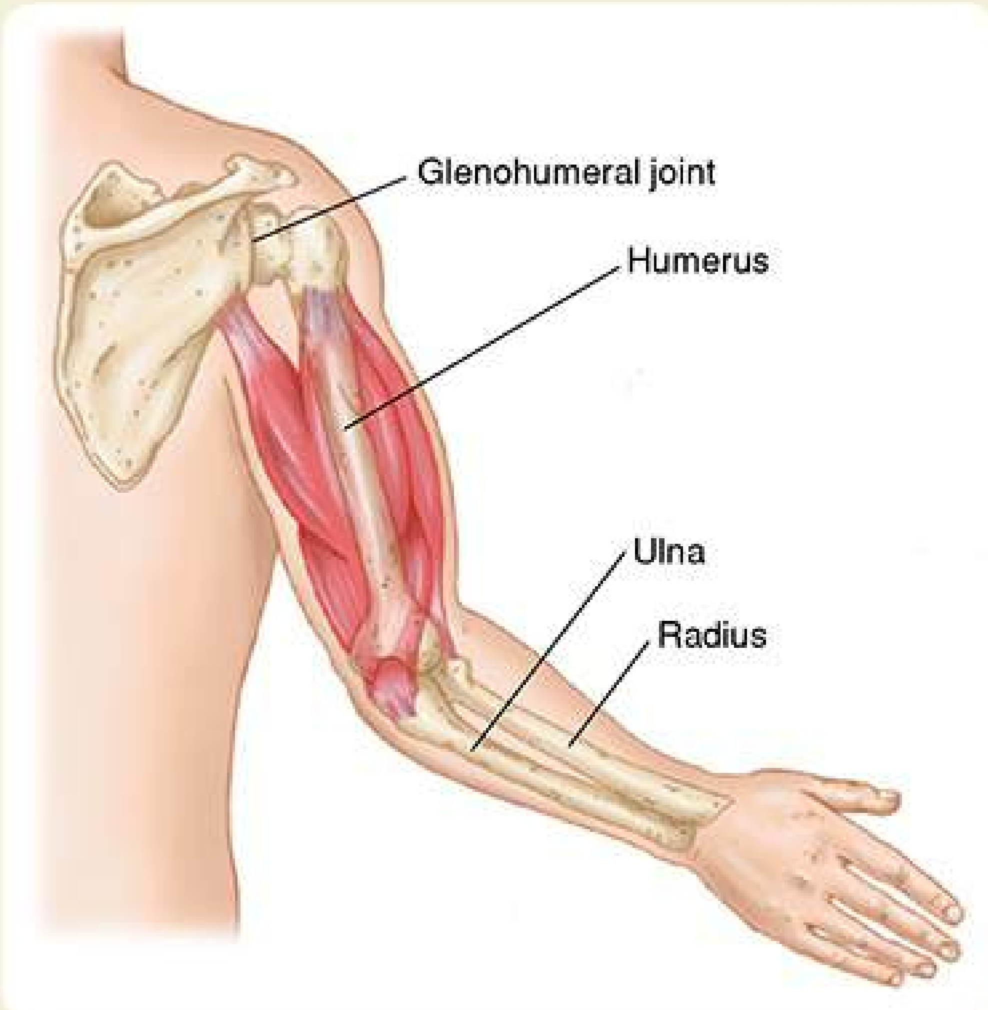


Figure 31-6 The anatomy of the arm.

The radius and ulna make up the forearm. The radius, the larger of the two forearm bones, lies on the thumb side of the forearm. The ulna is narrow and is on the little finger side of the forearm. Because the radius and the ulna are parallel, when one is broken, the other is often broken as well.

The hand contains three sets of bones: wrist bones (carpals), hand bones (metacarpals), and finger bones (phalanges) **Figure 31-7**. The carpals are vulnerable to fracture when a person falls on an outstretched hand. Phalanges are more apt to be injured by a crush injury, such as being slammed in a door.

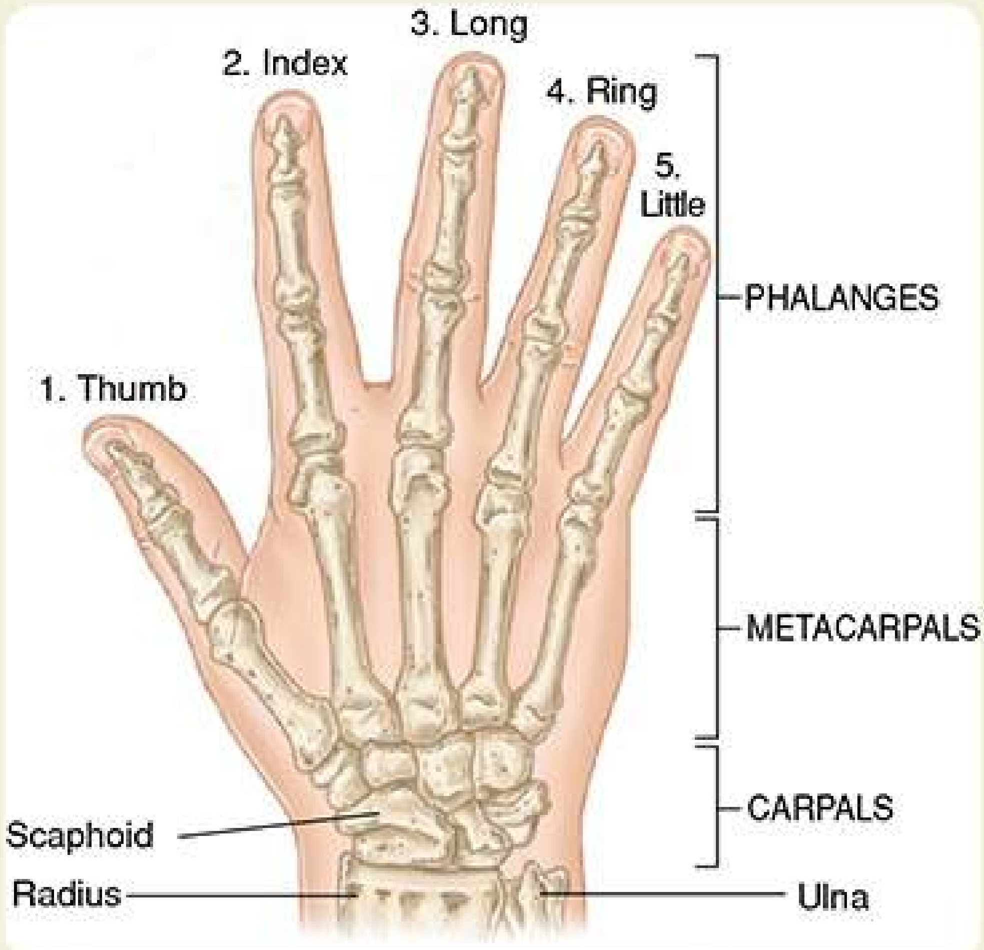


Figure 31-7 The anatomy of the wrist and hand.

The pelvis supports the body weight and protects the structures within the pelvis: the bladder, rectum, and female reproductive organs. The pelvic girdle is actually three separate bones—the ischium, ilium, and pubis—fused together to form the innominate (or hip) bone. The two iliac bones are joined posteriorly by tough ligaments to the sacrum at the sacroiliac joints; the two pubic bones are connected anteriorly by equally tough ligaments to one another at the pubic symphysis. These joints allow very little motion, so the pelvic ring is strong and stable.

The lower extremity consists of the bones of the thigh, leg, and foot **Figure 31-8**. The femur (thighbone) is a long, powerful bone that connects in the ball-and-socket joint of the pelvis and in the hinge joint of the knee. The femoral *head* is the ball-shaped part that fits into the acetabulum. It is connected to the shaft (diaphysis), or long tubular portion of the femur, by the femoral neck. The femoral neck is a common site for fractures, generally referred to as hip fractures, especially in the older population. The greater trochanter and lesser trochanter are the names given to lateral and medial bony protuberances below the femoral neck and just above the shaft of the femur.

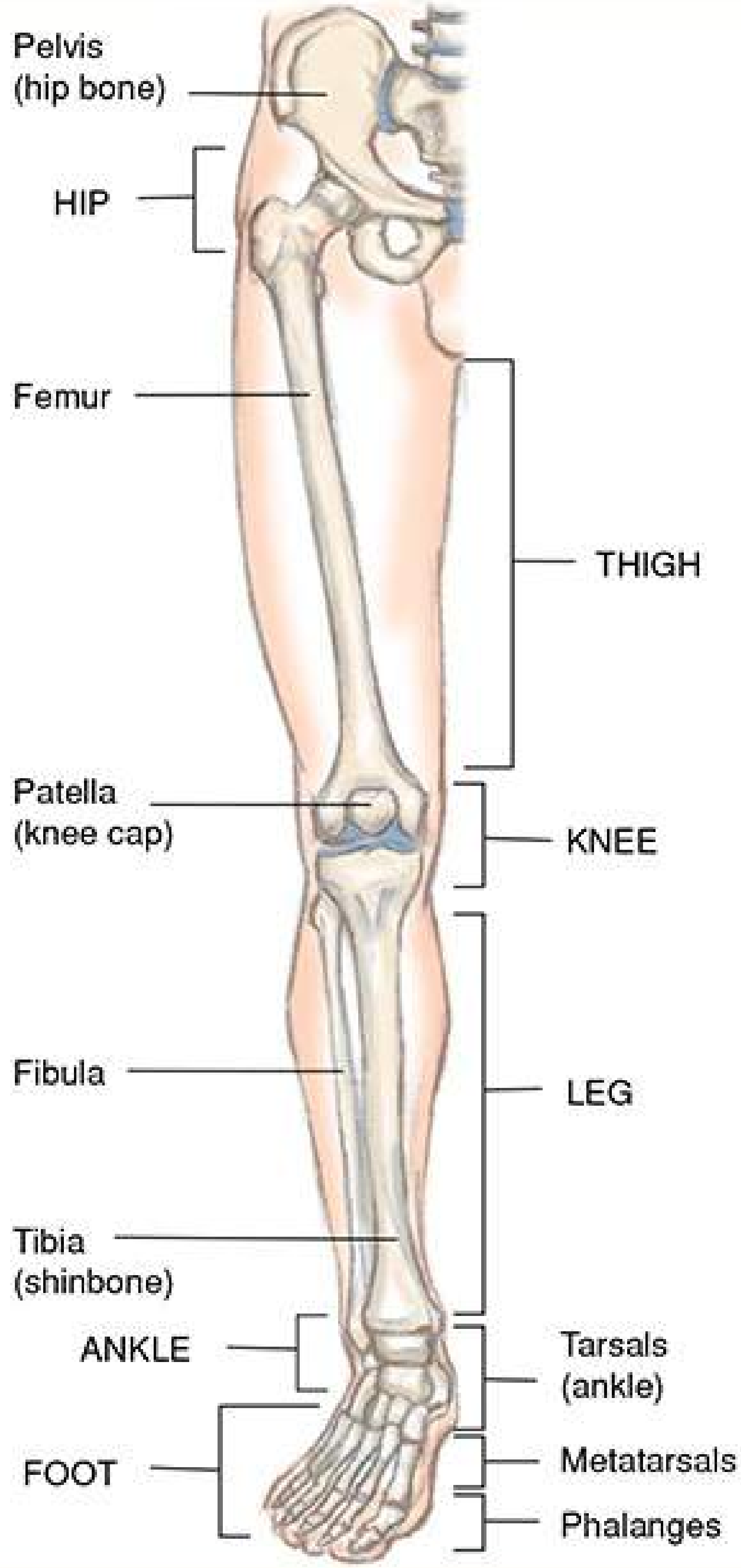


Figure 31-8 The bones of the thigh, leg, and foot.

The lower leg consists of two bones, the tibia and the fibula. The **tibia** (shinbone) is the larger of the two leg bones that are responsible for supporting the major weight-bearing surface of the knee and ankle. The tibia connects to the patella (knee cap) via the patellar tendon just below the knee joint and runs down the front of the lower leg. The tibia is vulnerable to direct blows and can be felt just beneath the skin. The much smaller **fibula** runs behind and beside the tibia. The fibula is an important anchor for ligaments surrounding the knee joint, and it forms the lateral side of the ankle joint.

The foot consists of three classes of bones: ankle bones (tarsals), foot bones (metatarsals), and toe bones (phalanges) **Figure 31-9**. The largest of the tarsal bones is the heel bone, or **calcaneus**, which is subject to injury with axial loading injuries, such as when a person jumps from a height and lands on the feet.

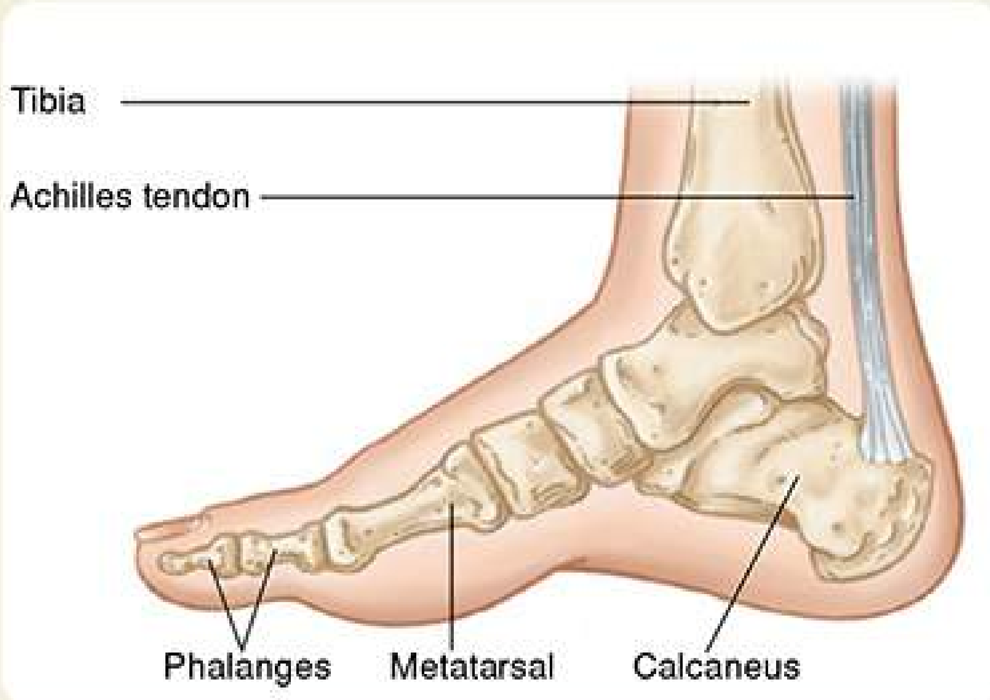


Figure 31-9 The bones of the foot and ankle.

The bones of the skeleton provide a framework to which the muscles and tendons are attached. Bone is a living tissue that contains nerves and receives oxygen and nutrients from the arterial system. Therefore, when a bone breaks, a patient typically experiences severe pain and bleeding. Bone marrow, located in the center of each bone, constantly produces red blood cells to provide oxygen and nourishment to the body and remove waste. White blood cells and platelets are also produced in the marrow cavity.

A **joint** is formed wherever two bones come into contact. The sternoclavicular joint, for example, is where the sternum and the clavicle come together. Joints are held together in a tough fibrous structure known as a capsule, which is supported and strengthened in certain key areas by bands of fibrous tissue called **ligaments**. In moving joints, the ends of the bones are covered with a thin layer of cartilage known as **articular cartilage**. This cartilage is a pearly white substance that allows the ends of the bones to glide easily. Joints are bathed and lubricated by synovial (joint) fluid.

Some joints, such as the shoulder, allow motion to occur in a circular manner. Other joints, such as the knee and elbow, act as hinges. Still other joints, including the sacroiliac joint in the lower back and the sternoclavicular joints, allow only a minimum amount of motion. Certain joints, such as the sutures in the skull (present until about 18 months of age), fuse together during growth to create a solid, immobile, bony structure **Figure 31-10**.

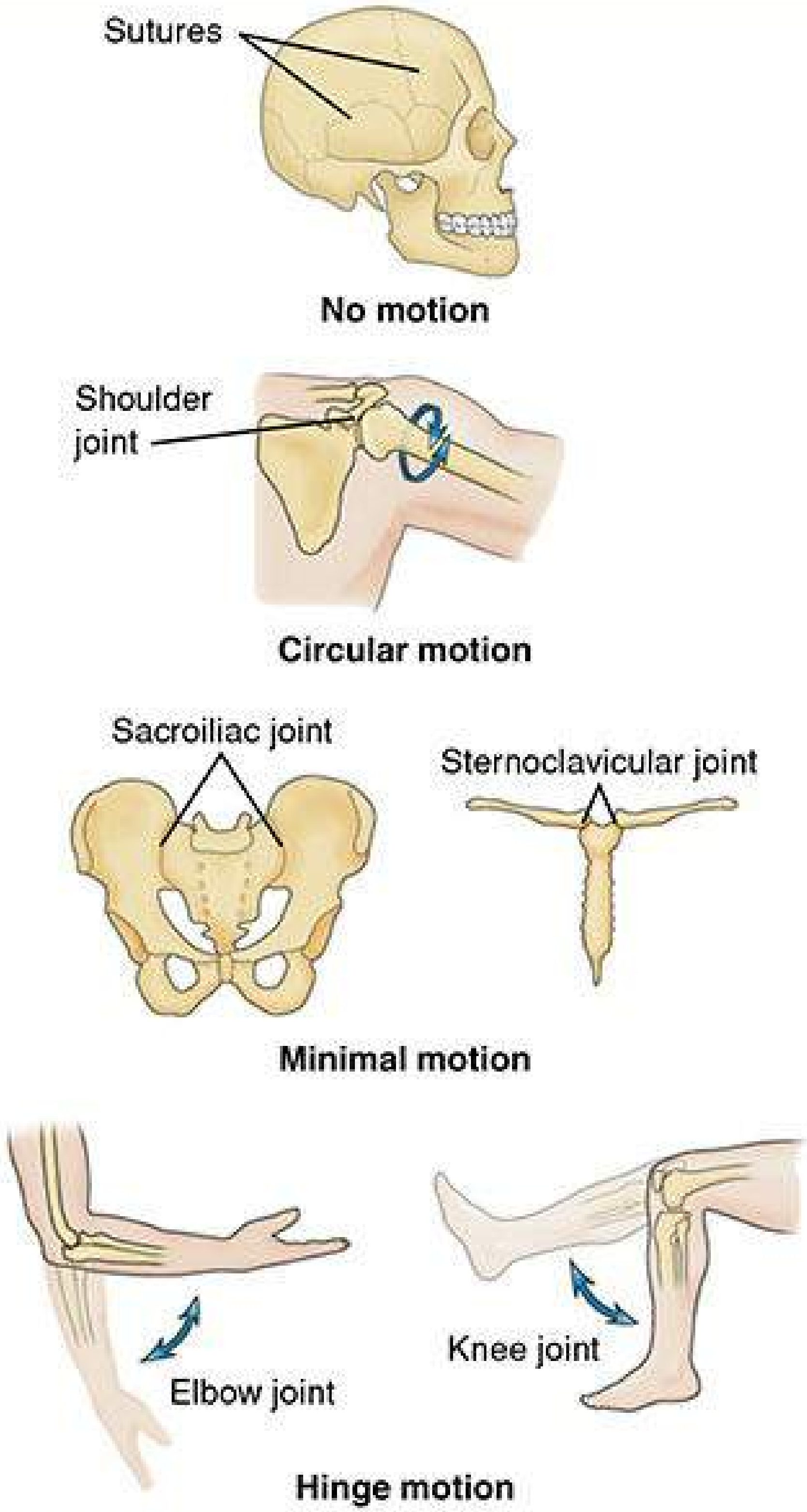


Figure 31-10 Joints have many functions. Some joints allow for motion to occur in a circular manner; others act as hinges. Still others allow only a minimum amount of motion or none at all.

Musculoskeletal Injuries

Injury to bones and joints is often associated with injury to the surrounding soft tissues, especially to the adjacent nerves and blood vessels. The entire area is known as the **zone of injury** Figure 31-11. Depending on the amount of kinetic energy the tissues absorb from forces acting on the body, the zone may extend to a distant point. For this reason, do not be distracted by a patient's obvious injury; you must first complete a primary assessment to check for life-threatening injuries. This is especially true in assessing damage from high-energy trauma, which is discussed next.

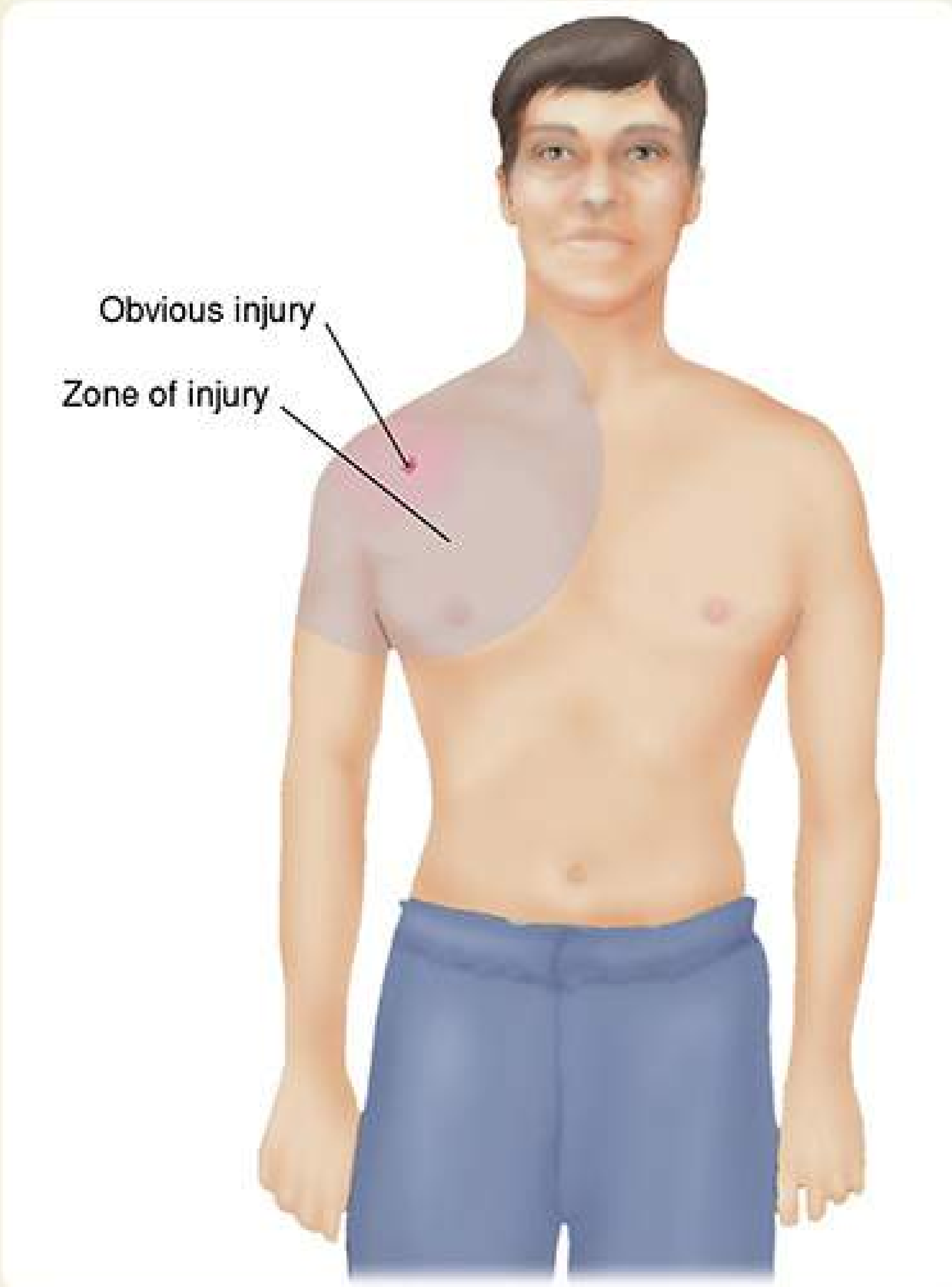


Figure 31-11 The zone of injury is the area of soft tissue, including the adjacent nerves and blood vessels, that surround the obvious injury of a bone or joint.

Mechanism of Injury

Significant force is generally required to cause fractures and dislocations. This force may be applied to the limb in any of the following ways **Figure 31-12**:

- Direct blows

- Indirect forces
- Twisting forces
- High-energy injuries

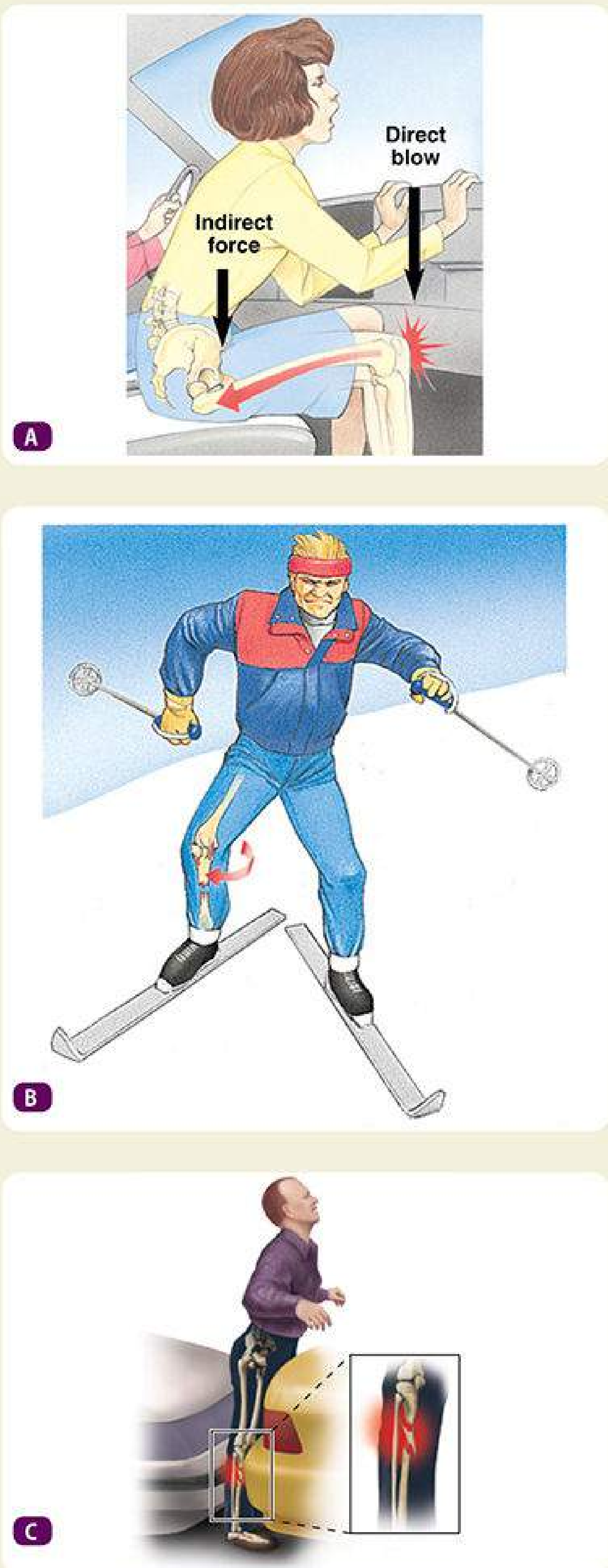


Figure 31-12 Significant force is required to cause fractures or dislocations. Among these are **(A)** direct blows and indirect forces, **(B)** twisting forces, and **(C)** high-energy crush injuries.

A direct blow fractures the bone at the point of impact. An example is the patella (knee cap) that fractures when it strikes the dashboard in a motor vehicle crash.

Indirect force may cause a fracture or dislocation at a distant point, as when a person falls and lands on an outstretched hand. The direct impact may cause a wrist fracture, but the indirect force can also cause dislocation of the elbow or a fracture of the forearm, humerus, or even clavicle. Therefore, when you are caring for patients who have fallen, immediately identify the point of contact and the mechanism of injury (MOI) so that you decrease the chance of overlooking any associated injuries.

Twisting forces are a common cause of musculoskeletal injury, especially to the anterior cruciate ligament (ACL) or the medial cruciate ligament (MCL) in the knee. Skiing injuries often happen because of twisting. A ski becomes caught, and the skier falls, applying a twisting force to the lower extremity.

High-energy injuries, such as those that result from motor vehicle crashes, falls from heights, gunshot wounds, and other extreme forces, produce severe damage to the skeleton, surrounding soft tissues, and vital internal organs. A patient may have multiple injuries to many body parts, including more than one fracture or dislocation in a single limb.

A significant MOI is not always necessary to fracture a bone. A slight force can easily fracture a bone that is weakened by a tumor, infection, or osteoporosis, a generalized bone disease that is common among postmenopausal women. In geriatric patients with osteoporosis, minor falls or simple twisting injuries can cause a fracture, most often of the wrist, spine, or hip. You should suspect the presence of a fracture in any older patient who reports pain and has sustained even a mild injury.

Fractures

A **fracture** is a broken bone. More precisely, it is a break in the continuity of the bone, often occurring as a result of an external force **Figure 31-13**. The break can occur anywhere on the surface of the bone and in many different types of patterns. Contrary to a common misconception, there is no difference between a broken bone and a fractured bone. A potential complication of fractures is compartment syndrome (discussed later in the chapter), which refers to elevated pressure within a fascial compartment.

Figure 31-13 A fracture can occur anywhere on the surface of a bone and may or may not break the skin.

Fractures are classified as either closed or open. In assessing and treating patients with possible fractures or dislocations, your first priority is to determine whether the overlying skin is damaged. If it is not, the patient has a **closed fracture**. However, making this determination is not always as easy as it sounds. With an **open fracture**, there is an external wound, caused either by the same blow that fractured the bone or by the broken bone ends lacerating the skin. The wound may vary in size from a very small puncture to a gaping tear that exposes bone and soft tissue. Regardless of the extent and severity of the damage to the skin, you should treat any injury that breaks the skin as a possible open fracture. Complications of open fractures include increased blood loss and a higher likelihood of infection. Be sure to wear gloves if there are any open wounds.

Fractures are also described by whether the bone is moved from its normal position. A **nondisplaced fracture** (also known as a hairline fracture) is a simple crack of the bone that may be difficult to distinguish from a sprain or simple contusion. Radiograph examinations are required for physicians to diagnose a nondisplaced fracture. A **displaced fracture** produces actual deformity, or distortion, of the limb by shortening, rotating, or angulating it. Often, the deformity is very obvious and can be associated with crepitus. However, in some cases the deformity is minimal. Be sure to look for differences between the injured limb and the opposite uninjured limb in any patient with a suspected fracture of an extremity **Figure 31-14**.

Figure 31-14 Always compare the injured limb with the uninjured limb when checking for deformity.

Medical personnel often use the following special terms to describe particular types of fractures Figure 31-15:

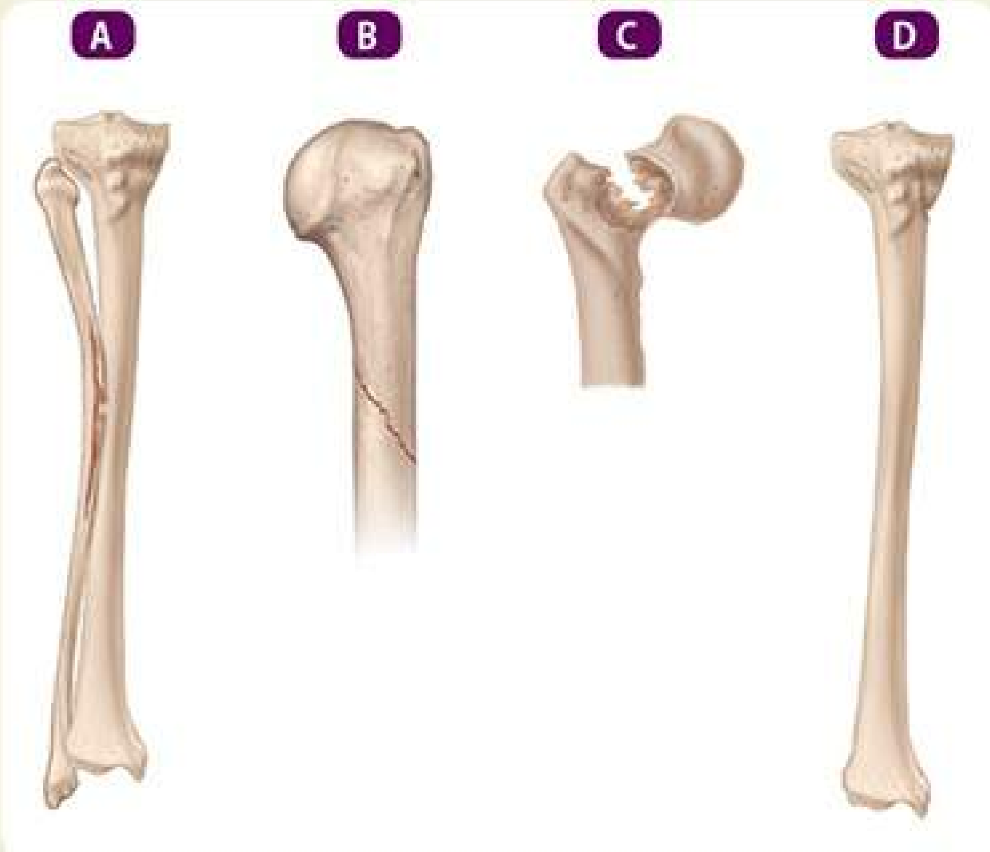


Figure 31-15 Special terms to describe fractures. **A.** Greenstick fracture. **B.** Oblique fracture. **C.** Pathologic fracture. **D.** Incomplete fracture.

A, B, C, D: © Jones & Bartlett Learning.

- **Comminuted.** A fracture in which the bone is broken into more than two fragments.
- **Epiphyseal.** A fracture that occurs in a growth section of a child's bone and may lead to growth abnormalities.
- **Greenstick.** An incomplete fracture that passes only partway through the shaft of a bone but may still cause substantial angulation; occurs in children.
- **Incomplete.** A fracture that does not run completely through the bone; a nondisplaced partial crack.
- **Oblique.** A fracture in which the bone is broken at an angle across the bone. This is usually the result of a sharp, angled blow to the bone.
- **Pathologic.** A fracture of weakened or diseased bone, seen in patients with osteoporosis, infection, or cancer; often produced by minimal force.
- **Spiral.** A fracture caused by a twisting or spinning force, causing a long, spiral-shaped break in the bone. This is sometimes the result of abuse in young children.
- **Transverse.** A fracture that occurs straight across the bone. This is usually the result of a direct blow injury.

Suspect a fracture if one or more of the following signs is present in any patient who has a history of injury and reports pain.

Deformity

The limb may appear to be shortened, rotated, or angulated at a point where there is no joint **Figure 31-16**. Always use the opposite, uninjured limb as a mirror image for comparison.

Figure 31-16 Obvious deformity, shortening, rotation, or angulation should increase your index of suspicion for a fracture.

Tenderness

Point tenderness on palpation in the zone of injury is the most reliable indicator of an underlying fracture, although it does not tell you the type of fracture **Figure 31-17**.

Guarding

An inability to use the extremity is the patient's way of immobilizing it to minimize pain. The muscles around the fracture contract in an attempt to prevent any movement of the broken bone. Guarding does not occur with all fractures; some patients may continue to use the injured part for a time. Occasionally, non-displaced fractures are less painful, and there is minimal soft-tissue damage.

Figure 31-17 Point tenderness is the sensitive spot at the site of injury that can be located by palpation along the bone with the tip of your finger.

Swelling

Rapid swelling usually indicates bleeding from a fracture and is typically followed by substantial pain. Often, if the swelling is severe, it may mask deformity of the limb **Figure 31-18**. Generalized swelling from fluid buildup may occur several hours after an injury.

Figure 31-18 Swelling that occurs in association with a fracture can often mask deformity of the limb.

Bruising

Fractures are almost always associated with **ecchymosis** (discoloration) of the surrounding soft tissues **Figure 31-19**. Bruising may be present after almost any injury and may take hours to develop; it is not specific to bone or joint injuries. The discoloration associated with acute injuries is usually redness, as you may have seen with someone who has been punched. Within hours or days, blue, purple, and black discoloration will appear, followed by yellow and green.

Figure 31-19 Fractures almost always have associated bruising into the surrounding soft tissue.

© fotokostic/iStockphoto.

Crepitus

A grating or grinding sensation known as **crepitus** can be felt and sometimes even heard when fractured bone ends rub together.

False Motion

Also called free movement, **false motion** is a point in the limb where there is no joint. It is a positive indication of a fracture.

Exposed Fragments

In open fractures, bone ends may protrude through the skin or be visible within the wound **Figure 31-20**. *Never* attempt to push the end of a protruding bone back into place. This will increase the risk for infection.

Figure 31-20 Bone ends may protrude through the skin or be visible within the wound of an open fracture.

Pain

Pain, along with tenderness, bruising, and bleeding, commonly occurs in association with fractures. Remember to use the OPQRST mnemonic to assess pain: Onset; Provocation/palliation; Quality; Region/Radiation; Severity; and Time (duration).

Locked Joint

A joint that is locked into position is difficult and painful to move. Keep in mind that crepitus and false motion appear only when a limb is moved or manipulated and are associated with injuries that are extremely painful. Do not manipulate the limb excessively in an effort to elicit these signs. This sign is more commonly the result of a soft-tissue injury within the joint (typically the knee or elbow), but the presence of a locked joint should alert you to the possibility of an underlying fracture.

Dislocations

A **dislocation** is a disruption of a joint in which the bone ends are no longer in contact. The supporting ligaments are often torn, usually completely, allowing the bone ends to separate from each other **Figure 31-21**. A fracture-dislocation is a combination injury at the joint in which the joint is dislocated and there is a fracture of the end of one or more of the bones.

A dislocated joint may sometimes spontaneously **reduce**, or return to its normal position before your assessment. In this situation, you will be able to confirm the dislocation only by taking a patient history. Often, however, the joint surfaces remain completely separated from one another. A dislocation that does not spontaneously reduce is a serious problem. The ends of the bone can be locked in a displaced position, making any attempt at motion of the joint very difficult and very painful. Commonly dislocated joints include the fingers, shoulder, elbow, hip, and knee.

Figure 31-21 A dislocation is a disruption of a joint in which the bone ends are no longer in contact. **A.** The clinical appearance of an elbow dislocation. **B.** Radiograph appearance of the same elbow.

A: © E.M. Singletary, M.D. Used with permission.; B: © Medical Body Scans/Science Source.

The signs and symptoms of a dislocated joint are similar to those of a fracture **Figure 31-22**:

- Marked deformity
- Swelling
- Pain that is aggravated by any attempt at movement
- Tenderness on palpation
- Virtually complete loss of normal joint motion (locked joint)
- Numbness or impaired circulation to the limb or digit

Sprains

A **sprain** occurs when a joint is twisted or stretched beyond its normal range of motion. As a result, the supporting capsule and ligaments are stretched or torn, resulting in injury to the ligaments, articular capsule, synovial membrane, and tendons crossing the joint. A sprain should be considered a partial dislocation.

Figure 31-22 Joint dislocations, such as this finger, are characterized by deformity, swelling, pain with any movement, tenderness, locking, and impaired circulation.

Sprains can range from mild to severe, depending on the amount of damage done to the supporting ligaments. The most severe sprains involve actual tearing of the ligament and may allow joint dislocation. Mild sprains are caused by ligament stretching rather than tearing. A sprain can occur in any joint, but sprains most often occur in the knee, shoulder, and ankle. Most sprains occur after a person misjudges a step or landing. Evasive moves, like those done during a sporting event, commonly cause sprains in athletes. Some patients might report hearing a “snap” when the injury occurred.

After the injury, the joint alignment generally returns to a fairly normal position, so the joint is not significantly displaced. In contrast with fractures and dislocations, sprains usually do not involve deformity, and joint mobility is usually limited by pain, not by joint incongruity. The following signs and symptoms often indicate that the patient may have a sprain **Figure 31-23**:

- The patient is unwilling to use the limb (guarding).

- Swelling and ecchymosis are present at the injured joint as a result of torn blood vessels.
- Pain prevents the patient from moving or using the limb normally.
- Instability of the joint is indicated by increased motion, especially at the knee; however, this may be masked by severe swelling and guarding.

Figure 31-23 Sprains most often occur in the knee or ankle and are characterized by swelling, bruising, point tenderness, pain, and joint instability.

A fracture can look like a sprain, and vice versa. You will frequently not be able to distinguish a nondisplaced fracture from a sprain. Therefore, it is important to document the MOI, because certain sprains and fractures occur more consistently with certain mechanisms. Your approach should always be to determine the MOI. The basic principles of prehospital management for sprains, dislocations, and fractures are essentially the same and are discussed later in the chapter.

▶ Strain

A **strain** (pulled muscle) is a stretching or tearing of the muscle and/or tendon, causing pain, swelling, and bruising of the soft tissues in the area. It occurs because of an abnormal contraction or from excessive stretching. Strains may range from minute separation to complete rupture. Unlike a sprain, no ligament or joint damage typically occurs.

Often no deformity is present and only minor swelling is noted at the site of the injury. Some patients may report a “snap” when a muscle tears. Some may report increased sharp pain with passive movement of the injured extremity. Patients may report severe weakness of the muscle. Most patients also have extreme point tenderness. The general treatment of strains is similar to the prehospital management for sprains, dislocations, and fractures.

▶ Amputations

An **amputation** is an injury in which an extremity is completely severed from the body. This injury can damage every aspect of the musculoskeletal system—from bone to ligament to muscle. Amputations can occur as a result of trauma or a surgical intervention.

▶ Complications

Orthopaedic injuries can lead to numerous complications—not just those involving the skeletal system, but also systemic changes or illness. It is essential that you do not focus all of your attention on the skeletal injury. Keep in mind that there is a patient attached to the injured extremity! For example, pregnant women who sustain pelvic fractures tend to have higher mortality rates. Therefore, it is imperative to treat not only the fracture, but also the other needs of the woman and fetus.

The likelihood of a complication is often related to the strength of the force that caused the injury, the injury's location, and the patient's overall health. Any injury to a bony structure is likely to be accompanied by bleeding. In general, the greater the force that caused the injury, the greater the hemorrhage will be. Following a fracture, the sharp ends of the bone may damage muscles, blood vessels, arteries, and nerves, or the ends may penetrate the skin and produce an open fracture. A significant loss of tissue may occur at the fracture site if the muscle is severely damaged or if the penetration of the bone into the skin causes a large deformity.

To prevent contamination following an open fracture, brush away any obvious debris on the skin surrounding an open fracture before applying a dressing. Do not enter or probe the open fracture site in an attempt to retrieve debris because this may lead to further contamination.

Long-term disability is one of the most devastating consequences of an orthopaedic injury. In many cases, a severely injured limb can be repaired and made to look almost normal. Unfortunately, many patients cannot return to work for long periods because of the extensive rehabilitation required and because of chronic pain. As an EMT, you have a critical role in mitigating the risk of long-term disability. You can help reduce the risk or duration of long-term disability by preventing further injury, reducing the risk of wound infection, minimizing pain by the use of cold and analgesia, and transporting patients with orthopaedic injuries to an appropriate medical facility.

Assessing the Severity of Injury

You must become skilled at quickly and accurately assessing the severity of an injury. The Golden Period (the time from injury to definitive care) is critical not only for life, but also for preserving limb viability. In an extremity with anything less than complete circulation, prolonged hypoperfusion can cause significant damage. For this reason, any suspected open fracture or vascular injury is considered a critical emergency. In a patient who has multisystem trauma, any additional bleeding can increase problems with underlying injuries or overall perfusion.

Remember that most injuries are not critical; you can identify critical injuries by using the musculoskeletal injury grading system shown in Table 31-1 as a guideline.

YOU are the Provider — PART 2

When you arrive at the scene, you find the patient, a 21-year-old woman, sitting on the ground with an ice pack over her left tibia. She is conscious and alert and tells you that another player fell against her leg.

Recording Time: 0 Minutes	
Appearance	Anxious; in obvious pain
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Radial pulses, increased rate; strong and regular

The patient denies having any other injuries and tells you that she heard a "snap" when the other player fell against her leg. She is in severe pain.

3. What initial treatment should you provide to this patient?
4. What are some indicators of a fractured bone?

Table 31-1 Musculoskeletal Injury Grading System

Minor Injuries

- Minor sprains
- Fractures or dislocations of digits

Moderate Injuries

- Open fractures of digits
- Nondisplaced long bone fractures
- Nondisplaced pelvic fractures
- Major sprains of a major joint

Serious Injuries

- Displaced long bone fractures
- Multiple hand and foot fractures
- Open long bone fractures
- Displaced pelvic fractures
- Dislocations of major joints
- Multiple digit amputations
- Laceration of major nerves or blood vessels

Severe, Life-Threatening Injuries (Survival is Probable)

- Multiple closed fractures
- Limb amputations
- Fractures of both long bones of the legs (bilateral femur fractures)

Critical Injuries (Survival is Uncertain)

- Multiple open fractures of the limbs
- Suspected pelvic fractures with hemodynamic instability

Patient Assessment

As an EMT, your assessments, attempts to splint, and efforts to stabilize the patient's condition are very important. However, always look at the big picture, evaluating the overall complexity of the situation to determine and treat any life threats. For example, overlooking an obstructed airway to splint a lower leg fracture could be deadly for the patient. Always carefully assess the MOI to try to determine the amount of kinetic energy that an injured limb has absorbed, and maintain a high index of suspicion for associated injuries.

It is not important to distinguish among fractures, dislocations, sprains, and contusions. In most cases, your assessment will be reported as an "extremity injury." However, you must be able to distinguish mild injuries from severe injuries because some severe injuries may compromise neurovascular function, which could threaten long-term function.

Scene Size-up Information

Information from dispatch may indicate the MOI, the number of patients involved, and any first aid procedures used prior to your arrival. This will be useful information for you to think about as you travel to the scene. Remember, the information given by the dispatcher is only as accurate as the patient's or bystander's report. In addition, the situation may change prior to your arrival at the incident. Dispatch information can still be used to help you consider whether spinal immobilization will be needed, the equipment you may need, and whether hazards might be present.

As you arrive at the scene, try to identify the forces associated with the MOI. Could they have produced injuries other than the musculoskeletal injuries reported by dispatch? Consider the possibility of hidden bleeding; internal injuries that you cannot see and closed fractures of the femur are examples. Standard precautions may be as simple as gloves. With a severe MOI or other risk factors, a mask and gown may be necessary. Eye protection may also be indicated. Evaluate the need for law enforcement support, advanced life support, or additional ambulances, and request them early based on your initial scene assessment.

When you assess a patient who has experienced a significant MOI, look for indicators of the MOI and be alert for both primary and secondary injuries. Primary injuries occur as a result of the MOI, whereas secondary injuries are the result of what happens after the initial injury. For example, being hit by a motor vehicle will often result in a primary pelvic injury and often a secondary head injury when the patient rolls onto the hood of the car. As you put together information from dispatch and your observations of the scene, consider what injuries the MOI would lead you to expect. For example, when you approach a rear-end motor vehicle crash, you should suspect head, neck, and chest injuries.

Primary Assessment

The primary assessment should focus on identifying and managing life threats. Treating the patient according to his or her level of consciousness and ABCs is always the priority. Threats to airway, breathing, and circulation are considered life threatening and must be treated immediately to prevent mortality. Significant bleeding, internal or external, is an immediate life threat. If the patient has obvious life-threatening external hemorrhage, it should be addressed first (even before airway and breathing), and then begin treating the patient for shock as quickly as possible. For example, if you are unable to control arterial bleeding from extremities by using direct pressure, apply a **tourniquet** (if possible). Arterial bleeding from a compound fracture should be treated prior to giving oxygen.

When evaluating the patient's level of consciousness and orientation, check for responsiveness using the AVPU scale, and assess mental status by asking the patient about his or her chief complaint. If the patient is alert, this should help direct you to any apparent life threats. An unresponsive patient may have an underlying life-threatening condition. You should administer high-flow oxygen via a nonrebreathing mask (or a bag-valve mask (BVM), if indicated) to all patients whose level of consciousness is less than alert and oriented, and provide rapid transport to the emergency department (ED).

Perform a primary assessment of the patient and ask about the MOI. Was it a direct blow, indirect force, twisting force, or high-energy injury? In many situations, the musculoskeletal complaints will be simple and usually not life threatening; however, some situations, such as those with a significant MOI, will include multiple problems that include musculoskeletal injuries. The initial interaction with your patient will provide you with a starting point and help you to distinguish the simple from the complex injuries. If there was significant trauma and multiple body systems were affected, the musculoskeletal injuries may be a lower priority. Scene time should not be wasted on prolonged musculoskeletal assessment or splinting fractures that are otherwise not life threatening. The expression "splinting to death" is used to describe such a situation; you are so involved in splinting fractures that the patient dies from other injuries.

Words of Wisdom

Medical emergences can result in falls and fractures. For example, a cardiac event or stroke can cause a fall and fractured hip in an older person.

Fractures and sprains usually do not create airway and breathing problems. Other problems, such as injuries to the head, intoxication, or other related illnesses and injuries, may cause inadequate breathing. Evaluating the chief complaint and MOI will help you to identify whether the patient has an open airway and whether breathing is present and adequate. In a conscious patient, this is as simple as noting whether the patient can speak normally. In an unconscious patient, it is as simple as opening the airway using the appropriate technique to check for breathing. Remember, very little else matters if the patient's airway and breathing are inadequate.

Words of Wisdom

If a spinal injury is suspected after evaluating the MOI and signs and symptoms, take the appropriate precautions and prepare for immobilization per local protocols.

Your circulatory assessment should focus on determining whether the patient has a pulse, has adequate perfusion, or is bleeding. If your patient is conscious, he or she will have a pulse. If the patient is unconscious, make sure there is a pulse by palpating the carotid artery. Hypoperfusion (shock) and bleeding problems will most likely be your primary concern. If the skin is pale, cool, or clammy and capillary refill time is slow, treat your patient for shock immediately. Maintain a normal body temperature, because trauma patients can rapidly become hypothermic even in warm environments. If musculoskeletal injuries in the extremities are suspected, they must be at least initially stabilized, if not splinted, prior to moving. Eliminating this cause of shock may need to be done later in your assessment.

If the patient has an airway or breathing problem, or significant bleeding, provide rapid transport to the hospital after quickly treating these life threats. A patient who has a significant MOI but whose condition appears otherwise stable should also be transported promptly to the closest appropriate hospital. Patients with bilateral fractures of the long bones (humerus, femur, or tibia) have been subjected to a high amount of kinetic energy, which should dramatically increase your index of suspicion for serious unseen injuries. When a decision for rapid transport is made, you can use a long backboard as a splinting device to splint the whole body rather than splinting each extremity individually. If you take time to splint the patient's arms and legs individually, you may delay the prompt surgical intervention that may be needed for other injuries when a significant MOI has occurred. Individual splints should be applied en route if the ABCs are stable and time permits.

Patients with a simple MOI, such as twisting of an ankle or dislocating a shoulder, may be further assessed and their condition stabilized on scene prior to transport if no other problems exist.

Handling Injured Extremities During Assessment and Transport

Recall that fractures can break through the skin and cause external bleeding. This may occur during the initial injury or during manipulation of the extremity while preparing for splinting or transport. Careful handling of the extremity minimizes this risk. If external bleeding is present, bandage the extremity quickly to control bleeding. The dressings that cover the wound and bone should be kept clean to reduce the potential for bone infection. The bandage should be secure enough to control bleeding without restricting circulation distal to the injury. Monitor bandage tightness by assessing the circulation, sensation, and movement distal to the bandage. Swelling from fractures and internal bleeding may cause bandages to become too tight. If bleeding cannot be controlled, quickly apply a tourniquet.

Also handle fractures carefully while preparing for transport. Careful handling is necessary to limit pain and prevent sharp bone ends from breaking through the skin or damaging nerves and blood vessels in the extremity.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint. Obtain a medical history and be alert for injury-specific signs and symptoms and for any pertinent negatives, such as no pain or loss of sensation.

Obtain a SAMPLE history for all trauma patients. How much and in what detail you explore this history depends on the seriousness of the patient's condition and how quickly you need to transport the patient to the hospital. For patients with simple fractures, dislocations, or sprains, it is easier to obtain a SAMPLE history. At the scene you may have access to family members and others who have information about the patient's history. Make an attempt to obtain this history without delaying time to definitive care.

OPQRST can be of limited use in cases of severe injury and is usually too lengthy when matters of airway, breathing, circulation, and rapid transport require immediate attention. However, OPQRST may be useful when the MOI is unclear, the patient's condition is stable, or details of the injury are uncertain. This more detailed questioning for simple trauma may help you and the hospital staff to better understand the specific injury.

Secondary Assessment

If significant trauma has likely affected multiple systems, start with a secondary assessment of the entire body to be sure that you have found all of the problems and injuries. Begin with the head and work systematically toward the feet, checking the head, chest, abdomen, extremities, and back. The goal is to identify hidden and potentially life-threatening injuries. This secondary assessment will also help you to prepare for packaging and rapid transport. Knowing if an arm or leg is broken will be important when log rolling and securing the patient onto a backboard.

Use the DCAP-BTLS approach to assess the musculoskeletal system. Identify any extremity deformities that likely represent significant musculoskeletal injury, and stabilize them appropriately. Contusions and abrasions may overlie more subtle injuries and should prompt you to carefully evaluate the stability and neurovascular status of the limb. The presence of puncture wounds or other signs of penetrating injury should alert you to the possibility of an open fracture. Associated burns must be identified and treated appropriately. Palpate for tenderness, which, like contusions or abrasions, may be the only significant sign of an underlying musculoskeletal injury.

When lacerations are present in an extremity, an open fracture must be considered, bleeding controlled, and dressings applied. Careful inspection for swelling with comparison with the opposite limb may also reveal otherwise occult musculoskeletal injury. You may find a hematoma in the zone of injury during the assessment.

If your assessment reveals no external signs of injury, ask the patient to move each limb carefully, stopping immediately if a movement causes pain. Skip this step in your evaluation if the patient reports neck or back pain; even slight motion could cause permanent damage to the spinal cord.

When nonsignificant trauma has occurred and you suspect that your patient has a simple strain, sprain, dislocation, or fracture, take the time to focus your secondary assessment on that particular injury. Look for DCAP-BTLS. Be sure to assess the entire zone of injury by removing clothing from the area and looking and palpating for injuries. In musculoskeletal injuries, this zone generally extends from the joint above (proximal) to the joint below (distal), front and back.

Remember to evaluate the circulation, motor function, and abnormal sensations distal to the injury. Many important blood vessels and nerves lie close to the bone, especially around the major joints. Therefore, any injury or deformity of the bone may be associated with vessel or nerve injury. For this reason, you must assess neurovascular function every 5 to 10 minutes during the assessment, depending on the patient's condition, until the patient is at the hospital. Always recheck the neurovascular function before and after you splint or otherwise manipulate the limb. Manipulation can cause a bone fragment to press against or impale a nerve or vessel. Failure to restore circulation in this situation can lead to death of the limb. Always give priority to patients with impaired circulation resulting from bone fragments.

Words of Wisdom

If the patient has two or more injured extremities, treat the patient as a significant trauma patient and provide rapid transport to the hospital. The likelihood of other more severe injuries is greater when two or more bones have been broken.

Because many of the steps require patient cooperation, you will not be able to assess sensory and motor functions in an unconscious patient, but you can evaluate the limb for deformity, swelling, ecchymosis, false motion, and crepitus.

Examination of the injured limb should include the 6 Ps of musculoskeletal assessment—pain, paralysis, paresthesia (numbness or tingling), pulselessness, pallor, and pressure. Assess neurovascular status as described in Chapter 9, *Patient Assessment*.

Words of Wisdom

Extremity injuries that impair circulation or nerve function in distal tissues are urgent conditions. Patients with these injuries need careful assessment, prompt transport, and frequent reassessment of distal functions. It is also crucial to report this information in your initial radio contact with the hospital to allow personnel to prepare for a condition in which prompt surgery may be necessary to save the limb.

Determine a baseline set of vital signs, including pulse rate, rhythm, and quality; respiratory rate, rhythm, and quality; blood pressure; skin condition; and pupil size and reaction to light. These need to be obtained as soon as possible. Your patient may appear to be tolerating the injury well until you reassess these vital signs and they indicate otherwise. Trending these vital signs helps you to understand whether your patient's condition is improving or worsening over time, particularly during long transports. Shock or hypoperfusion is common in musculoskeletal injuries; therefore, this baseline information is very important in assessing your patient's condition.

Reassessment

Repeat the primary assessment to ensure your interventions are working as they should. Perform a reassessment every 5 minutes for an unstable patient and every 15 minutes for a stable patient.

Because trauma patients often have multiple injuries, you must assess their overall condition, stabilize the ABCs, and control any serious bleeding before further treating the injured area. In a critically injured patient, secure the patient to a backboard to immobilize the spine, pelvis, and extremities and provide prompt transport to a trauma center. In this situation, a secondary assessment with extensive evaluation and splinting of limb injuries in the field is a waste of valuable time. Perform the primary assessment and transport, reassessing the patient en route to the ED.

If the patient has no life-threatening injuries, you may take extra time at the scene to stabilize the patient's overall condition and more completely evaluate the injury. If possible, gently and carefully remove the patient's clothing to look for open fractures or dislocations, severe deformity, swelling, and/or ecchymosis.

When you have finished assessing the extremity, apply a secure splint to stabilize the injury prior to transport. The joint above and below the site of injury should be included in the splint. To minimize the potential for complications, the splint should be well padded. A comfortable and secure splint will reduce pain, reduce shock, and minimize compromised circulation. A good rule is to check the patient's circulation, motor function, and sensation before and after splinting. Splint application will be discussed later in the chapter.

The main goal in providing care for musculoskeletal injuries is stabilization in the most comfortable position that allows for maintenance of good circulation distal to the injury. This should be done whether you are preparing the patient for rapid transport or you have as much time as you need to assess and treat the patient.

Your radio report to the hospital should include a description of the problems found during your assessment. In particular, you should report problems with the patient's ABCs, open fractures, and compromised circulation that occurred before or after splinting. Many times the hospital staff can arrange for specialists or consider antibiotics early if they are aware of problems. How much information you include in your radio report will depend on your local protocols. Additional details, such as the mandated reporting of situations involving elder or child abuse, can be given during your verbal report at the hospital when you transfer care to the nursing staff or physician.

It is important to document the presence or absence of circulation, motor function, and sensation distal to the injury before you move an extremity, after manipulation or splinting of the injury, and on arrival at the hospital. Hospital staff may refer to your notes to clarify confusing situations or communication problems. Your careful documentation becomes part of the patient's permanent medical record and may protect you from legal action that the patient may pursue later. Do not rely on your memory for details from situations; your memory is unreliable. Always document your findings.

Emergency Medical Care

Your first steps in providing care for any patient are the primary assessment and stabilizing the patient's ABCs. If needed, perform a secondary assessment of either the entire body or the specific area of injury. Always follow standard precautions and be alert for signs and symptoms of internal bleeding. Internal bleeding should be suspected whenever the MOI suggests that severe forces have affected the body.

Follow the steps in **Skill Drill 31-1** when caring for patients with musculoskeletal injuries:

Skill Drill 31-1 Caring for Musculoskeletal Injuries

Step 1

Cover open wounds with a dry, sterile dressing, and apply pressure to control bleeding. Assess distal pulse and motor and sensory function. If bleeding cannot be controlled, quickly apply a tourniquet.

Step 2

Apply a splint, and elevate the extremity about 6 in. (15 cm) (slightly above the level of the heart). Assess distal pulse and motor and sensory function.

Step 3

Apply cold packs if there is swelling, but do not place them directly on the skin.

Step 4

Position the patient for transport, and secure the injured area.

1. Remove any jewelry. Completely cover open wounds with a dry, sterile dressing, and apply direct pressure to control bleeding. Assess distal pulse and motor and sensory function. If bleeding cannot be controlled, quickly apply a tourniquet. Once you have applied a sterile dressing, treat an open fracture in the same way as a closed fracture **Step 1**.
2. Apply the appropriate splint, and elevate the extremity. It is essential to splint the joint above and below the injury to ensure adequate stabilization. Patients with lower extremity injuries should lie supine with the limb elevated about 6 inches (15 cm) to minimize swelling. For any patient, be sure to position the injured limb slightly above the level of the heart. Never allow the injured limb to flop about or dangle from the edge of the backboard. Always assess pulse and motor and sensory functions before and after the application of splints. Assess the pulse by palpation, evaluate motor function by asking the patient to open his or her hand or flex his or her foot, and assess sensation and capillary

refill on the flesh near the tip of the index finger. Finally, assess the skin color and condition, and evaluate sensory function by touch **Step 2**.

3. If swelling is present, apply cold packs to the area; however, avoid placing cold packs directly on the skin or other exposed tissues **Step 3**.
4. Prepare the patient for transport. A patient with an isolated upper extremity injury will most likely be more comfortable in a semiseated position rather than in a supine position; however, assuming there is no risk of spinal injury, either position is acceptable. Ensure that the extremity is elevated above the level of the heart and secured so that it does not dangle from the edge of the backboard or stretcher **Step 4**.
5. Transport your patient to the most appropriate facility, and consider the use of advanced life support backup for pain management.
6. Inform hospital personnel about all wounds that have been dressed and splinted and any associated injuries treated by the EMS unit.

Splinting

A **splint** is a flexible or rigid device that is used to protect and maintain the position of an injured extremity **Figure 31-24**. Unless the patient's life is in immediate danger, you should splint all fractures, dislocations, and sprains before moving the patient. By preventing movement of fracture fragments, bone ends, a dislocated joint, or damaged soft tissues, splinting reduces pain and makes it easier to transfer and transport the patient. In addition, splinting will help to prevent the following:

Figure 31-24 Splinting reduces pain and prevents additional damage to the injured extremity.

- Further damage to muscles, the spinal cord, peripheral nerves, and blood vessels from broken bone ends
- Laceration of the skin by broken bone ends. One of the primary indications for splinting is to prevent a closed fracture from becoming an open fracture (conversion).
- Restriction of distal blood flow resulting from pressure of the bone ends on blood vessels
- Excessive bleeding of the tissues at the injury site caused by broken bone ends
- Increased pain from movement of bone ends

- Paralysis of extremities resulting from a damaged spine

A splint is simply a device to prevent motion of the injured part. It can be made from any material on occasions when you need to improvise. However, you should have an adequate supply of standard commercial splints on hand.

When no splinting materials are available, the arm can be bound to the chest wall, and an injured leg can be bound to the uninjured leg to provide temporary stability. The three basic types of splints are rigid, formable, and traction splints.

General Principles of Splinting

The following principles of splinting apply to most situations:

1. Remove clothing from the area of any suspected fracture or dislocation so that you can inspect the extremity for DCAP-BTLS.

Words of Wisdom

Straightening or splinting an injured limb can compromise distal functions, as can the initial injury. Record the status of distal circulation and nervous function (neurovascular status) before and after straightening or splinting. At a minimum, your written record should describe these functions before splinting and confirm that they were normal immediately after splinting and on hospital arrival. For all but the shortest transports, also indicate the results of reassessments while en route.

2. Note and record the patient's neurovascular status distal to the site of the injury, including pulse, sensation, and movement. Continue to monitor the neurovascular status until the patient reaches the hospital.
3. Cover open wounds with a dry, sterile dressing before splinting. Be sure to follow standard precautions. Do not intentionally replace protruding bones. Notify the receiving hospital of all open wounds.
4. Do not move the patient before splinting an extremity unless there is an immediate danger to the patient or you.
5. In a suspected fracture of the shaft of any bone, be sure to stabilize the joints above and below the fracture.
6. With injuries in and around the joint, be sure to stabilize the bones above and below the injured joint.
7. Pad all rigid splints to prevent local pressure and patient discomfort.
8. While applying the splint, maintain manual stabilization to minimize movement of the limb and to support the injury site.
9. If fracture of a long bone shaft has resulted in severe deformity, use constant, gentle manual traction to align the limb so that it can be splinted. This is especially important if the distal part of the extremity is cyanotic or pulseless.
10. If you encounter resistance to limb alignment, splint the limb in its deformed position.
11. Immobilize all suspected spinal injuries in a neutral in-line position on a backboard.
12. If the patient has signs of shock (hypoperfusion), align the limb in the normal anatomic position, and provide transport (total body immobilization).
13. When in doubt, splint.

Rigid Splints

Rigid (nonformable) splints are made from firm material and are applied to the sides, front, and/or back of an injured extremity to prevent motion at the injury site. Common examples of rigid splints include padded board splints, molded plastic and metal splints, padded wire ladder splints, and folded cardboard splints. As always, be sure to follow standard precautions. It takes two EMTs to apply a rigid splint. Follow the steps in Skill Drill 31-2:

YOU are the Provider — PART 3

A nurse present at the scene assists by stabilizing the leg above the ankle and below the knee while you expose the injury. The patient has an obvious deformity in the midshaft area of her tibia/fibula; however, there are no open wounds. As you further assess the injury, your partner obtains the patient's vital signs.

Recording Time: 5 Minutes	
Respirations	22 breaths/min; adequate depth
Pulse	112 beats/min; strong and regular

Skin	Pink, warm, and moist
Blood pressure	130/78 mm Hg
Oxygen saturation (Spo_2)	98% (on ambient air)

5. How should you proceed with your assessment of this patient's injury?
6. How should you treat an injured extremity in which distal perfusion is absent?

1. Gently support the limb at the site of injury as your partner prepares and begins to position the equipment. Apply steady, in-line traction if necessary. Maintain this support until the splint is completely applied **Step 1**. Assess distal pulse and motor and sensory function.
2. Place the rigid splint under or alongside the limb.
3. Place padding between the limb and the splint to make sure there is even pressure and even contact. Look for bony prominences, and pad them **Step 2**.
4. Apply bindings to hold the splint securely to the limb **Step 3**.
5. Check and record the distal nervous and circulatory (neurovascular) function **Step 4**.

There are two situations in which you must splint the limb in the position of deformity—when the deformity is severe, as is the case with many dislocations, and when you encounter resistance or extreme pain when applying gentle traction to the fracture of a shaft of a long bone. In either situation, apply padded board splints to each side of the limb and secure them with soft roller bandages **Figure 31-25**. Most dislocations should be splinted as found, but follow local protocols. Attempts to realign or reduce dislocations may lead to more damage.

Skill Drill 31-2 Applying a Rigid Splint

Step 1

Provide gentle support and in-line traction for the limb. Assess distal pulse and motor and sensory function.

Step 2

Place the splint alongside or under the limb. Pad between the limb and the splint as needed to ensure even pressure and contact.

Step 3

Secure the splint to the limb with bindings.

Step 4

Assess and record distal neurovascular function.

Formable Splints

The most commonly used formable (soft) splint is the precontoured, inflatable, clear plastic air splint. These splints are available in a variety of sizes and shapes, with or without a zipper that runs the length of the splint. Always inflate the splint after applying it. The air splint is comfortable, provides uniform contact, and has the added advantage of applying firm pressure to a bleeding wound. Air splints are used to stabilize injuries below the elbow or below the knee.

Figure 31-25 If you encounter resistance or extreme pain when applying traction to a long bone, apply padded board splints to each side of the limb, and secure them with soft roller bandages, stabilizing the limb in its deformed position.

Air splints have some drawbacks, particularly in cold weather areas. The zipper can stick, clog with dirt, or freeze. Significant weather changes affect the air pressure in the splint, which decreases as the environment grows colder and increases as the environment grows warmer. The same thing happens when there are changes in altitude, which can be a problem with helicopter transport of patients. Therefore, you should carefully monitor the splint and let air out if the splint becomes overinflated.

The method of applying an air splint depends on whether it has a zipper. With either type, you must first cover open wounds with a dry, sterile dressing, making sure that you use standard precautions. For a splint that has a zipper, follow the steps in **Skill Drill 31-3**:

1. Assess distal pulse and motor and sensory function.
2. Hold the injured limb slightly off the ground, applying gentle traction and supporting the site of injury. Have your partner place the open, deflated splint around the limb **Step 1**.
3. Zip up the splint, and inflate it by pump or by mouth. When this is done, test the pressure in the splint. With proper inflation, you should be able to compress the walls of the splint together with a firm pinch between the thumb and index finger near the edge of the splint.

Skill Drill 31-3 Applying a Zippered Air Splint

Step 1

Assess distal pulse and motor and sensory function. Support the injured limb, and apply gentle traction as your partner applies the open, deflated splint.

Step 2

Zip up the splint, inflate it by pump or by mouth, and test the pressure. Check and record distal neurovascular function.

4. Check and record pulse and motor and sensory functions, and monitor them periodically until the patient reaches the hospital **Step 2**.

If you use an unzippered or partially zippered type of air splint, follow the steps in **Skill Drill 31-4**:

1. Assess distal pulse and motor and sensory function.
2. Your partner supports the patient’s injured limb until splinting is accomplished.
3. Place your arm through the splint. Extend your hand beyond the splint, and grasp the hand or foot of the injured limb **Step 1**.
4. Apply gentle traction to the hand or foot while sliding the splint onto the injured limb. The hand or foot of the injured limb should always be included in the splint **Step 2**.
5. Your partner inflates the splint by pump or by mouth **Step 3**.
6. Test the pressure in the splint. This is something that you must do with either type of air splint.
7. Check and record pulse and motor and sensory functions, and monitor them en route.

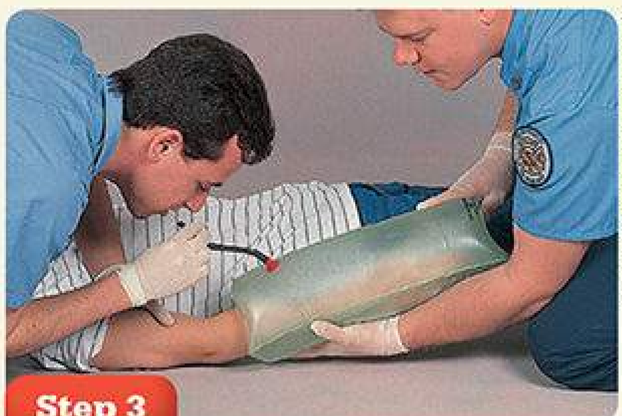
Skill Drill 31-4 Applying an Unzippered Air Splint

Step 1

Assess distal pulse and motor and sensory function. Your partner supports the injured limb. Place your arm through the splint to grasp the patient's hand or foot.

Step 2

Apply gentle traction while sliding the splint onto the injured limb.



Step 3

Your partner inflates the splint by pump or by mouth. Assess distal pulse and motor and sensory function.

Other formable splints include vacuum splints, pillow splints, structural aluminum malleable (SAM) splints, a sling and swathe, and pelvic binders for pelvic fractures. Just like an air splint, a vacuum splint can be easily shaped to fit around a deformed limb. Instead of pumping air in, however, you can use a hand pump to pull the air out through a valve. Follow the steps in **Skill Drill 31-5** to apply a vacuum splint:

1. Assess distal pulse and motor and sensory function.
2. Your partner supports and stabilizes the injured limb, applying traction if needed **Step 1**.
3. Gently place the injured limb onto the vacuum splint, and wrap the splint around the limb **Step 2**.
4. Draw the air out of the splint through the suction valve, and then seal the valve. Once the valve is sealed, the vacuum splint becomes rigid, conforming to the shape of the deformed limb and stabilizing it **Step 3**.
5. Check distal circulation and nervous functions, and monitor them en route.

Skill Drill 31-5 Applying a Vacuum Splint

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Step 1

Assess distal pulse and motor and sensory function. Your partner stabilizes and supports the injury.

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Step 2

Place the splint, and wrap it around the limb.

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Step 3

Draw the air out of the splint through the suction valve, and then seal the valve. Assess distal pulse and motor and sensory function.

Traction Splints

Application of in-line **traction** is the act of pulling on a body structure in the direction of its normal alignment. It is the most effective way to realign a fracture of the shaft of a long bone so that the limb can be splinted more effectively. Traction splints are used primarily to secure fractures of the shaft of the femur, which are characterized by pain, swelling, and deformity of the midthigh.

Excessive traction can be harmful to an injured limb. When applied correctly, however, traction stabilizes the bone fragments and improves the overall alignment of the limb. Do not attempt to force the bone fragments back into alignment. In the field, the goals of in-line traction are as follows:

1. Stabilize the fracture fragments to prevent excessive movement.
2. Align the limb sufficiently to allow it to be placed in a splint.

3. Avoid potential neurovascular compromise.

Several different types of lower extremity traction splints are commercially available, such as the Hare traction splint, the Sager splint, the Reel splint, and the Kendrick splint Figure 31-26. Each has its own unique method of application; therefore, it is important to practice using each method frequently. Consult with your agency on which traction splint you will use in the field, and make sure that you are comfortable applying this device to a patient.

Traction splints are not suitable for use on the upper extremity because the major nerves and blood vessels in the patient's axilla cannot tolerate counter-traction forces.

Figure 31-26 The Kendrick traction splint.

Courtesy of Kendrick EMS. Used with permission.

Do not use traction splints for any of the following conditions:

- Injuries of the upper extremity
- Injuries close to or involving the knee
- Injuries of the pelvis
- Partial amputations or avulsions with bone separation
- Lower leg, foot, or ankle injuries

Proper application of a traction splint requires a minimum of two EMTs. Before you apply a traction splint, be sure to control any external bleeding. The amount of traction that is required varies but often does not exceed 15 pounds (7 kg). Use the least amount of force necessary. Grasp the foot or hand at the end of the injured limb firmly; once you start pulling, do not stop until the limb is fully splinted. Releasing manual traction before the limb is secured will allow the muscles to contract, allowing the bone fragments to cause more damage to surrounding tissue. Always apply the direction of traction along the long axis of the limb. Imagine where the uninjured limb would lie, and pull gently along the line of that imaginary limb until the injured limb is in approximately that position **Figure 31-27**. Grasping the foot or hand and the initial pull of traction usually causes the patient some discomfort as the bone fragments move. A second EMT should support the injured limb directly under the site of the fracture. This initial discomfort quickly subsides, and you can then apply further gentle traction. However, if the patient strongly resists the traction or if it causes more pain that persists, stop and splint the limb in the deformed position.

Figure 31-27 To apply traction, imagine the position where the uninjured limb would lie, and then gently pull along that line until the injured limb is in that position. Do not release traction once you have applied it.

To apply a Hare traction splint, follow the steps in **Skill Drill 31-6**:

1. Cut open the patient's pant leg, or otherwise expose the injured lower extremity. Follow standard precautions as needed. Be sure to assess and record the pulse and motor function and sensation distal to the injury.
2. Place the splint beside the patient's uninjured leg, and adjust it to the proper length, with the ring at the ischial tuberosity and the splint extending 12 inches (30 cm) beyond the foot. Open and adjust the four Velcro support straps, which should be positioned at the midthigh, above the knee, below the knee, and above the ankle **Step 1**.
3. Manually support and stabilize the injured limb so that no motion will occur at the fracture site while your partner fastens the appropriate-sized ankle hitch about the patient's ankle and foot. Normally, the patient's shoe is removed for this procedure **Step 2**.
4. Support the leg at the site of the suspected injury while your partner manually applies gentle longitudinal traction to the ankle hitch and foot. Use only enough force to align (reposition) the limb so that it will fit into the splint; do not attempt to align the fracture fragments anatomically **Step 3**.

Skill Drill 31-6 Applying a Hare Traction Splint

Step 1

Expose the injured limb and check pulse, motor, and sensory function. Place the splint beside the uninjured limb, adjust the splint to proper length, and prepare the straps.

Step 2

Support the injured limb as your partner fastens the ankle hitch about the foot and ankle.

Step 3

Continue to support the limb as your partner applies gentle in-line traction to the ankle hitch and foot.

Step 4

Slide the splint into position under the injured limb.

Step 5

Pad the groin and fasten the ischial strap.

Step 6

Connect the loops of the ankle hitch to the end of the splint as your partner continues to maintain traction. Carefully tighten the ratchet to the point that the splint holds adequate traction.

Step 7

Secure and check support straps. Assess pulse and motor and sensory functions.

Step 8

Secure the patient and splint to the backboard in a way that will prevent movement of the splint during patient movement and transport.

5. Slide the splint into position under the patient's injured limb, making certain that the ring is seated well on the ischial tuberosity **Step 4**.
6. Pad the groin area, and gently apply the ischial strap **Step 5**.
7. While your partner continues to maintain traction, connect the loops of the ankle hitch to the end of the splint. Then apply gentle traction to the connecting strap between the ankle hitch and the splint, just strongly enough to maintain limb alignment. Use caution. This splint comes with a ratchet mechanism to tighten the strap. Overtightening can overstretch the limb and further injure the patient. Adequate traction has been applied when the leg is the same length as the other leg or the patient feels relief **Step 6**.
8. Once proper traction has been applied, fasten the support straps so that the limb is securely held in the splint. Check all proximal and distal support straps to make sure they are secure **Step 7**.
9. At this point, reassess distal pulses and motor function and sensation.
10. Place the patient securely on a backboard for transport to the ED. You may need to load the patient feetfirst into the ambulance so that you do not shut the door against the splint **Step 8**.

Because the traction splint stabilizes the limb by producing countertraction on the ischium and in the groin, pad these areas well. Avoid excessive pressure on the external genitalia. Always use commercially available padded ankle hitches rather than pieces of rope, cord, or tape. Such improvised hitches can sometimes be painful and can potentially obstruct circulation in the foot.

The Sager splint is lightweight and easy to store and applies a measurable amount of traction. Best of all, you can apply it by yourself when necessary. As with any splint, in addition to knowing the precise sequence of steps to apply the splint properly, you must practice the splinting technique frequently to maintain the necessary skills. Follow the steps below to apply a Sager splint **Skill Drill 31-7**:

1. Expose the injured extremity. Using standard precautions as needed, assess and record the pulse, motor function, and sensation distal to the injury.

Skill Drill 31-7 Applying a Sager Traction Splint

Step 1

After exposing the injured area, check the patient's pulse and motor and sensory functions. Adjust the thigh strap so that it lies anteriorly when secured.

Step 2

Estimate the proper length of the splint by placing it next to the uninjured limb. Fit the ankle pads to the ankle.

Step 3

Place the splint at the inner thigh, apply the thigh strap at the upper thigh, and secure snugly.

Step 4

Tighten the ankle harness just above the malleoli. Secure the cable ring against the bottom of the foot.

Step 5

Extend the splint's inner shaft to apply traction of about 10% of body weight.

Step 6

Secure the splint with elasticized cravat bandages.

Step 7

Secure the patient to a backboard. Check pulse and motor and sensory functions.

2. Before applying the splint, adjust the thigh strap so that it will lie anteriorly when secured in place **Step 1**.
3. Estimate the proper splint length by placing it alongside the uninjured limb, so that the wheel is at the level of the heel.
4. Arrange the ankle pads to fit the size of the patient's ankle **Step 2**.
5. Place the splint along the inner aspect of the limb, and slide the thigh strap around the upper thigh so that the perineal cushion is snug against the groin and the ischial tuberosity. Tighten the thigh strap snugly **Step 3**.
6. Secure the ankle harness tightly around the patient's ankle just above the malleoli.
7. Pull the cable ring snugly up against the bottom of the foot **Step 4**.
8. Pull out the inner shaft of the splint to apply traction of approximately 10% of body weight, using a maximum of 15 pounds (7 kg) **Step 5**.
9. Secure the limb to the splint using elasticized cravat bandages **Step 6**.
10. Secure the patient to a backboard.
11. Check pulse and motor and sensory functions **Step 7**.

Pelvic Binder

Pelvic binders are used to splint the bony pelvis to reduce hemorrhage from bone ends, venous disruption, and pain **Figure 31-29**. A pelvic binder is meant to provide temporary stabilization until definitive immobilization can be achieved. Generally, pelvic binders are lightweight, made of soft material, easily applied by one EMT, and should allow access to the abdomen, perineum, anus, and groin for examination and diagnostic testing. Because there are various manufacturers of pelvic binder devices, you should be familiar with the manufacturer's instructions for your specific device.

Words of Wisdom

Reel Splint

The Reel splint is a traction splint that is also used by the US military. Many devices used in combat eventually appear in the ambulance and are used by EMTs in the field. This splint is designed to be used on a lower extremity **Figure 31-28**.

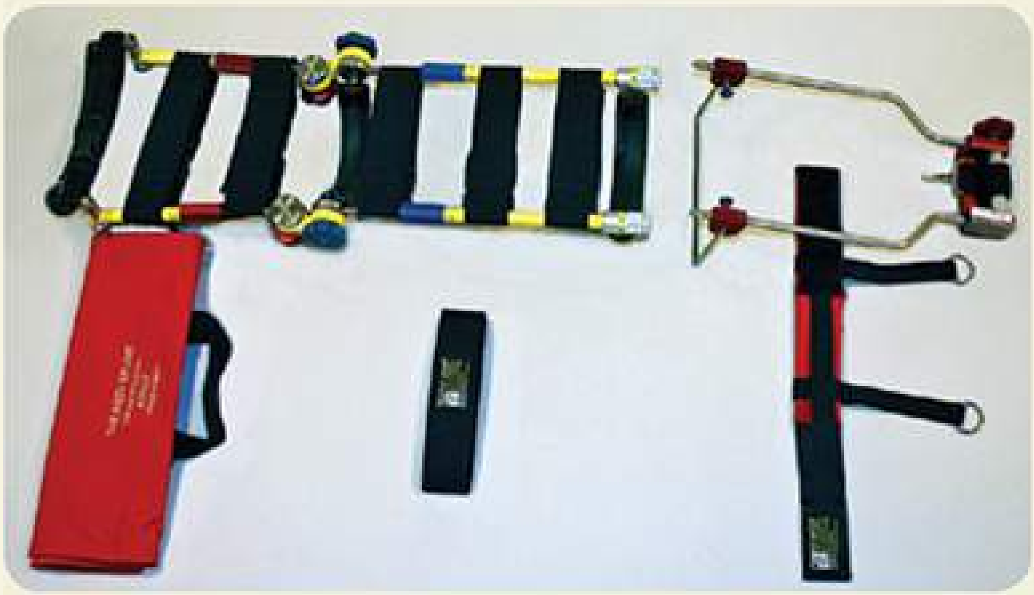


Figure 31-28 The Reel splint is also used by the US military.

Figure 31-29 Pelvic binders are meant to provide temporary stabilization until definitive immobilization can be achieved. *Note:* on a real patient, the clothing would be cut away prior to application of the splint.

Hazards of Improper Splinting

You must be aware of the hazards associated with the improper application of splints, including the following:

- Compression of nerves, tissues, and blood vessels
- Delay in transport of a patient with a life-threatening injury
- Reduction of distal circulation
- Aggravation of the injury
- Injury to tissue, nerves, blood vessels, or muscles as a result of excessive movement of the bone or joint

Transportation

Once an injured limb is adequately splinted, the patient is ready to be transferred to a backboard or stretcher and transported.

Very few, if any, musculoskeletal injuries justify the use of excessive speed during transport. The limb will be stable once a dressing and splint have been applied. However, a patient with a pulseless limb must be given a higher priority. Still, if the hospital is only a few minutes away, speeding to the ED will make no difference to the patient's time to definitive treatment. If the treatment facility is an hour or more away, a patient with a pulseless limb should be transported by helicopter or immediate ground transportation. If circulation in the distal limb is impaired, always notify medical control so that proper steps can be taken quickly once the patient arrives in the ED.

Specific Musculoskeletal Injuries

Injuries of the Clavicle and Scapula

The clavicle, or collarbone, is one of the most commonly fractured bones in the body. Fractures of the clavicle occur commonly in children when they fall on an outstretched hand. They can also occur with crush injuries of the chest. A patient with a fracture of the clavicle will report pain in the shoulder and will usually hold the arm across the front of his or her body **Figure 31-30**. A young child often reports pain throughout the entire arm and is unwilling to use any part of that limb. These complaints may make it difficult to localize the point of injury, but, generally, swelling and point tenderness occur over the clavicle. Because the clavicle is subcutaneous (just beneath the skin), the skin will occasionally "tent" over the fracture fragment. The clavicle lies directly over major arteries, veins, and nerves; therefore, fracture of the clavicle may lead to neurovascular compromise.

Figure 31-30 A patient with a fracture of the clavicle will usually hold the arm across the front of his or her body.

Words of Wisdom

Point tenderness and severe pain with or without gross instability are the most reliable indicators of an underlying fracture.

Fractures of the scapula, or shoulder blade, occur much less frequently because this bone is well protected by many large muscles. Fractures of the scapula are almost always the result of a forceful, direct blow to the back, directly over the scapula, which may also injure the thoracic cage, lungs, and heart. For this reason, you must carefully assess the patient for signs of breathing problems. Provide supplemental oxygen and prompt transport for patients who are having difficulty breathing. Remember, it is the associated chest injuries, not the fractured scapula itself, that pose the greatest threat of long-term disability.

Abrasions, contusions, and significant swelling may also occur, and the patient will often limit use of the arm because of pain at the fracture site. The scapula also has bony projections that may be fractured with a lesser degree of force.

Figure 31-31 With acromioclavicular separations, the distal end of the clavicle usually sticks out.

© Mike Devlin/Science Source.

The joint between the outer end of the clavicle and the acromion process of the scapula is called the **acromioclavicular (AC) joint**. This joint is frequently separated during sports, such as football or hockey, when a player falls and lands on the point of the shoulder, driving the scapula away from the outer end of the clavicle. This dislocation is often called an AC separation. The distal end of the clavicle will often stick out, and the patient will report pain, including point tenderness over the AC joint **Figure 31-31**.

Fractures of the clavicle and scapula and AC separations can all be splinted effectively with a sling and swathe. A **sling** is any bandage or material that helps support the weight of an injured upper extremity, relieving the downward pull of gravity on the injured site. To be effective, a sling must apply gentle upward support to the olecranon process of the ulna. The knot of the sling should be tied to one side of the neck so that it does not press uncomfortably on the cervical spine **Figure 31-32A**.

To fully stabilize the shoulder region, a **swathe**, a bandage that passes completely around the chest, must be used to bind the arm to the chest wall. The swathe should be tight enough to prevent the arm from swinging freely, but not so tight as to compress the chest and compromise breathing. Leave the patient's fingers exposed so that you can assess neurovascular function at regular intervals **Figure 31-32B**

Commercially available shoulder stabilizers or slings will provide adequate splinting for injuries of the shoulder region, as will triangular bandage slings.

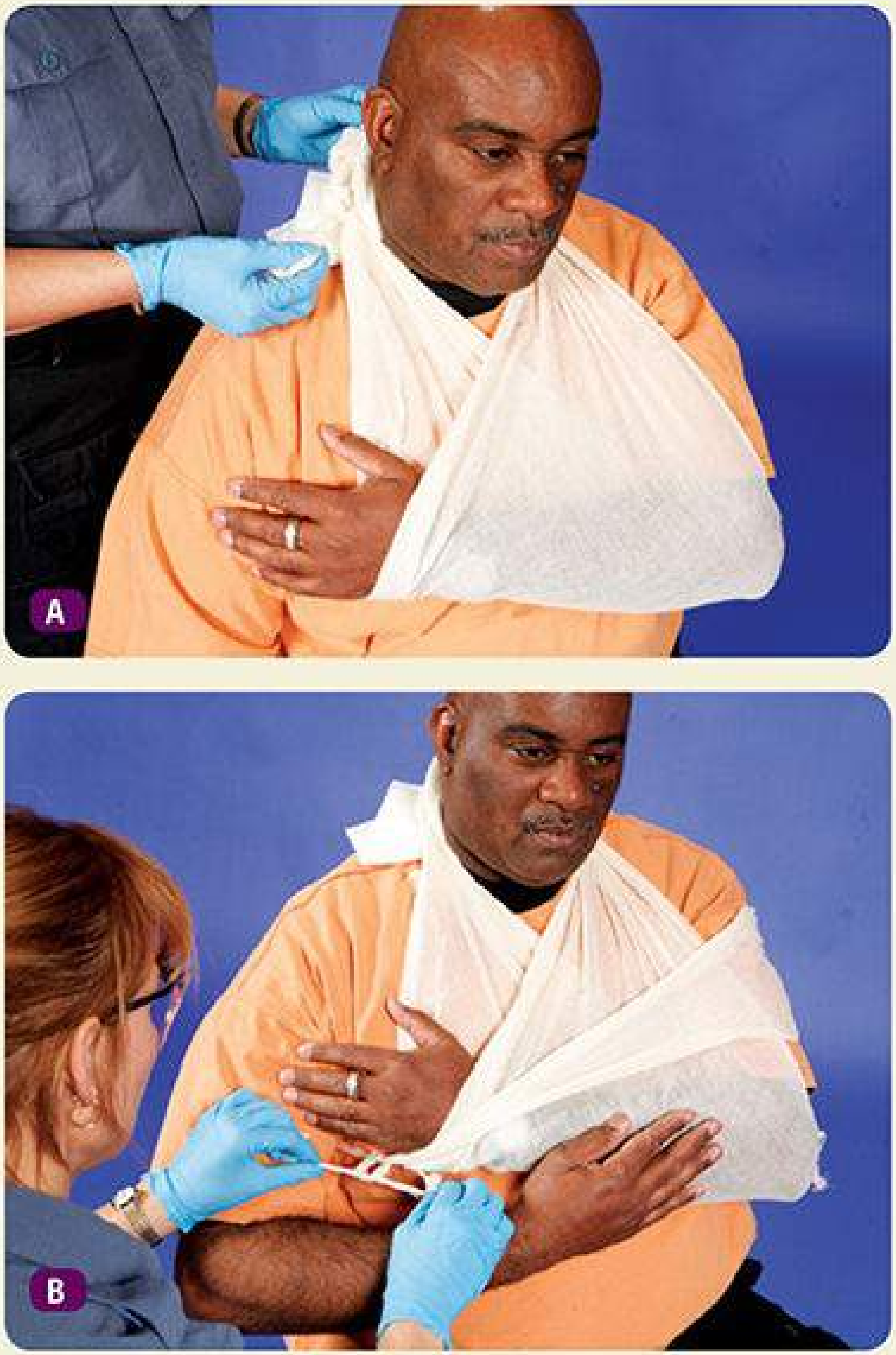


Figure 31-32 **A.** Apply a sling so that the knot is tied to one side of the neck. **B.** Bind the arm to the chest wall with a swathe so that the arm cannot swing freely. Leave the patient's fingers exposed so that you can assess distal circulation.

Dislocation of the Shoulder

The glenohumeral joint (shoulder joint) is where the head of the humerus, the supporting bone of the upper arm, meets the **glenoid fossa** of the scapula. The glenoid fossa joins with the humeral head to form the glenohumeral joint. In shoulder dislocations, the humeral head most commonly dislocates anteriorly, coming to lie in front of the scapula as a result of forced abduction (away from the midline) and external rotation of the arm **Figure 31-33**.

Shoulder dislocations are extremely painful. The patient will guard the shoulder and try to protect it by holding the dislocated arm in a fixed position away from the chest wall **Figure 31-34**. The shoulder joint will usually be locked, and the shoulder will appear squared off or flattened. The humeral head will protrude anteriorly underneath the pectoralis major on the anterior chest wall. As a result, the axillary nerve may be compressed, causing a numb patch on the outer aspect of the shoulder. Be sure to document this finding. Some patients may also report some numbness in the hand because of either nervous or circulatory compromise.

Figure 31-33 Most shoulder dislocations are anterior. Note the absence of the normal rounded appearance of the shoulder.

Figure 31-34 A patient with a dislocated shoulder will guard the shoulder, trying to protect it by holding the arm in a fixed position away from the chest wall.

Stabilizing an anterior shoulder dislocation is difficult because any attempt to bring the arm in toward the chest will produce pain. You must splint the joint in whatever position is most comfortable for the patient. If necessary, place a pillow or rolled blankets or towels between the arm and chest to fill up the space between them **Figure 31-35**. Once the arm has been stabilized in this way, the elbow can usually be flexed to 90 degrees without causing further pain. At this point, you can apply a sling to the forearm and wrist to support the weight of the arm. Finally, secure the arm in the sling to the pillow and chest with a swathe. Transport the patient in a seated or semiseated position.

Figure 31-35 Splint the shoulder joint in a position of comfort, and place a pillow or towel between the arm and the chest wall to stabilize the arm, after which the elbow can be flexed to 90°. Apply a sling, and secure the arm to the chest with a swathe.

Dislocation of the shoulder disrupts the supporting ligaments of the anterior aspect of the shoulder. Often, these ligaments fail to heal properly, so dislocation recurs, each time causing further neurovascular compromise and joint injury. In certain cases, surgical repair may be required. Some patients are able to reduce (set) their own dislocated shoulders. Generally, however, this maneuver must be done in a hospital setting and only after radiograph films have been obtained.

Words of Wisdom

When you assess a patient with a possible shoulder dislocation, position yourself behind the patient and compare the shoulders. The dislocated side is often lower than the uninjured side.

Posterior dislocation is less common than anterior shoulder dislocation. Football players, especially linemen, are susceptible to this injury. The arm will often be locked in adduction (toward the midline), so it cannot be rotated. Reducing the dislocation usually requires medical supervision.

Fracture of the Humerus

Fractures of the humerus occur either proximally, in the midshaft, or distally at the elbow Table 31-2. Fractures of the proximal humerus resulting from falls are common among older people. Fractures of the midshaft occur more often in young patients, usually as the result of a violent injury.

With any severely angulated fracture, consider applying traction to realign the fracture fragments before splinting them. Check your local protocols for indications and techniques for applying traction to a severely angulated fracture. Support the site of the fracture with one hand, and with the other hand, grasp the two humeral condyles (its lateral and medial protrusions) just above the elbow. Pull gently in line with the normal axis of the limb Figure 31-36. Once you achieve gross realignment of the limb, splint the arm with a sling and swathe, supplemented by a padded board splint on the lateral aspect of the arm Figure 31-37. If the patient reports significant pain or resists gentle traction, splint the fracture in the deformed position with a padded wire ladder or a padded board splint, using pillows to support the injured limb. Note that compartment syndrome, discussed later in this chapter, can develop in the forearm in children with these fractures.

Figure 31-36 To align a severe deformity associated with a humeral shaft fracture, apply gentle pressure to the humeral condyles, as shown in this uninjured arm.

Figure 31-37 Splint a humeral shaft fracture with a sling and swathe supplemented by a padded board splint on the lateral aspect of the arm.

Elbow Injuries

Fractures and dislocations often occur around the elbow, and the different types of injuries are difficult to distinguish without radiographic examinations. However, they all produce similar limb deformities and require the same emergency care. Injuries to nerves and blood vessels are quite common in this region. Such injuries can be caused or worsened by inappropriate emergency care, particularly by excessive manipulation of the injured joint.

Fracture of the Distal Humerus

This type of fracture, also known as a supracondylar or intercondylar fracture, is common in children. Frequently, the fracture fragments rotate significantly, producing deformity and causing injuries to nearby vessels and nerves. Swelling occurs rapidly and is often severe.

Dislocation of the Elbow

This type of injury typically occurs in athletes and rarely in young children. It can occur in toddlers when they are lifted or pulled by the arm (sometimes called “nursemaid’s elbow”), although it is not technically a joint dislocation. The ulna and radius are most often displaced posteriorly relative to the humerus. The ulna, the bone on the little finger side of the forearm, and the radius, the bone on the thumb side of the forearm, both join the distal humerus. The posterior displacement makes the olecranon process of the ulna much more prominent Figure 31-38. The joint is usually locked, with the forearm moderately flexed on the arm; this position makes any attempt at motion extremely painful. As with a fracture of the distal humerus, there is swelling and significant potential for vessel or nerve injury.

Table 31-2 Characteristics and Treatment of Fractures of the Humerus

Type	Characteristics	Treatment
Proximal humeral fractures	▪ Significant swelling, but no significant deformity of the upper arm ▪ Neurovascular compromise uncommon ▪ If neurologic compromise present, any or all of the brachial plexus may be affected, depending on the degree of displacement ▪ Concurrent soft-tissue injuries possible ▪ Possible rotator cuff injury (If radiograph films show no fracture, a tear of the rotator cuff is possible, especially if the patient cannot rotate the arm)	▪ Stabilize in a sling and swathe or a shoulder stabilizer. ▪ Use the chest wall as a splint, and secure the injured arm to the chest wall. ▪ Place a short, padded board splint on the lateral side of the arm under the sling and swathe for additional support.
Midshaft fractures	▪ Gross angulation of the arm ▪ Marked instability and crepitus of fracture fragments ▪ Possible neurovascular compromise ▪ Possible entrapment of the radial nerve (The patient cannot extend or dorsiflex the wrist or fingers and may report numbness on the dorsum of the hand; classic "wrist drop.")	▪ Stabilize with a sling and swathe or a shoulder stabilizer. ▪ Use the chest wall as a splint, and secure the injured arm to the chest wall. ▪ Place a short, padded board splint on the lateral side of the arm under the sling and swathe for additional support.
Distal humeral fractures	▪ Significant swelling at the elbow ▪ Possible neurovascular compromise ▪ Possible injury to the ulnar or median nerve (Document nerve status before and after any attempt to reduce or stabilize the fracture.)	▪ Stabilize in a splint, in addition to a sling and swathe or a shoulder stabilizer.

Figure 31-38 Posterior dislocation of the elbow makes the olecranon process of the ulna much more prominent.

© JUNG YEON-JE/AFP/Getty.

Elbow Joint Sprain

This diagnosis is often mistakenly applied to an occult, nondisplaced fracture, since it can be difficult to distinguish between sprains and fractures.

Fracture of the Olecranon Process of the Ulna

This fracture can result from direct or indirect forces and is often associated with lacerations and abrasions. The patient will be unable to actively extend the elbow.

Fractures of the Radial Head

Often missed during diagnosis, this fracture generally occurs as a result of a fall on an outstretched arm or a direct blow to the lateral aspect of the elbow. Attempts to rotate the forearm will cause discomfort.

Care of Elbow Injuries

All elbow injuries are potentially serious and require careful management. Always assess distal neurovascular functions periodically in patients with elbow injuries. If you find strong pulses and good capillary refill, splint the elbow injury in the position in which you found it, adding a wrist sling if this seems helpful. Two padded board splints, one applied to each side of the limb and secured with soft roller bandages, usually are enough to stabilize the arm **Figure 31-39A**. Make sure the board extends from the shoulder joint to the wrist joint, stabilizing the entire bone above and below the injured joint. Alternatively, you can mold a padded wire ladder splint or a SAM splint to the shape of the limb **Figure 31-39B**. If necessary, you may add further support to the limb with a pillow.

YOU are the Provider — PART 4

As the nurse continues to manually stabilize the patient's leg, you retrieve the splinting supplies from the ambulance, and your partner reassesses her vital signs.

Recording Time: 13 Minutes	
Level of consciousness	Conscious and alert
Respirations	22 breaths/min; adequate depth
Pulse	110 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	134/80 mm Hg
Spo_2	99% (on ambient air)

7. How should you splint this patient's injury?
8. What are some methods for providing pain relief from orthopaedic trauma?

A cold, pale hand or a weak or absent pulse and poor capillary refill indicate that the blood vessels have likely been injured. Further care of this patient must be dictated by a physician. Notify medical control immediately. If you are within 10 to 15 minutes of the hospital, splint the limb in the position in which you found it, and provide prompt transport. Otherwise, medical control may direct you to try to realign the limb to improve circulation in the hand.

If the limb is pulseless and significantly deformed at the elbow, apply gentle manual traction in line with the long axis of the limb to decrease the deformity. This maneuver may restore the pulse. Be careful, because excessive manipulation may only worsen the vascular problem. If no pulse returns after one attempt, splint the limb in the most comfortable position for the patient. If the pulse is restored by gentle longitudinal traction, splint the limb in whatever position allows the strongest pulse. Provide prompt transport for all patients with impaired distal circulation.

Figure 31-39 **A.** Two padded board splints provide adequate stabilization for an injured elbow. **B.** A structural aluminum malleable splint can be molded to the shape of the limb so that you can splint it in the position in which it was found.

Special Populations

Growth plate injuries in children are common, especially around the wrist, elbow, knee, and ankle. Injuries tend to occur through these cartilaginous growth centers because they are inherently weaker than the surrounding bone. Since longitudinal growth of the limb is dependent upon the function of the growth plate, it is extremely important to recognize the possibility of growth plate injuries, stabilize the injured limb, and transport the patient in a timely manner to an appropriate center with pediatric, pediatric orthopaedic, and pediatric surgical coverage. Proper functioning of the injured growth plate throughout the remainder of skeletal growth may depend on timely anatomic reduction of the fracture and close follow-up by an orthopaedist.

Any deformity close to a joint in children younger than 16 years should be assumed to be a growth plate injury. Treat and transport the patient appropriately.

Fractures of the Forearm

Fractures of the shaft of the radius and ulna are common in people of all age groups but are seen most often in children and older people. Usually, both bones break at the same time when the injury is the result of a fall on an outstretched hand **Figure 31-40**. An isolated fracture of the shaft of the ulna may occur as the result of a direct blow to it; this is known as a nightstick fracture.

Fractures of the distal radius, which are especially common in older patients with osteoporosis, are known as Colles fractures. The term silver fork deformity is used to describe the distinctive appearance of the patient's arm **Figure 31-41**. In children, this fracture may occur through the growth plate and can have long-term consequences.

To stabilize fractures of the forearm or wrist, you can use a padded board, air, vacuum, or pillow splint. If the shaft of the bone has been fractured, be sure to include the elbow joint in the splint. Splinting of the elbow joint is not essential with fractures near the wrist; however, the patient will be more comfortable if you add a sling or pillow for more support. If possible, elevate the injured extremity above the heart to help alleviate swelling.

Figure 31-40 Fractures of the forearm often occur in children as a result of a fall on an outstretched hand.

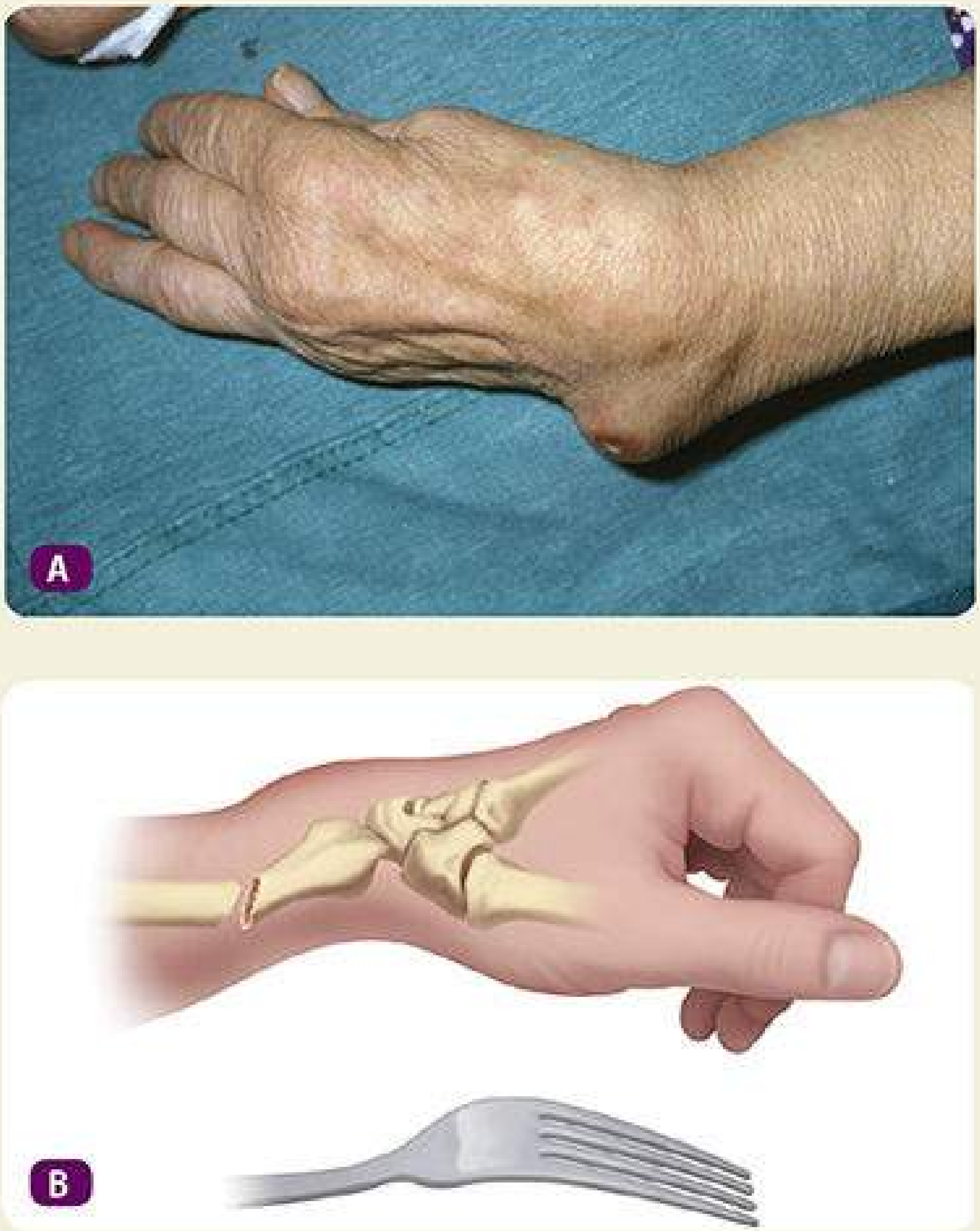


Figure 31-41 **A.** Fractures of the distal radius produce a characteristic silver fork deformity. **B.** An artist's illustration.

A: © Dr. M.A. Ansary/Science Source; B: © Jones & Bartlett Learning.

Injuries of the Wrist and Hand

Injuries of the wrist, ranging from dislocations to sprains, must be confirmed by radiograph examination. Dislocations are usually associated with a fracture, resulting in a fracture dislocation. Another common wrist injury is the isolated, nondisplaced fracture of a carpal bone, especially the scaphoid. Any questionable wrist sprain or fracture should be splinted and evaluated in the ED or an orthopaedic surgeon's office.

Special Populations

In the United States over 80,000 distal radial fractures a year occur in people older than 65 years.

Hand injuries vary widely, some with potentially serious consequences. Industrial, recreational, and home accidents often result in dislocations, fractures, lacerations, burns, and amputations. Because the fingers and hands are required to function in such intricate ways, any injury that is not treated properly may result in permanent disability, as well as deformity. For this reason, all injuries to the hand, including simple lacerations, should be evaluated by a physician. For example, do not attempt to "pop" a dislocated finger joint back in place **Figure 31-42**. Always take any amputated parts to the hospital with the patient. Be sure to wrap the amputated part in a dry or moist sterile dressing, depending on your local protocol, and place it in a dry plastic bag. Put the bag in a cooled container; do not soak the part in water or allow it to freeze.

Figure 31-42 Dislocation of the finger joint. Do not try to "pop" the joint back into place.

A bulky forearm dressing makes an effective splint for any hand or wrist injury. Follow the steps in **Skill Drill 31-8**:

1. Follow standard precautions.
2. Cover open wounds with a dry, sterile dressing.
3. Assess distal pulse and motor and sensory function.
4. Supporting the injured limb, form the injured hand into the **position of function**, with the wrist slightly bent down and all finger joints moderately flexed. This is the position that is used to hold a can most comfortably.

Skill Drill 31-8 Splinting the Hand and Wrist

Step 1

Support the injured limb and move the hand into the position of function. Place a soft roller bandage in the palm.

Step 2

Apply a padded board splint on the palmar side with fingers exposed.

Step 3

Secure the splint with a roller bandage.

5. Place a soft roller bandage into the palm of the hand **Step 1**.
6. Apply a padded board splint to the palmar side of the wrist, leaving the fingers exposed **Step 2**.
7. Secure the entire length of the splint with a soft roller bandage **Step 3**. Assess distal pulse and motor and sensory function.
8. Apply a sling and swathe, or prop the splinted hand and wrist on a pillow or on the patient's chest during transport to the hospital.

Fractures of the Pelvis

Fracture of the pelvis often results from direct compression in the form of a heavy blow that literally crushes the pelvis. The blow may be from a motor vehicle crash, a weapon, a falling object, or a fall from a height. Injuries to the pelvis can also be caused by indirect forces. For example, when the knee strikes the dashboard in a motor vehicle crash, the impact of the force is transmitted along the line of the femur (thighbone), which is the longest and largest bone in the body. The head of the femur is driven into the pelvis, causing it to fracture. However, not all pelvic fractures result from violent trauma. Even a simple fall can produce a fracture of the pelvis, especially in older people with osteoporosis.

Fractures of the pelvis may be accompanied by life-threatening loss of blood from the laceration of blood vessels affixed to the pelvis at certain key points. Up to several liters of blood may drain into the pelvic space and the **retroperitoneal space**, which lies between the abdominal cavity and the posterior abdominal wall. The result is significant hypotension, shock, and sometimes death. For this reason, you must take immediate steps to treat shock, even if there is only minimal swelling. Often, there are no visible signs of bleeding until severe blood loss has occurred. Be prepared to resuscitate the patient rapidly if this becomes necessary.

Because the pelvis is surrounded by heavy muscle, open fractures of the pelvis are uncommon. However, pelvis fracture fragments can lacerate the rectum and vagina, creating an open fracture that is often overlooked. Once the protective pelvic ring is broken, the structures it is designed to protect, including the urinary bladder, are more susceptible to injury. The bladder may be lacerated by pelvic bone fragments, or it may tear as a result of direct pressure on the bladder itself or tension on the urethra.

You should suspect a fracture of the pelvis in any patient who has sustained a high-velocity injury and reports discomfort in the lower back or abdomen. Because the area is covered by heavy muscle and other soft tissue, deformity or swelling may be very difficult to see. The most reliable sign of fracture of the pelvis is simple tenderness or instability on firm compression and palpation. Firm compression on the two iliac crests will produce pain at a fracture site in the pelvic ring. Assess for tenderness by taking the following steps **Figure 31-43**:

1. Place the palms of your hands over the lateral aspect of each iliac crest, and apply firm but gentle inward pressure on the pelvic ring.
2. With the patient lying supine, place a palm over the anterior aspect of each iliac crest, and apply firm downward pressure.
3. Use the palm of your hand to firmly but gently palpate the pubic symphysis, the firm cartilaginous joint between the two pubic bones. This area will be tender if there is injury to the anterior portion of the pelvic ring.

YOU are the Provider — PART 5

After properly splinting the patient's leg, you place her onto the stretcher, load her into the ambulance, and begin transport to the hospital. You reassess her condition and vital signs en route and note that her condition remains stable. You call your radio report in to the receiving facility; your estimated time of arrival is 8 minutes.

Recording Time: 23 Minutes	
Level of consciousness	Conscious and alert
Respirations	20 breaths/min; adequate depth
Pulse	115 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	128/76 mm Hg
Spo_2	98% (on ambient air)

During transport, the patient reports numbness and tingling in her left foot. Your reassessment reveals that her pedal pulse is weaker than it was before and that her foot looks pale and feels cool.

9. What is the most likely cause of the patient's complaint? What can you can do to remedy the situation?
10. What factors increase the risk of complications following orthopaedic trauma?

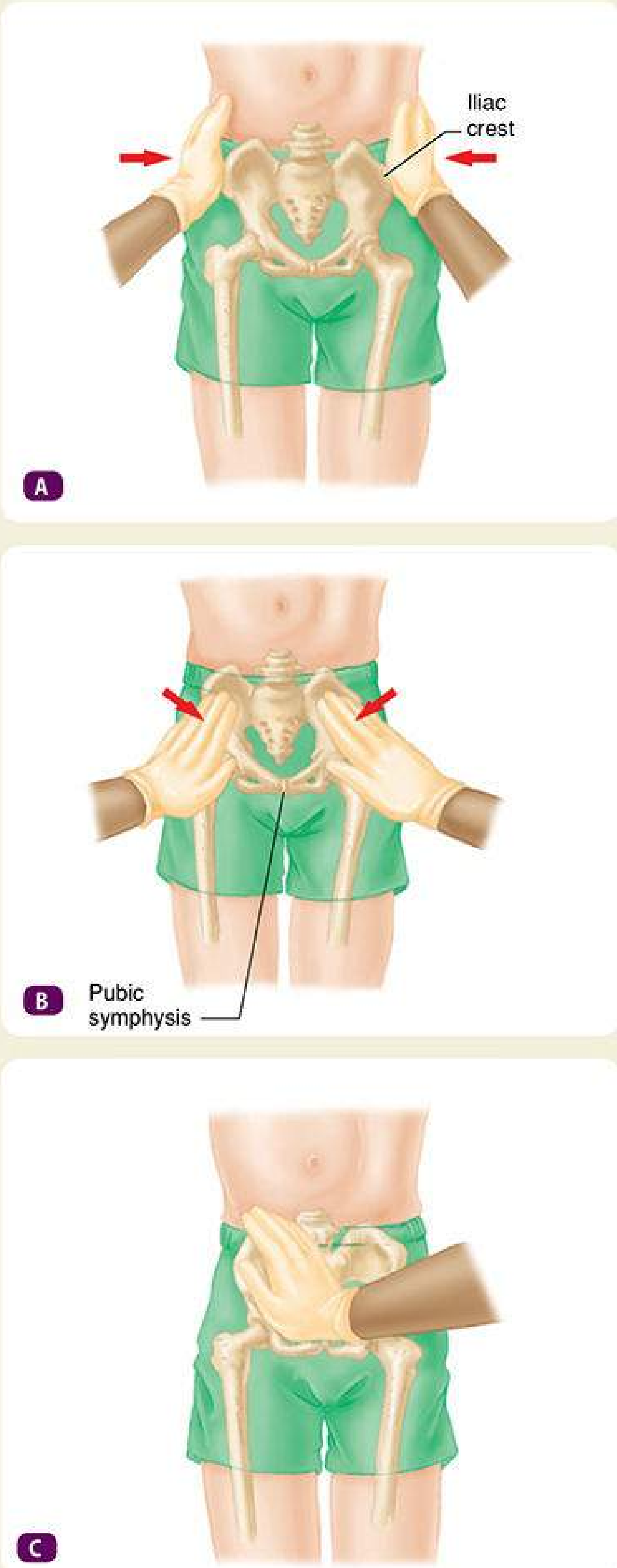


Figure 31-43 **A.** To assess for tenderness or instability in the pelvic region, place your hands over the lateral aspect of each iliac crest, and gently compress the pelvis. **B.** With the patient in a supine position, place your palms over the anterior aspect of each iliac crest, and apply firm but gentle downward pressure. **C.** Palpate the pubic symphysis with the palm of your hand.

If there has been injury to the bladder or the urethra, the patient will have lower abdominal tenderness and may have evidence of **hematuria** (blood in the urine) or blood at the urethral opening.

Perform the primary assessment, and carefully monitor the general condition of any patient whom you suspect has a pelvic fracture, because he or she is at high risk for hypovolemic shock. Patients in stable condition can be secured to a backboard or a scoop stretcher to stabilize isolated fractures of the pelvis.

Dislocation of the Hip

The hip joint is a very stable ball-and-socket joint that dislocates only after significant injury. Most dislocations of the hip are posterior. The femoral head is displaced posteriorly to lie in the muscles of the buttock. Posterior dislocation of the hip most commonly occurs as a result of a motor vehicle crash in which the knee meets with a direct force, such as the dashboard, and the entire femur is driven posteriorly, dislocating the hip joint **Figure 31-44**. Thus, you should suspect a hip dislocation in any patient who has been in a motor vehicle crash and has a contusion, laceration, or obvious fracture in the knee region. Very rarely does the femoral head dislocate anteriorly; in this circumstance, the legs are suddenly and forcibly spread wide apart and locked in this position.

Posterior dislocation of the hip is frequently complicated by injury to the sciatic nerve, which is located directly behind the hip joint. The **sciatic nerve** is the largest nerve in the lower extremity; it controls the activity of muscles in the posterior thigh and below the knee and the sensation in most of the leg and foot. When the head of the femur is forced out of the hip socket, it may compress or stretch the sciatic nerve, leading to partial or complete paralysis of the nerve. The result is decreased sensation in the leg and foot and frequently weakness in the foot muscles. Generally, only the dorsiflexors, the muscles that raise the toes or foot, are involved, causing the "foot drop" that is characteristic of damage to the peroneal portion of the sciatic nerve.

Patients with a posterior dislocation of the hip typically lie with the hip joint flexed (the knee joint drawn up toward the chest) and the thigh rotated inward toward the midline of the body over the top of the opposite thigh **Figure 31-45A**. With the less common anterior dislocation, the limb is in the opposite position, extended straight out, externally rotated, and pointing away from the midline of the body.

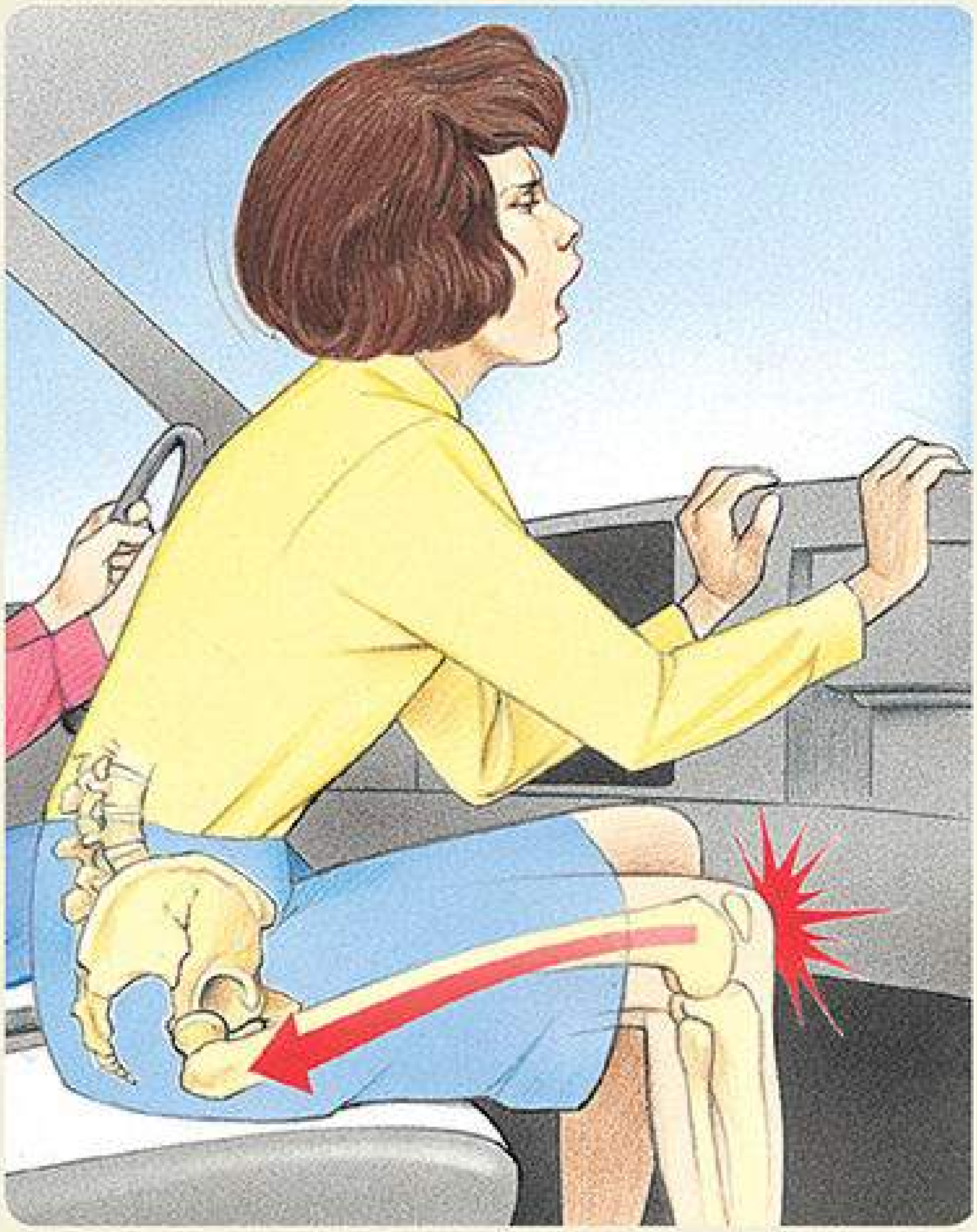


Figure 31-44 Posterior dislocation of the hip can occur as a result of the knee hitting the dashboard in a motor vehicle crash. The impact drives the femur posteriorly (see arrow), dislocating the joint.

Dislocation of the hip is associated with very distinctive signs. The patient will have severe pain in the hip and will strongly resist any attempt to move the joint. The lateral and posterior aspects of the hip region will be tender on palpation. With some thin patients, you can palpate the femoral head deep within the muscles of the buttock. Check for a sciatic nerve injury by carefully assessing sensation and motor function in the lower extremity. Occasionally, sciatic nerve function will be normal at first and then slowly diminish.

As with any other extremity injury, do not attempt to reduce the dislocated hip in the field unless medical control directs you to do so. Splint the dislocation in the position of the deformity, and place the patient supine on a backboard. Support the affected limb with pillows and rolled blankets, particularly under the flexed knee **Figure 31-45B**. Then secure the entire limb to the backboard with long straps so that the hip region will not move, and provide prompt transport.

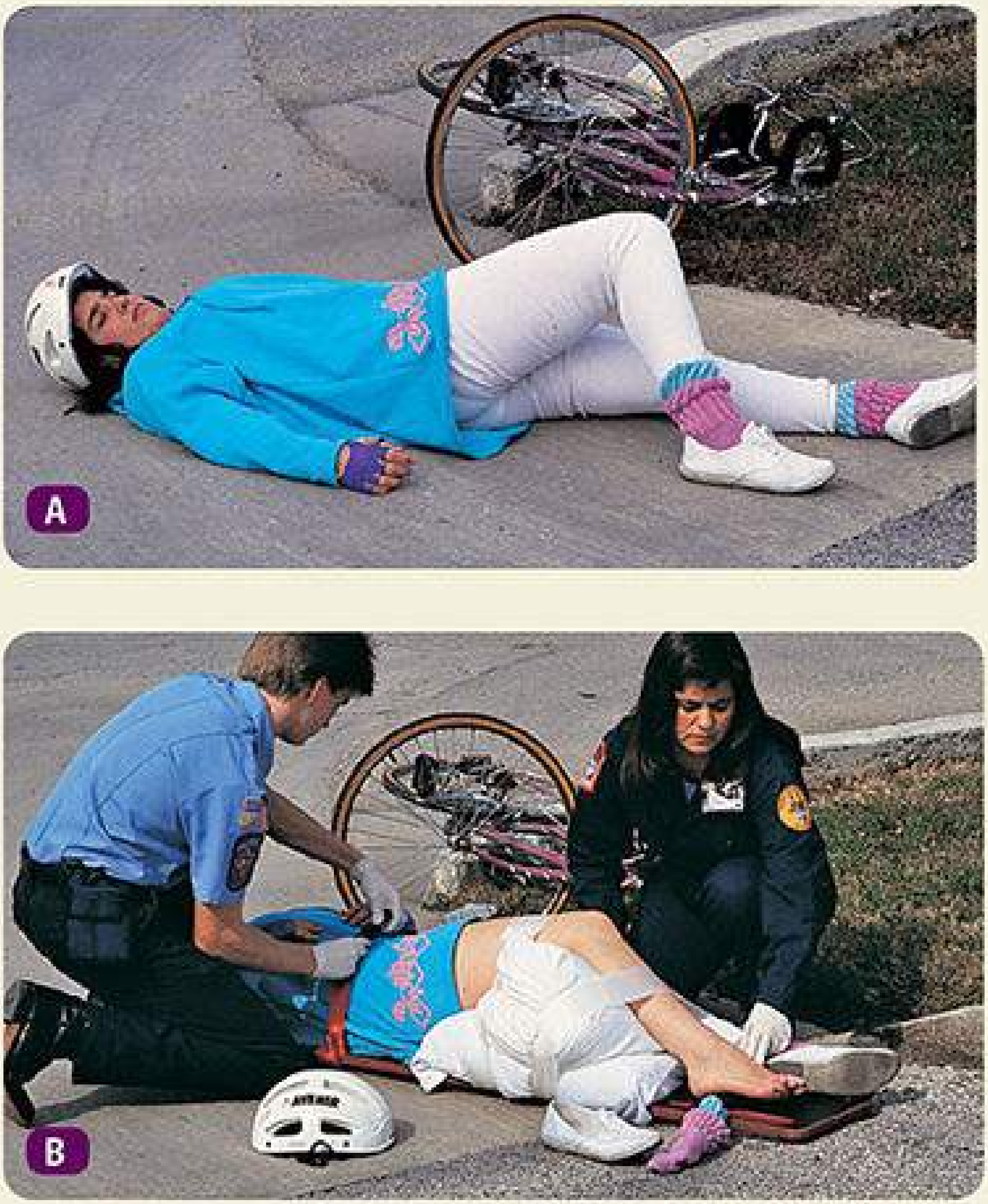


Figure 31-45 **A.** The usual position of a patient with a posterior dislocation of the hip. The hip joint is flexed, and the thigh is rotated inward and adducted across the midline of the body. **B.** Support the affected limb with pillows and blankets, particularly under the flexed knee. Secure the entire limb to a backboard with long straps to prevent movement during transport.

Fractures of the Proximal Femur

Fractures of the proximal (upper) end of the femur are common fractures, especially in older people and patients with osteoporosis. Although these fractures are usually called hip fractures, they rarely involve the hip joint. Instead, the break goes through the neck of the femur, the intertrochanteric (middle) region, or across the proximal shaft of the femur (subtrochanteric fractures). These three fracture types may also be a result of high-energy injuries in younger patients.

Patients with displaced fractures of the proximal femur display a very characteristic deformity. They lie with the leg externally rotated, and the injured leg is usually shorter than the opposite, uninjured limb. When the fracture is not displaced, this deformity is not present. With any kind of hip fracture, patients typically are unable to walk or move the leg because of pain in the hip region or in the groin or inner aspect of the thigh. The hip region is usually tender on palpation, and gentle rolling of the leg will cause pain but will not do further damage. On occasion, the pain is referred to the knee, and it is not uncommon for a geriatric patient with a hip fracture to report knee pain after a fall. Assess the pelvis for any soft-tissue injury and bandage appropriately. In addition, assess pulses and motor and sensory functions, looking for signs of vascular and nerve damage. Once your assessment is complete, splint the lower extremity of an older patient who has fallen and reports pain in either the hip or the knee, even if there is no deformity, and then transport the patient to the ED.

The age of the patient and the severity of the injury will dictate how you splint the fracture. A geriatric patient with an isolated hip fracture does not require a traction splint. You can effectively stabilize such a fracture by placing the patient on a backboard or scoop stretcher, using pillows or rolled blankets to support the injured limb in the deformed position. Then secure the injured limb carefully to the device with long straps.

All patients with hip fractures may have a significant amount of blood loss. Therefore, you should treat with high-flow oxygen, monitor vital signs frequently, and be alert for signs of shock.

Special Populations

As the population of older adults grows to approximately 20% of the general population, it is important that EMTs prepare for a future in which older patients may constitute the majority of emergency calls.

Femoral Shaft Fractures

Fractures of the femur can occur in any part of the shaft, from the hip region to the femoral condyles just above the knee joint. Following a fracture, the large muscles of the thigh spasm in an attempt to “splint” the unstable limb. The muscle spasm often produces significant deformity of the limb, with severe angulation or external rotation at the fracture site. Usually, the limb also shortens significantly. Fractures of the femoral shaft may be open, and fragments of bone may protrude through the skin. As with any other open fracture, never attempt to push the bone(s) back into the skin.

There is often a significant amount of blood loss, as much as 500 to 1,000 mL, after a fracture of the shaft of the femur. With open fractures, the amount of blood loss may be even greater. Thus, it is not unusual for hypovolemic shock to develop. Handle patients with these fractures with extreme care because any extra movement or fracture manipulation may increase the amount of blood loss.

Because of the severe deformity that occurs with these fractures, bone fragments may penetrate or press on important nerves and vessels and produce significant damage. For this reason, you must carefully and periodically assess the distal neurovascular function in patients who have sustained a fracture of the femoral shaft. Remove the clothing from the affected limb so that you can adequately inspect the injury site for any open wounds. Remember to follow standard precautions when any blood or body fluids are present. Monitor the patient’s vital signs closely, and continue to watch for the onset of hypovolemic shock. You must provide rapid transport in this situation.

Cover any open wound with a dry, sterile dressing. If the foot or leg below the level of the fracture shows signs of impaired circulation (is pale, cold, or pulseless), apply gentle longitudinal traction to the deformed limb in line with the long axis of the limb. Gradually turn the leg from the deformed position to restore the limb’s overall alignment. Often, this restores or improves circulation to the foot. If it does not, the patient may have sustained a serious vascular injury and may be in need of prompt medical attention.

A fracture of the femoral shaft is best stabilized with a traction splint, such as a Sager splint.

Injuries of Knee Ligaments

The knee is very vulnerable to injury; therefore, many different types of injuries occur in this region. Ligament injuries, for example, range from mild sprains to complete dislocation of the joint. The patella can also dislocate. In addition, all the bony elements of the knee (distal femur, upper tibia, and patella) can fracture.

The knee is especially susceptible to ligament injuries, which occur when abnormal bending or twisting forces are applied to the joint. Such injuries are often seen in both recreational and competitive athletes. The ligaments on the medial side of the knee are most frequently injured, typically when the foot is fixed to the ground and the lateral aspect of the knee is struck by a heavy object, such as when a football player is tackled from the side.

Usually, a patient with a knee ligament injury will report pain in the joint and be unable to use the extremity normally. When you examine the patient, you will generally find swelling, occasional ecchymosis, point tenderness at the injury site, and a joint effusion (excess fluid in the joint).

Splint all suspected knee ligament injuries. The splint should extend from the hip joint to the foot, stabilizing the bone above the injured joint (the femur) and the bone below it (the tibia). A variety of splints can be used, including a padded rigid long leg splint or two padded board splints securely applied to the medial and lateral aspects of the limb. A backboard, a pillow splint, or simply binding the injured limb to its uninjured mate is an acceptable—but less effective—splinting technique. The patient will usually be able to straighten the knee to allow you to apply the splint. However, if you encounter resistance or pain when trying to straighten the knee, splint it in the flexed position. Then continue to monitor the distal neurovascular function until the patient reaches the hospital.

Dislocation of the Knee

Dislocations of the knee are true emergencies that may threaten the limb. When the knee is dislocated, the ligaments that provide support to it may be damaged or torn. When this happens, the proximal end of the tibia completely displaces from its juncture with the lower end of the femur, usually producing a significant deformity. Although substantial ligament damage always occurs with a knee dislocation, the more urgent injury is often to the popliteal artery, which is frequently lacerated or compressed by the displaced tibia. When gross deformity, severe pain, and an inability to move the joint cause you to suspect a dislocation of the knee, always check the distal circulation carefully before taking any other step. If the distal pulses are absent, contact medical control immediately for further stabilization and transport instructions.

The direction of dislocation refers to the position of the tibia with respect to the femur. Posterior knee dislocations, which result from extreme hyperextension of the knee, are the most common, occurring in almost half of all cases. Commonly, the anterior and posterior cruciate ligaments are damaged, but there is also a high risk of injury to the popliteal artery.

Medial dislocations result from a direct blow to the lateral part of the leg. Because the deforming force causes the medial aspect of the knee to stretch apart, there is a high likelihood of injury to the medial ligaments. When the force is applied from the medial direction, a lateral dislocation occurs and the lateral part of the knee is stretched apart, injuring the lateral ligament. Lateral and medial dislocations happen far less commonly and are less likely to injure the popliteal artery.

Patients with a knee dislocation will typically report pain in the knee and report that the knee "gave out." If the knee did not spontaneously reduce, there may be evidence of significant deformity and decreased range of motion. Complications may include limb-threatening popliteal artery disruption, injuries to the nerves, and joint instability. Do not confuse this injury with a relatively minor patella dislocation, discussed below.

If adequate distal pulses are present, splint the knee in the position in which you found it, and transport the patient promptly. Do not attempt to manipulate or straighten any severe knee injury if there are good distal pulses. If the limb is straight, apply standard rigid long leg splints to at least two sides of the limb to stabilize it **Figure 31-46A**. If the knee is bent and the foot has a good pulse, splint the joint in the bent position, using parallel padded board splints secured at the hip and ankle joint to provide a stable A-frame **Figure 31-46B**. Secure the limb to a backboard or stretcher with pillows and straps to eliminate any motion during transport.

On rare occasions, and depending on local protocol, medical control may instruct you to realign a deformed, pulseless limb to reduce compression of the popliteal artery and, thus, restore distal circulation. Only make one attempt to do this. First, straighten the limb by applying gentle longitudinal traction in the axis of the limb. Once you apply manual traction, maintain it until the limb is fully splinted; otherwise, the limb will return to its deformed position. If traction significantly increases the patient's pain, do not continue. As you apply traction, monitor the posterior tibial pulse to see whether it returns. Splint the limb in the position in which you feel the strongest pulse. If you are unable to restore the distal pulse, splint the limb in the position that is most comfortable for the patient, and then provide prompt transport to the hospital. Notify medical control of the status of the distal pulse so that treatment can be arranged in advance.

Fractures About the Knee

Fractures about the knee may occur at the distal end of the femur, at the proximal end of the tibia, or in the patella. Because of local tenderness and swelling, it is easy to confuse a nondisplaced or minimally displaced fracture about the knee with a ligament injury. Likewise, a displaced fracture about the knee may produce significant deformity that makes it look like a dislocation. Manage these two types of injuries as follows:

- If there is an adequate distal pulse and no significant deformity, splint the limb with the knee straight.
- If there is an adequate pulse and significant deformity, splint the joint in the position of deformity.

- If the pulse is absent below the level of the injury, suspect possible vascular and nerve damage, and contact medical control immediately for further instructions.
- Never use a traction splint if you suspect a fractured knee.

Figure 31-46 **A.** When the injured knee is straight, apply padded board splints extending from the hip to the ankle. **B.** If the knee is flexed and the foot has good pulses, apply padded board splints with the knee in the flexed position.

Dislocation of the Patella

A dislocated patella most commonly occurs in teenagers and young adults who are engaged in athletic activities. Some patients have recurrent dislocations of the patella. As with recurrent dislocation of the shoulder, a minor twisting may be enough to produce the problem. Usually, the dislocated patella displaces to the lateral side. The displacement of the patella produces a significant deformity in which the knee is held in a moderately flexed position, and the patella is displaced to the lateral side of the knee Figure 31-47.

Splint the knee in the position in which you found it; most often, this is with the knee flexed to a moderate degree. To stabilize the knee, apply padded board splints to the medial and lateral aspects of the joint, extending from the hip to the ankle. Use pillows to support the limb on the stretcher.

Occasionally, as you apply the splint, the patella will return to its normal position spontaneously. When this occurs, stabilize the limb as for a knee ligament injury in a padded long leg splint, and transport the patient to the ED. Report the spontaneous reduction as soon as you arrive at the hospital so that the medical staff is aware of the severity of the injury.

Figure 31-47 Usually, the dislocated patella displaces to the lateral side, and the knee is held in a partially flexed position.

Injuries of the Tibia and Fibula

Fracture of the shaft of the tibia or the fibula may occur at any place between the knee joint and the ankle joint. Often both bones fracture at the same time. Even a single fracture may result in severe deformity, with significant angulation or rotation. Because the tibia is located just beneath the skin, open fractures of this bone are relatively common Figure 31-48.

Fractures of the tibia and fibula should be stabilized with a padded rigid long leg splint or an air splint that extends from the foot to the upper thigh. Once splinted, the affected leg should be secured to the opposite leg. Traction splints are not indicated for isolated tibial fractures. As with most other fractures of the shaft of long bones, you should correct severe deformity before splinting by applying gentle longitudinal traction. The goal is to restore a position that will take a standard splint; it is not necessary to replace the fracture fragments in their anatomic position.

Fractures of the tibia and fibula are sometimes associated with vascular injury as a result of the distorted position of the limb following injury. Realigning the limb frequently restores an adequate blood supply to the foot. If it does not, transport the patient promptly and notify medical control while you are en route.

Ankle Injuries

The ankle is a commonly injured joint. Ankle injuries occur in people of all ages and range in severity from a simple sprain, which heals after a few days of rest, to severe fracture-dislocations. As with other joints, it is sometimes difficult to tell a nondisplaced ankle fracture from a simple sprain without radiograph examination **Figure 31-49**. Therefore, any ankle injury that produces pain, swelling, localized tenderness, or the inability to bear weight must be evaluated by a physician. The most frequent mechanism of ankle injury is twisting, which stretches or tears the supporting ligaments. A more extensive twisting force may result in fracture of one or both malleoli. Dislocation of the ankle is usually associated with fractures of one or both malleoli.

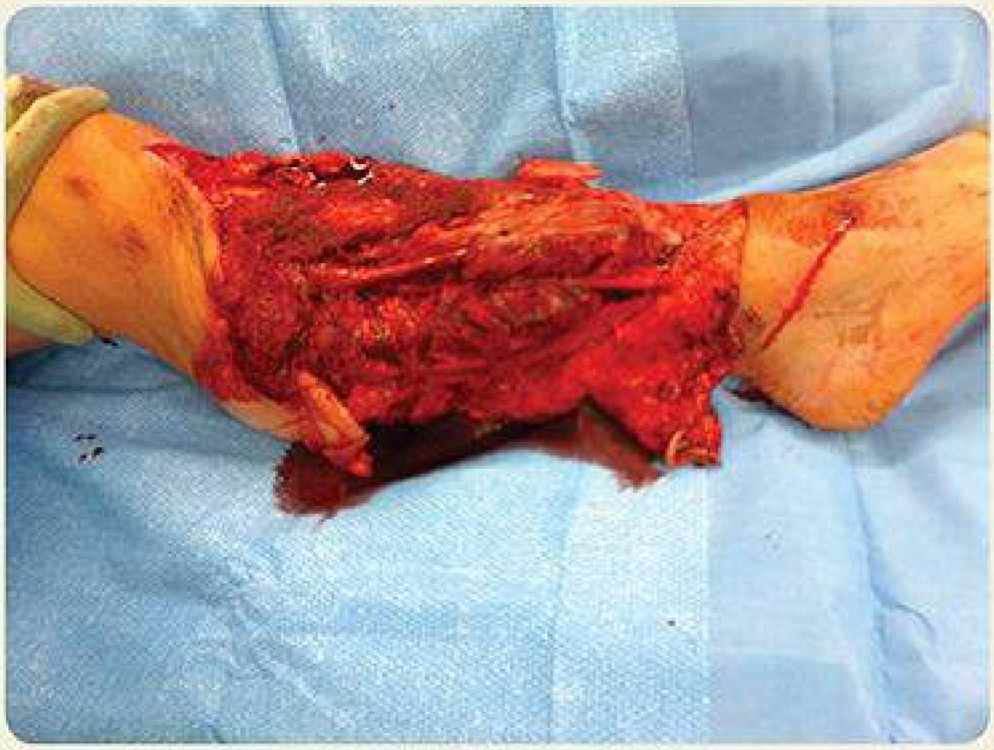


Figure 31-48 Because the tibia is so close to the skin, open fractures are relatively common.

You can manage the wide spectrum of injuries to the ankle in the same way, as follows:

1. Dress all open wounds.
2. Assess distal neurovascular function.
3. Correct any gross deformity by applying gentle longitudinal traction to the heel.
4. Before releasing traction, apply a splint.

You can use a padded rigid splint, an air splint, or a pillow splint. Make sure it includes the entire foot and extends up the leg to the level of the knee joint.

Foot Injuries

Injuries to the foot can result in the dislocation or fracture of one or more of the tarsals, metatarsals, or phalanges of the toes. Toe fractures are especially common.

Of the tarsal bones, the calcaneus, or heel bone, is the most frequently fractured. Injury often occurs when the patient falls or jumps from a height and lands directly on the heel. The force of injury compresses the calcaneus, producing immediate swelling and ecchymosis. If the force of impact is great enough, as from a fall from a roof or tree, there may also be other fractures.

Figure 31-49 Swelling about the ankle is characteristic of sprains and fractures.

Frequently, the force of injury is transmitted up the legs to the spine, producing a fracture of the lumbar spine **Figure 31-50**. When a patient who has jumped or fallen from a height reports heel pain, ask him or her about back pain and carefully check the spine for tenderness and deformity.

If you suspect that the foot is dislocated, immediately assess for pulses and motor and sensory functions. If pulses are present, stabilize the extremity using a commercially available splint or a pillow splint, leaving the toes exposed so that you can periodically assess neurovascular function. If pulses are absent, contact medical control and discuss reduction of dislocation if the local scope of practice permits.

Injuries of the foot are associated with significant swelling but rarely with gross deformity. Vascular injuries are uncommon. As in the hand, lacerations about the ankle and foot may damage important underlying nerves and tendons. Puncture wounds of the foot are common and may cause serious infection if not treated early. All of these injuries must be evaluated and treated by a physician.

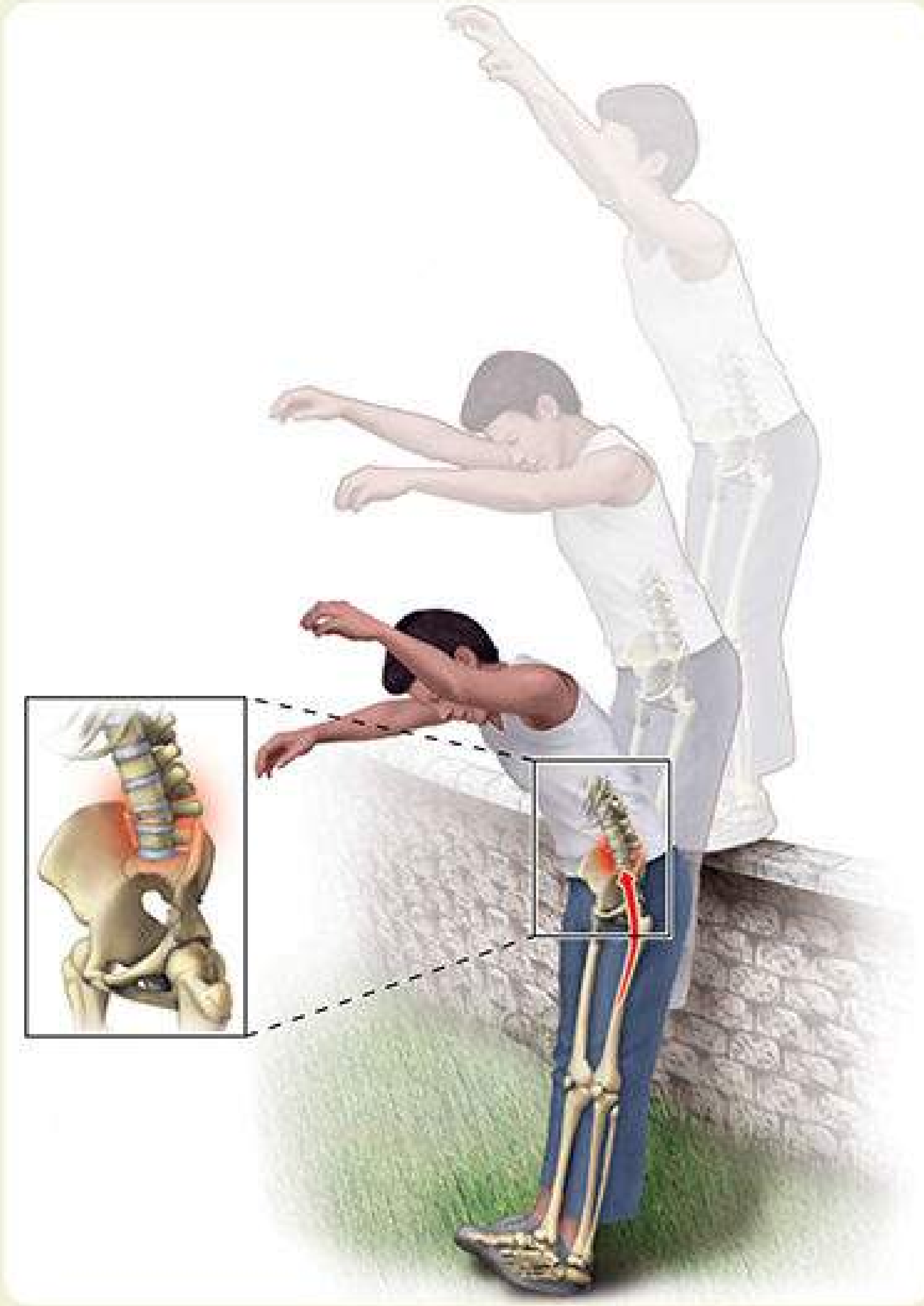


Figure 31-50 Frequently after a fall, the force of injury is transmitted up the legs to the spine, sometimes resulting in a fracture of the lumbar spine.

To splint the foot, apply a rigid padded board splint, an air splint, or a pillow splint, stabilizing the ankle joint and the foot Figure 31-51. Leave the toes exposed so that you can periodically assess neurovascular function.

When the patient is lying on the stretcher, elevate the foot approximately 6 inches (15 cm) to minimize swelling. All patients with lower extremity injuries should be transported in the supine position to allow for elevation of the limb. Never allow the foot and leg to dangle off the stretcher onto the floor or ground.

If a patient has fallen from a height and reports heel pain, use a backboard to immobilize any suspected spinal injury in addition to splinting the foot.

Sprains and Strains

Because it may be difficult to differentiate among the various types of injuries in the field, it is best to err on the side of caution and treat every severe sprain as if it is a fracture. Therefore, general treatment of sprains and strains is similar to that of fractures and includes RICES (Rest, Ice, Compression, Elevation, and Splinting as described in Chapter 26, *Soft-Tissue Injuries*). In addition, reduce or protect the limb from weight-bearing activity. Manage pain as soon as is practical.

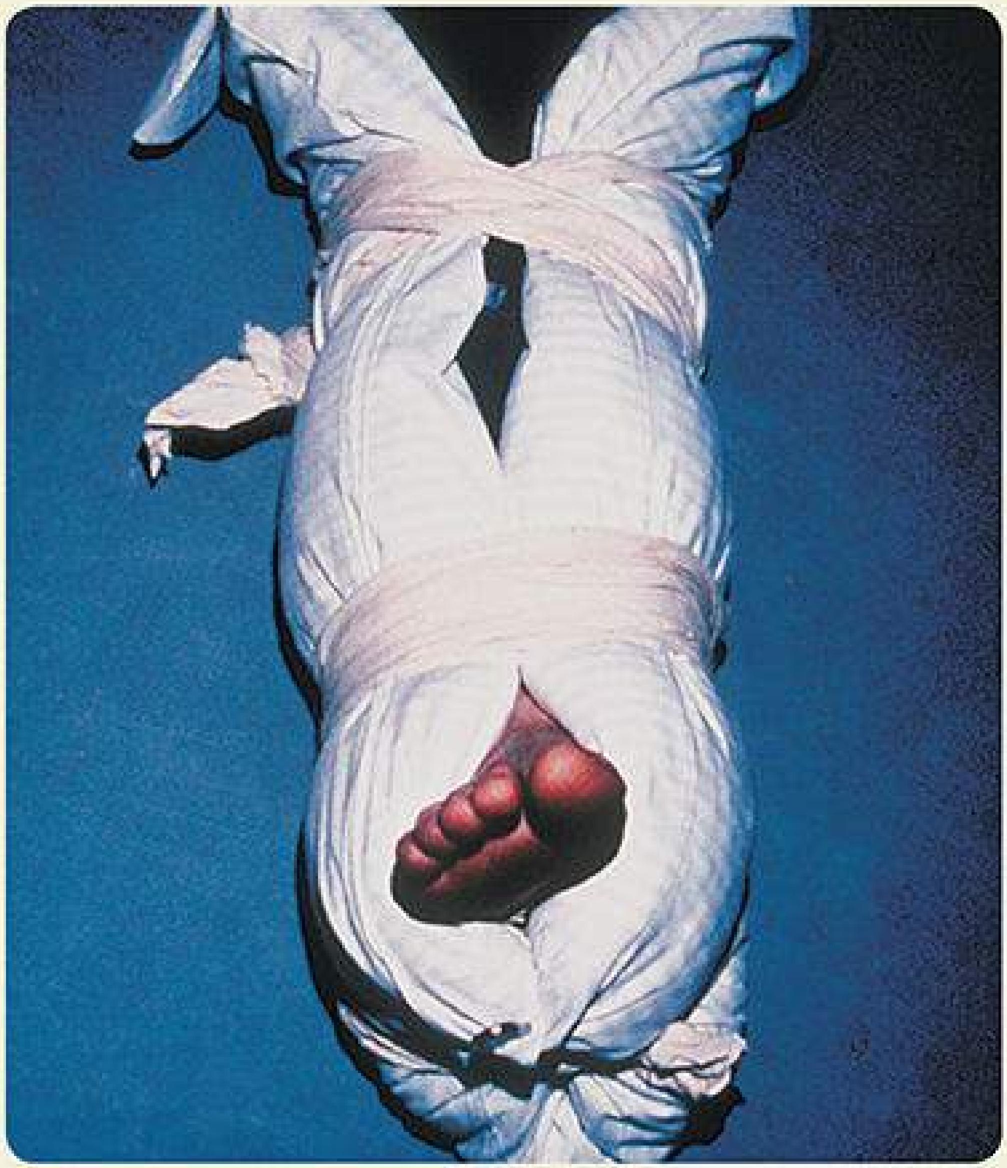


Figure 31-51 A pillow splint provides excellent stabilization of the foot.

Amputations

You must control bleeding and treat for shock when dealing with traumatic amputations. Complete traumatic amputations may occasionally not bleed much if the cut vessels go into spasm, reducing blood loss.

Surgeons today can occasionally reattach amputated parts **Figure 31-52**. However, correct prehospital care of the amputated part is vital to successful reattachment. With partial amputations, make sure to stabilize the part with bulky compression dressings and a splint to prevent further injury. Do not sever any partial amputations; this may complicate later reattachment. Hemorrhage from complete or incomplete amputations can be severe and life threatening. Control any bleeding from the stump. If bleeding is severe, quickly apply a tourniquet.

With a complete amputation, make sure to wrap the clean part in a sterile dressing and place it in a plastic bag. Follow your local protocols regarding how to preserve amputated parts. In some areas, dry sterile dressings are recommended for wrapping amputated parts; in other areas, dressings moistened with sterile saline are recommended. Put the bag in a cool container filled with ice. Lay the wrapped part on a bed of ice; do not pack it in ice. The goal is to keep the part cool without allowing it to freeze or develop frostbite. The amputated part should be transported with the patient to the appropriate resource hospital.

Compartment Syndrome

Be on the alert for **compartment syndrome**, which most commonly occurs with a fractured tibia in adults or forearm in children and can be overlooked, especially in patients with an altered level of consciousness. Compartment syndrome typically develops within 6 to 12 hours after injury, usually as a result of excessive bleeding, a severely crushed extremity, or the rapid return of blood to an ischemic limb. This syndrome is characterized by pain that is out of proportion to the injury, pain on passive stretch of muscles within the compartment, pallor (pale skin), decreased sensation, and decreased power (ranging from decreased strength and movement of the limb to complete paralysis). Compartment syndrome must be managed surgically.

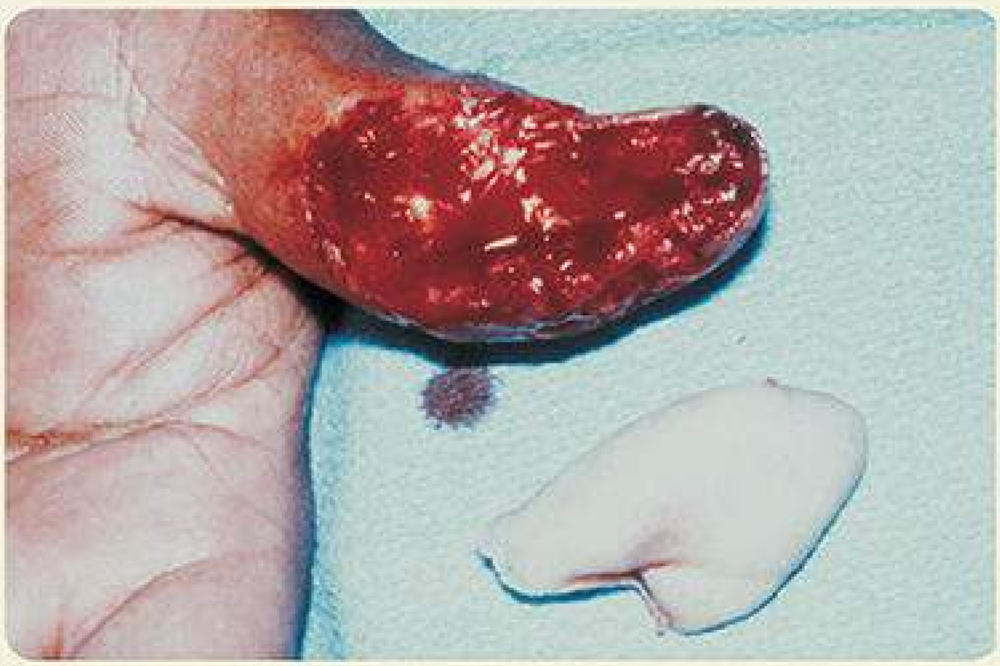


Figure 31-52 Amputated parts can occasionally be reattached, so make every attempt to find the part and transport it to the ED along with the patient.

If you have a patient with a fracture below the elbow or the knee, be on the lookout for extreme pain, decreased sensation or any tingling or numbness, pain on stretching of affected muscles, and decreased power. These are indicators that the pressure within a fascial compartment is elevated. If you suspect that a patient has compartment syndrome, splint the affected limb, keeping it at the level of the heart, and provide immediate transport, reassessing neurovascular status frequently during transport.

YOU are the Provider SUMMARY

1. Under which circumstances can orthopaedic injuries pose a threat to a patient's life?

Sprains, strains, and dislocations are rarely life threatening. Dislocations and isolated closed fractures can cause neurovascular damage and permanent disability if not treated promptly, but typically do not pose a threat to life. However, multiple closed long bone fractures, which can cause severe internal bleeding if bone fragments lacerate major blood vessels, can result in hypovolemic shock and death. Open fractures and extremity amputations (excluding fingers and toes) can also result in hypovolemic shock due to severe external bleeding. Amputation of a leg or arm can quickly lead to exsanguination (bleeding to death) if not promptly treated. Contamination of the wound could also lead to an infection of the underlying bone. Pelvic fractures are potentially life threatening because the pelvic cavity can accommodate a large volume of blood. Patients can die of pelvic fractures because hypovolemic shock occurs secondary to severe internal bleeding when a fractured bone fragment or dislocated bone lacerates or severs a major artery or vein or due to bleeding from fractured bone ends.

2. Given the information you have, can you rule out a critical injury?

No. As concise as the dispatch information can sometimes be, you will not know the extent of a patient's injury (or injuries) until you arrive at the scene and perform a patient assessment. In this case, all you know is that the patient is conscious and alert and breathing and has a possible leg fracture. While the dispatch information infers that this is an isolated injury secondary to a soccer-related incident, keep an open mind and avoid the preconceived notion that the leg injury is the only injury.

When you approach any patient, regardless of the nature of the call, you must perform a primary assessment in order to detect and correct immediate threats to airway, breathing, and circulation. Avoid tunnel vision when assessing and treating patients with orthopaedic trauma. A fractured leg may be the most obvious injury; however, it may not be the only injury. Furthermore, it may not be the most life-threatening injury.

3. What initial treatment should you provide to this patient?

Because the patient denies having any other injuries—for example, a neck injury, which may require spinal immobilization—your initial action, after taking standard precautions, should be to expose the injury site and then perform manual stabilization. With an injury in the tibia-fibula area, you or your partner should manually stabilize above the ankle and below the knee. Manual stabilization will help minimize the potential for further injury by preventing movement of the leg.

After you expose and manually stabilize the injury site, assess the patient for obvious signs of injury, such as swelling, deformity, bruising, and open wounds. The absence of deformity does not rule out an underlying fracture. Furthermore, swelling often masks underlying deformity. Treat any extremity injury as though an underlying fracture is present, and stabilize it appropriately.

4. What are some indicators of a fractured bone?

A fracture is defined as any break in the continuity of a bone and is classified as being open (overlying skin is not intact) or closed (overlying skin is intact). In many cases, the deformity is grossly obvious; in other cases, it is very subtle. Signs of a fracture include deformity, point tenderness, swelling, bruising, and crepitus:

5. How should you proceed with your assessment of this patient's injury?

This patient did not experience multisystem trauma or a significant mechanism of injury; therefore, a secondary assessment of the entire body is not indicated. Instead, focus on evaluating perfusion and sensory and motor functions distal to the injury. When you assess an extremity injury, remember the 6 Ps of musculoskeletal assessment: pain, paralysis, paresthesia, pulselessness, pallor, and pressure.

First, assess the patient's level of pain using a scale of 0 to 10. Next, assess perfusion. In some cases, a fractured bone end may compress or sever a blood vessel, resulting in inadequate or absent perfusion distal to the fracture. Compare the color of the skin with that of the uninjured limb. If perfusion is adequate, the skin should be pink and warm.

Palpate the dorsalis pedis pulse (on the top of the foot) and the posterior tibial pulse (on the posterior aspect of the ankle). Pulses that are weak or absent in comparison with pulses in the uninjured limb also suggest compromised perfusion.

Next, use a blunt object, and stroke it up the bottom and sides of her foot. If she is unable to feel you touching her foot, you should suspect that a nerve has been compressed or possibly severed by a fractured bone end. To test motor function, simply ask her to wiggle her toes; however, if this increases her pain, discontinue this part of the examination. Paresthesia (numbness or tingling) could indicate compromised perfusion and/ or nerve injury. A feeling of pressure distal to the injury site could indicate elevated pressure within a fascial compartment due to internal bleeding; if this continues, it could lead to compartment syndrome.

In addition to assessing perfusion and sensory and motor functions, assess the areas above and below the injury (the injury zone); in this case, the injury zone extends above her knee and below her ankle. Remember, her leg may be the most obvious injury, but it may not be the only injury.

6. How should you treat an injured extremity in which distal perfusion is absent?

As a general rule, you should splint an orthopaedic injury in the position it was found, provided that distal perfusion is intact. In some cases, an injured extremity may be so severely angulated that gentle longitudinal traction may be required in order to splint the injury effectively, even if distal perfusion is adequate.

If your assessment reveals that perfusion distal to the injury is compromised or absent (ie, pallor, absent distal pulses, cold skin), apply gentle longitudinal traction in order to realign the limb until perfusion is restored. The goal is not to return the extremity to its normal anatomic position, but rather to restore distal circulation. In many cases, gentle realignment of the limb restores adequate perfusion; however, if one attempt (local protocol may dictate more than one attempt) at realignment is unsuccessful, splint the injury, transport the patient as soon as possible, and notify the receiving facility early.

7. How should you splint this patient's injury?

Prior to splinting any extremity injury, assess the patient's distal perfusion and sensory and motor functions. Fractures of the tibia and fibula can be stabilized with a padded rigid leg splint; an air splint; or a vacuum splint that stabilizes the joints above and below the fracture site. In this case, stabilize the knee and ankle. As with most other fractures of the shaft of long bones, correct severe deformity before applying the splint by applying gentle longitudinal traction. Restore the deformed limb to a position that will accommodate a splint—not to its normal anatomic position. The affected leg, once splinted, should be secured to the opposite leg.

Immediately after the splint is secured in place, reassess distal perfusion and sensory and motor functions. If perfusion is found to be inadequate, the splint should be loosened or reapplied as necessary to restore this vital function.

8. What are some methods for providing pain relief from orthopaedic trauma?

Pain relief is an important aspect in the overall care of a patient with orthopaedic trauma. Pain increases anxiety, which only adds to the patient's problems.

After you apply the splint, which should be padded for comfort, elevate the injured extremity above the level of the heart. This will help reduce pain and swelling by encouraging blood to drain from the extremity.

Chemical cold packs wrapped with gauze or some other type of insulating material can be applied directly over the injury site. A cold stimulus applied to the skin constricts the blood vessels; this can help reduce swelling and pain.

Certain medications can be administered to the patient by a paramedic. In some cases, especially during a prolonged transport, it may be helpful to request ALS intervention.

9. What is the most likely cause of the patient's complaint? What can you can do to remedy the situation?

On the basis of the patient's complaint of numbness and tingling and your findings of pallor and weak pedal pulses, you should suspect that you applied the splint too tightly and that it is now impairing distal circulation.

Simply loosen the splint if it was applied too tightly. If you used padded board splints and triangular bandages (cravats), loosen the cravats. If you applied an air splint, release some of the air from the splint. If you applied a vacuum splint, gently attempt to spread the edges of the splint apart to the point at which the patient feels relief. If this is not possible and a prolonged transport time is anticipated, it would not be unreasonable to stop the ambulance and apply a different type of splint, provided that the patient's condition is stable. Regardless of the splint that you used, immediately reassess distal circulation after making any adjustments, and ask the patient whether the numbness and/or tingling has subsided. In most cases, these adjustments will lead to improvement.

10. What factors increase the risk of complications following orthopaedic trauma?

Orthopaedic injuries can lead to systemic complications. Do not focus all of your attention on the skeletal injury; after all, there is a patient attached to the injured extremity! The risk of complications following orthopaedic trauma is increased by a variety of factors, such as the amount of force that caused the injury, the injury location, and the patient's overall health. Injuries in patients who smoke cigarettes or who have diabetes, for example, tend to heal poorly and complications are more common.

Any fracture—open or closed—is accompanied by the risk of bleeding. In general, the severity of bleeding is directly related to the force that caused the injury. A significant loss of tissue may occur at the fracture site if the muscle is severely damaged or if the bone's penetration of the skin causes a large deformity.

Infection is another potential complication, especially in patients with open fractures or patients with other medical problems such as cigarette smoking or diabetes. To prevent contaminating an open fracture, and to minimize the risk of infection, brush away any obvious debris on the skin surrounding the fracture before covering it with a sterile dressing. Do not "probe" into an open fracture in an attempt to retrieve debris.

Long-term disability is one of the most devastating complications of orthopaedic trauma. In many cases, a severely injured limb can be successfully repaired; however, many patients may not be able to work for long periods because of severe, chronic pain and the extensive rehabilitation that is often required.

As an EMT, you can help reduce the risk of complications, thus reducing the risk or duration of long-term disability following orthopaedic trauma, by preventing further injury, properly splinting orthopaedic injuries, reducing the risk of wound infection, and transporting patients to an appropriate medical facility.

EMS Patient Care Report (PCR)

Date: 12-23-16	**Incident No.:** 012909	**Nature of Call:** Leg injury		**Location:** 404 Field Drive	
Dispatched: 1620	**En Route:** 1620	**At Scene:** 1625	**Transport:** 1644	**At Hospital:** 1656	**In Service:** 1707

Patient Information

Age: 21 **Sex:** F **Weight (in kg [lb]):** 50 kg (110 lb)	**Allergies:** Codeine **Medications:** Birth control pills **Past Medical History:** None **Chief Complaint:** Left leg pain

Vital Signs

Time: 1630	**BP:** 130/78	**Pulse:** 112	**Respirations:** 22	**Spo_2:** 98%
Time: 1638	**BP:** 134/80	**Pulse:** 110	**Respirations:** 22	**Spo_2:** 99%
Time: 1648	**BP:** 128/76	**Pulse:** 115	**Respirations:** 20	**Spo_2:** 98%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Cold pack; elevated injured leg

Narrative

Medic 8 dispatched to a soccer field for a patient with a "possible broken leg." Arrived on scene and found the patient, a 21-year-old woman, sitting on the ground with her left leg extended and covered with an ice pack. She was conscious and alert; her airway was patent, and her breathing was adequate. Patient states that she injured her left leg when another player fell against it during the game. Assessment of her leg revealed obvious deformity to the midshaft tibial area. Patient describes pain severity as a "9" on a 0 to 10 scale. No open injuries were noted. Pulse and sensory and motor functions were grossly intact distal to the injury. A nurse was present at the scene and assisted EMS by manually stabilizing the injury site. The patient denies any other injuries; she further denies any past medical history. Secondary assessment was performed and revealed no gross evidence of injury to the areas above her knee and below her ankle on the injured extremity. Her right lower extremity was also normal. Vital signs were obtained and noted above. Splinted injured extremity with padded board splints; pulse and sensory and motor functions were assessed after splinting and were found to be grossly intact. Secured patient onto stretcher, elevated her left leg with pillows, loaded her into the ambulance, and began transport. Applied cold pack to injury site for pain relief. Patient stated that elevation of her leg and the cold pack reduced her pain to a 5/10. Monitored patient's vital signs en route and noted that they remained stable. Patient began reporting paresthesia to her left foot during transport. Reassessment of area distal to the injury revealed that her foot was cool and pale and her pedal pulse was weaker than before. Loosened bandages that were securing splints in place, after which patient stated that the paresthesias resolved; her foot regained a pink color and became warm, and her pedal pulse was stronger following this intervention. Remainder of transport was uneventful. Delivered patient to emergency department, and gave verbal report to staff nurse. Medic 8 cleared the hospital and returned to service at 1707.**End of report**

Prep Kit

Ready for Review

- Skeletal or voluntary muscle attaches to bone and forms the major muscle mass of the body. This muscle contains veins, arteries, and nerves.
- There are approximately 206 bones in the human body. When this living tissue is fractured, it can produce bleeding and significant pain.
- A joint is a junction where two bones come into contact. Joints are stabilized in key areas by ligaments.
- A fracture is a broken bone, a dislocation is a disruption of a joint, a sprain is a stretching injury to the ligaments around a joint, and strain is a stretching of the muscle.
- Depending on the amount of kinetic energy absorbed by tissues, the zone of injury may extend beyond the point of contact. Always maintain a high index of suspicion for associated injuries.
- Fractures of the bones are classified as open or closed. Both are splinted in a similar manner, but remember to control bleeding and apply a sterile dressing to the open extremity injury before splinting.
- Fractures and dislocations are often difficult to diagnose without a radiograph examination. You will treat these injuries similarly. Stabilize the injury with a splint, and transport the patient.
- Signs of fractures and dislocations include pain, deformity, point tenderness, false motion, crepitus, swelling, and bruising.
- Signs of sprain include bruising, swelling, and an unstable joint.
- Compare the unaffected extremity with the injured extremity whenever possible.
- There are three main types of splints used by EMTs: rigid splints, traction splints, and formable splints.
- Remember to splint the injured extremity from the joint above to the joint below the injury site for complete stabilization.
- A sling and swathe is used commonly to treat shoulder dislocations and to secure injured upper extremities to the body. Lower extremities can be secured to the unaffected limb or to a backboard.
- The most common life-threatening musculoskeletal injuries are multiple fractures, open fractures with arterial bleeding, pelvic fractures, bilateral femur fractures, and limb amputations.

Vital Vocabulary

acromioclavicular (AC) joint A simple joint where the bony projections of the scapula and the clavicle meet at the top of the shoulder.

amputation An injury in which part of the body is completely severed.

articular cartilage A pearly white layer of specialized cartilage covering the articular surfaces (contact surfaces on the ends) of bones in synovial joints.

calcaneus The heel bone.

closed fracture Any break in a bone in which the overlying skin is not broken.

compartment syndrome An elevation of pressure within a closed fascial compartment, characterized by extreme pain, decreased pain sensation, pain on stretching of affected muscles, and decreased power; frequently seen in fractures below the elbow or knee in children.

crepitus A grating or grinding sensation or sound caused by fractured bone ends or joints rubbing together.

dislocation Disruption of a joint in which ligaments are damaged and the bone ends are no longer in contact.

displaced fracture A fracture in which bone fragments are separated from one another, producing deformity in the limb.

ecchymosis Bruising or discoloration associated with bleeding within or under the skin.

false motion Movement that occurs in a bone at a point where there is no joint, indicating a fracture; also called free movement.

fascia The fiberlike connective tissue that covers arteries, veins, tendons, and ligaments.

fibula The outer and smaller bone of the two bones of the lower leg.

fracture A break in the continuity of a bone.

glenoid fossa The part of the scapula that joins with the humeral head to form the glenohumeral joint.

hematuria Blood in the urine.

joint The place where two bones come into contact.

ligament A band of fibrous tissue that connects bones to bones. It supports and strengthens a joint.

nondisplaced fracture A simple crack in the bone that has not caused the bone to move from its normal anatomic position; also called a hairline fracture.

open fracture Any break in a bone in which the overlying skin has been broken.

pelvic binder A device to splint the bony pelvis to reduce hemorrhage from bone ends, venous disruption, and pain.

point tenderness Tenderness that is sharply localized at the site of the injury, found by gently palpating along the bone with the tip of one finger.

position of function A hand position in which the wrist is slightly dorsiflexed and all finger joints are moderately flexed.

reduce To return a dislocated joint or fractured bone to its normal position; to set.

retroperitoneal space The space between the abdominal cavity and the posterior abdominal wall, containing the kidneys, certain large vessels, and parts of the gastrointestinal tract.

sciatic nerve The major nerve to the lower extremities; controls much of muscle function in the leg and sensation in most of the leg and foot.

sling A bandage or material that helps to support the weight of an injured upper extremity.

splint A flexible or rigid device used to protect and maintain the position of an injured extremity.

sprain A joint injury involving damage to supporting ligaments, and sometimes partial or temporary dislocation of bone ends.

strain Stretching or tearing of a muscle; also called a muscle pull.

swathe A bandage that passes around the chest to secure an injured arm to the chest.

tibia The larger of the two lower leg bones responsible for supporting the major weight-bearing surface of the knee and the ankle; the *shinbone*.

tourniquet The bleeding control method used when a wound continues to bleed despite the use of direct pressure and elevation; useful if a patient is bleeding severely from a partial or complete amputation.

traction Longitudinal force applied to a structure.

zone of injury The area of potentially damaged soft tissue, adjacent nerves, and blood vessels surrounding an injury to a bone or a joint.

Assessment *in Action*

You and your partner are assigned to a post at an extreme sports competition. You are called to assess a 23-year-old man who was performing a midair trick on his bike when he lost control and landed on the bottom of the concrete ramp. When you arrive on scene, the patient is awake and alert and in extreme pain. He tells you that he flew over his handlebars and felt both of his upper legs snap. He denies experiencing any loss of consciousness.

1. You perform a secondary assessment of the entire body and find instability in the pelvis and deformity to the midshaft area of the femur in both legs. The patient's injuries were the result of a/an:

   A. high-energy impact.
   B. indirect force.
   C. direct blow.
   D. twisting force.

2. During your assessment of the lower extremities, the patient reports pain when you palpate his thigh. This is cw3alled:

   A. guarding.
   B. tenderness.
   C. swelling.
   D. bruising.

3. When you assess distal circulation in the patient's lower extremities, you should palpate the __________ pulse.

   A. femoral
   B. dorsalis pedis
   C. popliteal
   D. iliac

4. Further assessment of the patient reveals no other injuries or life threats. His vital signs include the following: pulse rate, 104 beats/ min; blood pressure, 118/72 mm Hg; and respirations, 20 breaths/min. Using the musculoskeletal grading system, you would classify this patient's injuries as:

A. minor.
B. moderate.
C. severe.
D. critical.

5. The primary goal of placing the patient's legs in in-line traction is to:

 A. minimize pain.
 B. avoid further neurovascular compromise.
 C. reduce swelling.
 D. prevent permanent disability.

6. You found instability in the pelvis during your assessment. How will you move this patient to your stretcher?

 A. Log roll the patient onto a backboard.
 B. Use a scoop stretcher.
 C. Ask the patient to slide onto the stretcher.
 D. Perform a direct ground lift.

7. Neurovascular function should be reassessed every _________ minutes.

 A. 5 to 10
 B. 10 to 15
 C. 15 to 20
 D. 20 to 30

8. Will this patient need ALS intervention? Why or why not?
9. Is this patient at risk for shock? Why or why not?
10. How can you help minimize the risk or duration of long-term disability in patients with musculoskeletal injuries?

CHAPTER
32

Environmental Emergencies

Courtesy of Neil Malcom Winkelmann.

National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Environmental Emergencies

Recognition and management of

› Submersion incidents (pp 1157–1160, 1164–1165)
› Temperature-related illness (pp 1143–1146, 1149–1152, 1154–1157)

Pathophysiology, assessment, and management of

› Near drowning (pp 1157–1160, 1162–1164)
› Temperature-related illness (pp 1143–1157)
› Bites and envenomations (pp 1166–1172)
› Dysbarism (p 1165)
  • High altitude (p 1165)
  • Diving injuries (pp 1160–1164)
› Electrical injury (pp 1165–1166)
› Radiation exposure (Chapter 40, *Terrorism Response and Disaster Management*)

Knowledge Objectives

1. Identify the four factors that affect how a person deals with exposure to a cold or hot environment. (pp 1141–1142)
2. Describe the five ways heat loss occurs in the body, and how the rate and amount of heat loss or gain can be modified in an emergency situation. (pp 1142–1143)
3. Describe the four general stages of hypothermia. (pp 1143–1144)
4. Describe local cold injuries and their underlying causes. (pp 1145–1146)

5. Describe the process of providing emergency care to a patient who has sustained a cold injury, including assessment of the patient, review of signs and symptoms, and management of care. (pp 1146–1150)
6. Explain the importance of following local protocols when rewarming a patient who is experiencing moderate or severe hypothermia. (p 1149)
7. Describe the three emergencies that are caused by heat exposure, including their risk factors, signs, and symptoms. (pp 1151–1152)
8. Describe the process of providing emergency care to a patient who is experiencing a heat emergency, including assessment of the patient, review of signs and symptoms, and management of care. (pp 1152–1157)
9. Describe drowning, including its incidence, risk factors, and prevention. (pp 1157–1158, 1165)
10. List the basic rules of performing a water and ice rescue. (p 1158)
11. Explain why EMTs should have a prearranged rescue plan based on the environment in which they work. (p 1158)
12. List five conditions that may result in a spinal injury following a submersion incident and the steps for stabilizing a patient with a suspected spinal injury in the water. (pp 1157–1160)
13. Discuss recovery techniques and resuscitation efforts EMTs may need to follow when managing a patient who has been involved in a submersion incident. (p 1160)
14. Describe the three types of diving emergencies, how they may occur, and their signs and symptoms. (pp 1160–1162)
15. Describe the process of providing emergency care to a patient who has been involved in a drowning or diving emergency, including assessment of the patient, review of signs and symptoms, and management of care. (pp 1162–1164)
16. Discuss the types of dysbarism injuries, including their incidence, risk factors, signs and symptoms, and emergency medical treatment. (p 1165)
17. Discuss lightning injuries, including their incidence, risk factors, signs and symptoms, and emergency medical treatment. (pp 1165–1166)
18. Describe the process of providing emergency care to patients who have been bitten by each of the following venomous spiders: (pp 1166–1167)
    - Black widow spider
    - Brown recluse spider
19. Describe the process of providing emergency care to a patient who has sustained a bite or sting from each of the following insects and arachnids, including steps the EMT should follow if a patient develops a severe reaction to the sting or bite: (pp 1167–1168, 1171–1172)
    - Hymenoptera (bees, wasps, yellow jackets, and ants)
    - Scorpions
    - Ticks
20. Describe the process of providing emergency care to a patient who has been bitten by each of the following types of snake and is showing signs of envenomation: (pp 1168–1171)
    - Pit viper
    - Coral snake
21. Describe the process of providing emergency care to a patient who has been stung by a coelenterate or other marine animal. (p 1173)

Skills Objectives

1. Demonstrate the emergency medical treatment of local cold injuries in the field. (p 1150)
2. Demonstrate how to use a warm-water bath to rewarm the limb of a patient who has sustained a local cold injury. (p 1150)
3. Demonstrate how to treat a patient with heat cramps. (p 1154)
4. Demonstrate how to treat a patient with heat exhaustion. (pp 1154–1156, Skill Drill 32-1)
5. Demonstrate how to treat a patient with heat stroke. (pp 1156–1157)
6. Demonstrate how to stabilize a patient with a suspected spinal injury in the water. (pp 1157–1160, Skill Drill 32-2)
7. Demonstrate how to care for a patient who is suspected of having an air embolism or decompression sickness following a drowning or diving emergency. (p 1164)
8. Demonstrate how to care for a patient who has been bitten by a pit viper and is showing signs of envenomation. (pp 1170–1171)
9. Demonstrate how to care for a patient who has been bitten by a coral snake and is showing signs of envenomation. (p

1171)

10. Demonstrate how to care for a patient who has sustained a coelenterate envenomation. (p 1173)

Introduction

The human body functions best when all body systems operate in balance, a concept known as **homeostasis**. Environmental factors such as temperature and atmospheric pressure can overwhelm the body's ability to cope with its surroundings. A variety of medical emergencies can result, particularly in children, older people, people with chronic illnesses, and young adults who overexert themselves. These can lead to mental status changes, functional changes and, possibly, death. Environmental emergencies can occur in any setting and often accompany other illnesses and injuries that require treatment at the same time. For example, a trauma patient with hypothermia has a higher risk of death than a patient with a normal body temperature. As an EMT, you can save lives by recognizing and responding properly to these emergencies, most of which require prompt treatment in the hospital.

In this chapter you will learn how the body regulates core temperature, and the ways in which heat loss can occur. The various forms of heat-, cold-, and water-related emergencies are described, including how to diagnose and treat hypothermia, frostbite, and hyperthermia. You will also learn about pressure-related emergencies, or dysbarism injuries, caused by diving and high-altitude climbing; injuries caused by lightning; and envenomation, caused by bites and stings.

Factors Affecting Exposure

The following four factors will affect how a person deals with a cold or hot environment. These can be used as prevention strategies for those who work or play in extreme environmental temperatures. Consider these factors during the assessment of your patient to determine whether he or she was prepared for a cold or hot environment. A hiker prepared for a warm summer hike in the foothills will present and respond to treatment differently than a traveler stranded in a hot vehicle because the radiator boiled over.

1. **Physical condition.** Patients who are ill or in poor physical condition will not be able to tolerate extreme temperatures as well as those whose cardiovascular, metabolic, and nervous systems are all functioning well. For example, an athlete in peak physical condition performs better and is less likely to experience injury or illness than someone with a less active lifestyle. Exertion also plays a role. For instance, a brisk walk will generate body heat when you are out in the cold but will also produce heat when it is not needed, such as walking on a hot asphalt road because your vehicle ran out of gasoline.

YOU are the Provider — PART 1

At 1415 hours, you are dispatched to a residence at 1102 Rosewood Avenue for a 55-year-old man who fainted after working in his garden. The temperature is 98°F (36.7°C) and the humidity is high. You and your partner proceed to the scene; your response time is 7 minutes.

1. How does the body normally balance heat production and elimination?
2. What factors can decrease the body's ability to eliminate excess heat?

2. **Age.** Children and older adults are more likely to experience temperature-related illness. Infants have poor thermoregulation (the body's ability to maintain normal temperature) at birth and do not have the ability to shiver and generate heat when needed until about 12 to 18 months. An infant's surface-area-to-mass ratio is larger than an adult's, so infants heat up and cool down faster. When you get cold, you put on a sweater; a small child may not think to do this or may have difficulty finding and putting one on. On the other end of the spectrum, older adults have a loss of subcutaneous tissues as they age, reducing the amount of insulation they have. Poor circulation also contributes to increased heat loss. This is why older people often wear extra layers of clothing. Medications can also affect an older person's body thermostat, putting him or her at increased risk for temperature-related emergencies. Finally, older patients are also at high risk for falls, and lying immobile on a hot or cold surface can rapidly lead to overexposure.
3. **Nutrition and hydration.** Your body needs calories for your metabolism to function. Staying well hydrated provides water as a catalyst for much of this metabolism. A lack of food or water will aggravate both hot and cold stress. Calories provide fuel to burn, creating heat during the cold, and water provides sweat for evaporation and removing heat. Alcohol use may increase fluid loss and place the patient at greater risk for temperature-related emergencies.
4. **Environmental conditions.** Factors such as air temperature, humidity level, and wind can complicate or improve environmental situations. A light breeze helps you stay cool when it is hot outside, but a cold wind when it is cold

outside can be uncomfortable. Extremes in temperature and humidity are not needed to produce hot or cold injuries. Many hypothermia cases occur at temperatures between 30°F (minus 1°C) and 50°F (10°C). Most heat stroke cases occur when the temperature is 80°F (26.7°C) and the humidity is 80%. When evaluating your patient's condition, consider the environment and whether your patient is prepared for that situation. Older patients may turn the heat down in the winter or neglect to use air conditioning in the summer because of cost concerns. Some people may not open windows in a heat wave for fear of burglars. An understanding of the environmental conditions may help in your treatment decisions and give you an idea about how the patient will respond to your care.

Cold Exposure

Normal body temperature is 98°F (36.7°C). Complicated regulatory mechanisms keep this internal temperature constant, regardless of the **ambient temperature**, the temperature of the surrounding environment. If the body, or any part of it, is exposed to cold environments, these mechanisms may be overwhelmed. Cold exposure may cause injury to individual parts of the body, such as the feet, hands, ears, or nose, or to the body as a whole.

Because heat always travels from a warmer place to a cooler place, body heat tends to move into the environment. Heat loss can occur in the following five ways:

- **Conduction** is the transfer of heat from a part of the body to a colder object or substance by direct contact, such as when a warm hand touches cold metal or ice, or is immersed in water with a temperature of less than 98°F (36.7°C). Heat can also be gained if the object or substance being touched is warm.
- **Convection** occurs when heat is transferred to circulating air, such as when cool air moves across the body surface. A person who stands outside in windy, wintry weather and wears only lightweight clothing is mainly experiencing heat loss by convection. A person can gain heat if the air moving across the person's body is hotter than the temperature of the environment, such as in deserts or industrial settings like foundries, but it is more common to see rapid heat gain in spas and hot tubs where the water temperature may be well above body temperature.
- **Evaporation** is the conversion of any liquid to a gas, a process that requires energy, or heat. Evaporation is the natural mechanism by which sweating cools the body. This is why swimmers coming out of the water feel a sensation of cold as the water evaporates from their skin. People who exercise vigorously in a cool environment may sweat and feel warm at first, but later, as their sweat evaporates, they can become cold.
- **Radiation** is the transfer of heat by radiant energy. Radiant energy is a type of invisible light that transfers heat. Radiation causes heat loss, such as when a person stands in a cold room. Heat can also be gained by radiation; for example, when a person stands by a fire.
- **Respiration** causes body heat loss as warm air in the lungs is exhaled into the atmosphere and cooler air is inhaled. In warm climates, the air temperature can be well above body temperature, causing an individual to gain heat with each breath.

The rate and amount of heat loss or gain by the body can be modified in three ways:

1. **Increase or decrease heat production.** One way for the body to increase its heat production is to increase the rate of metabolism of its cells; the body can accomplish this through shivering (active movement of many muscles to generate heat). Also, people often have a natural urge to move around when they are cold. When a person is hot, he or she tends to reduce the level of activity, thus reducing heat production.
2. **Move to an area where heat loss is decreased or increased.** The most obvious way to decrease heat loss from radiation and convection is to move out of a cold environment and seek shelter from the wind. The same holds true for a patient who is too hot. Simply moving the patient into the shade can reduce the ambient temperature by 10 degrees or more. If you cannot move the patient, create shade and increase air movement by fanning the patient.
3. **Wear the appropriate clothing for the environment.** To avoid heat loss in cold environments, wear layers of clothing that provide good insulation, such as wool, down, and synthetic fabrics. Protective clothing traps perspiration and prevents evaporation, which prevents cooling. Keep the head, hands, and feet covered, and remove wet clothing if possible. To encourage heat loss in hot environments, wear lightweight, loose-fitting clothing, particularly around the head and neck.

Hypothermia

When the entire body temperature falls, the condition is called **hypothermia**. Hypothermia means "low temperature." It is diagnosed when the **core temperature** of the body—the temperature of the heart, lungs, and vital organs—falls below 95°F

(35°C). The body can usually tolerate a drop in core temperature of a few degrees. However, below this critical point, the body cannot regulate its temperature and generate body heat. Progressive loss of body heat then begins.

To protect itself against heat loss, the body normally constricts blood vessels in the skin; this results in the characteristic appearance of blue lips and/or fingertips. As a secondary precaution against heat loss, the body tends to create additional heat by shivering. As cold exposure worsens and these mechanisms are overwhelmed, many body functions begin to slow down and mental status deteriorates. Eventually, the functioning of key organs such as the heart begins to slow. Untreated, this can lead to death.

Hypothermia can develop either quickly, as when someone is immersed in cold water, or gradually, as when a person is exposed to the cold environment for several hours or more. Recall that the temperature does not have to be below freezing for hypothermia to occur. In winter, hypothermia at temperatures above freezing may develop in people experiencing homelessness and those whose homes lack. Even in summer, swimmers who remain in the water for a long time are at risk of hypothermia. Like all heat-and cold-related injuries, hypothermia is more common among geriatric, pediatric, and ill people, who are less able to adjust to temperature extremes.

Patients with injuries or illness, such as burns, shock, head injury, stroke, generalized infection, injuries to the spinal cord, diabetes, and hypoglycemia, are more prone to hypothermia, as are patients who have taken certain drugs or consumed alcohol.

Signs and Symptoms

Signs and symptoms of hypothermia generally become more severe as the core temperature falls. Hypothermia generally progresses through four stages, as shown in Table 32-1. Although there is no clear distinction among the stages, the different signs and symptoms of each will help you estimate the severity of the condition. When you assess a patient in the field, you should be able to distinguish between mild and severe hypothermia.

Table 32-1 Characteristics of Systemic Hypothermia

Core Temperature	93° to 95°F (33.9° to 35°C)	89° to 92°F (31.7° to 33.3°C)	80° to 88°F (26.7° to 31.1°C)	<80°F (<26.7°C)
Signs and symptoms	Shivering, foot stamping	Loss of coordination, muscle stiffness	Coma	Apparent death
Cardiorespiratory response	Constricted blood vessels, rapid breathing	Slowing respirations, slow pulse	Weak pulse, dysrhythmias, very slow respirations	Cardiac arrest
Level of consciousness	Withdrawn	Confused, lethargic, sleepy	Unresponsive	Unresponsive

Figure 32-1 To assess a patient's core body temperature, pull back your glove and place the back of your hand on the patient's skin at the abdomen.

To assess the patient's core body temperature (CBT), pull back on your glove and place the back of your hand on the patient's skin at the abdomen **Figure 32-1**. This area of the body is usually well protected and will give you a quick, general idea of the patient's core temperature. If the skin feels cool, the patient is likely experiencing a generalized cold emergency.

If you work in a cold environment, and/or depending on local protocols, you may carry a hypothermia thermometer, which registers lower core temperatures. It must be inserted in the rectum for an accurate reading. Regular thermometers will not register the temperature of a patient who has significant hypothermia.

Mild hypothermia occurs when the core temperature is between 90°F and 95°F (32.2°C and 35°C). The patient is usually alert and shivering in an attempt to generate more heat through muscular activity. The patient may jump up and down and stamp his or her feet. Pulse rate and respirations are usually rapid. The skin in light-skinned people can be red, but may eventually appear pale, then cyanotic. People in a cold environment may have blue lips or fingertips because of the body's constriction of blood vessels at the skin to retain heat.

More severe hypothermia occurs when the core temperature is less than 90°F (32.2°C). Shivering stops and muscular activity decreases. At first, small, fine muscle activity such as coordinated finger motion ceases. Eventually, as the temperature falls further, all muscle activity stops and mental status deteriorates.

As the core temperature drops toward 85°F (29.4°C), the patient becomes lethargic, and usually stops fighting the cold. The level of consciousness decreases, and the patient may try to remove his or her own clothes. Poor coordination and memory loss follow, along with reduced or complete loss of sensation to touch, mood changes, and impaired judgment. The patient becomes less communicative, experiences joint or muscle stiffness, and has trouble speaking. The patient begins to appear stiff or rigid.

If the core temperature continues to fall to 80°F (26.7°C), vital signs slow; the pulse becomes slower and weaker, and respirations become shallow or absent. Cardiac dysrhythmias may occur as the blood pressure decreases.

At a core temperature of less than 80°F (26.7°C), all cardiorespiratory activity may cease, pupillary reaction is slow, and the patient may appear dead. However, *never assume that a cold, pulseless patient is dead.* Patients may survive severe hypothermia if proper emergency care is provided. It is critical that you perform an extended pulse check (up to a full minute). Assess at the carotid or femoral pulse. A patient in apparent cardiac arrest from hypothermia should not be considered dead until aggressive rewarming has been attempted, along with resuscitation. Remember the saying: "No one is dead unless they are *warm* and dead." It is important to note that patients who have died from a cause other than hypothermia will be cold to the touch; however, there will be additional, obvious signs of death such as rigor mortis. The "warm and dead" rule does not apply to such patients.

Words of Wisdom

The stress of the cold environment, a remote terrain, a feeling of impending doom, and impaired judgment may lead to suicidal tendencies in some patients with hypothermia. It is important to protect patients from harming themselves, while considering your own safety at all times.

Local Cold Injuries

Most injuries from cold are confined to exposed parts of the body. The extremities, particularly the feet and hands, and the ears, nose, and face are especially vulnerable to cold injury **Figure 32-2**. When exposed parts of the body become very cold but not frozen, injuries such as frostnip and immersion foot (also called trench foot) can result. When the parts become frozen, the injury is called **frostbite**.

If possible, determine the duration of the exposure, the temperature to which the body part was exposed, and the wind velocity during exposure. These important factors will help you determine the severity of a local cold injury. You should also investigate a number of underlying factors:

- Exposure to wet conditions
- Inadequate insulation from cold or wind
- Restricted circulation from tight clothing or shoes or circulatory disease
- Fatigue
- Poor nutrition
- Alcohol or drug abuse
- Hypothermia
- Diabetes
- Cardiovascular disease
- Age

In hypothermia, blood is shunted away from the extremities in an attempt to maintain the core temperature. This shunting of blood increases the risk of local cold injury to the extremities, ears, nose, and face. Thus, the patient with hypothermia should also be assessed for frostbite or other local cold injury. The reverse is also true. Remember, both local and systemic cold exposure injuries can occur in the same patient.

Figure 32-2 The extremities and the ears, nose, and face are particularly susceptible to frostbite.

A: Courtesy of Neil Malcom Winkelmann;
B: © Dr. P. Marazzi/Science Source;
C: © Chuck Stewart, MD.

Frostnip and Immersion Foot

After prolonged exposure to the cold, the skin may freeze whereas the deeper tissues are unaffected. This condition, which often affects the ears, nose, and fingers, is called frostnip. Because frostnip is usually painless, the patient often is unaware that a cold injury has occurred. Immersion foot occurs after prolonged exposure to cold water. It is particularly common in hikers or hunters who stand for a long time in a river or lake. With both frostnip and immersion foot, the skin is pale (blanched) and cold to the touch; normal color does not return after palpation of the skin. In some cases, the skin of the foot will be wrinkled, but it can also remain soft. The patient reports loss of feeling and sensation in the injured area.

Frostbite

Frostbite is the most serious local cold injury because the tissues are actually frozen. Freezing permanently damages cells, although the exact mechanism by which damage occurs is unknown. The presence of ice crystals within the cells may cause physical damage. The change in the water content in the cells may also cause changes in the concentration of critical electrolytes, producing permanent changes in the chemistry of the cell. When the ice thaws, further chemical changes occur in the cell, causing permanent damage or cell death, called necrosis or gangrene **Figure 32-3**. If gangrene occurs, the dead tissue must be surgically removed, sometimes by amputation. Following less severe damage, the exposed part will become inflamed, tender to touch, and unable to tolerate exposure to cold.

Figure 32-3 Gangrene (necrosis), or permanent cell death, occurs when tissue is frozen and destructive chemical changes occur in the cells.

Courtesy of Dr. Jack Poland/CDC.

Frostbite can be identified by the hard, waxy feel of the affected tissues **Figure 32-4**. The injured part feels firm to frozen as you gently touch it. If the frostbite is only skin deep, it will feel leathery or thick instead of hard. Blisters and swelling may be present. In light-skinned people with a deep injury that has thawed or partially thawed, the skin may appear red or white, or it may be mottled and cyanotic (purple and blue).

As with a burn, the depth of skin damage will vary. With superficial frostbite, only the skin is frozen; with deep frostbite, the deeper tissues are frozen as well. You may not be able to tell superficial from deep frostbite in the field. Even an experienced surgeon in a hospital setting may not be able to tell until several days have passed.

Figure 32-4 Frostbitten parts are usually hard and waxy to the touch.

Courtesy of Neil Malcom Winkelmann.

Assessment of Cold Injuries

Management of hypothermia in the field, regardless of the severity of the exposure, consists of stabilizing the ABCs and preventing further heat loss.

Scene Size-up

Typically, your scene assessment begins with information provided by dispatch. Note environmental conditions. Air temperature, wind chill, and whether it is wet or dry are important aspects of scene size-up and will likely affect the patient.

Ensure that the scene is safe for you and other emergency responders. Identify potential safety hazards, such as wet grass, mud, or icy streets. Cold environments may present special challenges both for you and your patient; consider special hazards such as avalanches. Use appropriate standard precautions and consider the number of patients you may have. Summon additional help, such as a search and rescue team, as quickly as possible.

As you observe the scene, look for indicators of the mechanism of injury (MOI). For example, if you find a vehicle in a secluded ditch off the highway and the vehicle's roof and hood are covered with fresh snow, then you may assume that the patient was in a motor vehicle crash and has been exposed to the cold for a long period of time.

Primary Assessment

In a cold emergency, your patient's chief complaint may be only that he or she is cold, or the cold may be an additional complication of an existing medical injury or trauma. Perform a rapid examination to determine whether a life threat exists, and if so, treat it. If the chief complaint is simply feeling cold, quickly assess the patient's core temperature by placing the back of your hand on the abdomen. Evaluate the patient's mental status quickly using the AVPU scale. An altered mental status indicates the intensity of the cold injury. Consider spinal immobilization based on your scene size-up and the chief complaint.

Your assessment should take into account the physiologic changes that occur as a result of hypothermia. If you believe the patient is in cardiac arrest, proceed directly to ("C") by providing high-quality chest compressions, then address airway and breathing ("A" and "B") afterward. Ensure that the patient has an adequate airway and is breathing. If your patient's breathing is slow or shallow, ventilation with a bag-valve mask (BVM) may be necessary. Use warmed and humidified oxygen if it is available, because it helps to warm the patient from the inside out.

If you cannot feel a radial pulse, gently palpate for a carotid pulse and wait for up to 60 seconds before you decide whether the patient is pulseless. Some physicians disagree about performing cardiopulmonary resuscitation (CPR) on a patient with hypothermia who appears to be pulseless. Such a patient actually may be in a kind of "metabolic icebox," having achieved a metabolic balance that CPR may disrupt. Even a pulse rate of 1 or 2 beats/min indicates cardiac activity, and cardiac activity may spontaneously recover once the body core is warmed. However, there is evidence that CPR, when correctly done, will increase blood flow to the critical parts of the body. For this reason, some authorities recommend starting CPR on a patient with hypothermia and no pulse. The American Heart Association recommends that CPR be started if the patient has no detectable pulse or breathing. Again, for a patient with hypothermia, this may require a prolonged pulse check of up to 60 seconds.

Perfusion will be compromised based on the severity of the cold exposure. Your assessment of the patient's skin will not be helpful in determining shock. Assume that shock is present and treat it appropriately. Bleeding may be difficult to find because of the slow-moving circulation and thick clothing. If the scene size-up, MOI, or chief complaint suggests the potential for bleeding, look for it carefully.

Even mild hypothermia can have serious consequences and complications, including cardiac dysrhythmias and blood clotting abnormalities. Therefore, all patients with hypothermia require rapid transport for evaluation and treatment. Assess the scene for the safest way to quickly move your patient from the cold environment. As you package your patient for transport, work quickly, safely, and gently. Rough handling of a patient with hypothermia may cause a cold, slow, weak heart to fibrillate. If transportation is delayed, protect the patient from further heat loss.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint. Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives.

Obtaining a patient's history in these situations may be difficult. If possible, find out how long your patient has been exposed to the cold environment, either from the patient or bystanders. Exposures may be short or prolonged in duration. For example, a patient may have acute hypothermia from sudden immersion in cold water or hypothermia that developed over the course of hours during an expedition. Your SAMPLE history can provide important information affecting both your treatment in the field and the treatment your patient will receive in the hospital. Recall that medications and underlying medical conditions may have an impact on the way cold affects the patient's metabolism. The patient's last oral intake and activity prior to the exposure will help to determine the severity of the cold injury.

Secondary Assessment

The secondary assessment is used to uncover injuries that may have been missed during the primary assessment. In some instances, such as a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

Focus your physical examination on the severity of hypothermia, assessing the areas of the body directly affected by cold exposure, and the degree of damage. Is the whole body cold (hypothermia) or just parts (frostbite)? These determinations will impact your treatment decisions. For example, a patient who stops shivering, but remains in a cold environment, will experience a rapid decrease in body temperature—a sign of severe hypothermia and a life-threatening emergency.

Determine the degree and extent of cold injury, as well as any other injuries or conditions that may not have been initially detected. The numbing effect of cold, both on the brain and on the body, may impair your patient's ability to tell you about other injuries or illnesses. Therefore, a careful examination of your patient's entire body will help you avoid missing important clues to your patient's condition.

Keep in mind that vital signs may be altered by the effects of hypothermia and can be an indicator of its severity. Respirations may be slow and shallow, resulting in low oxygen levels in the body. Low blood pressure and a slow pulse also indicate moderate to severe hypothermia. Carefully evaluate your patient for changes in mental status using the AVPU scale.

Determine a core body temperature using a hypothermia thermometer, if local protocols allow. Pulse oximetry will often be inaccurate due to the lack of perfusion in the extremities.

Reassessment

Repeat the primary assessment. Reassess vital signs and the chief complaint. Has the patient's condition improved with the interventions? Identify and treat changes in the patient's condition. Keep a close eye on your patient's level of consciousness and vital signs. As the body rewarms, the sudden redistribution of fluids and the release of built-up chemicals can have harmful effects, including cardiac dysrhythmias. Be vigilant even if the patient's condition appears to be improving.

Review all treatments that have been performed. In a cold-related emergency, depending on your local protocols, your treatment may only include oxygen delivery. Reassess oxygen delivery and continue to provide for a warm environment by removing any wet or frozen clothing. Do not remove any clothing frozen to the patient's skin.

YOU are the Provider PART 2

You arrive at the scene and find the patient, sitting under a tree in his garden; he is conscious, but confused. His wife tells you that he has been working outside all day. She further states that despite her efforts, he refused to take a break and drink some water. As your partner opens the jump kit, you perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Flushed
Level of consciousness	Conscious, but confused
Airway	Open, clear of secretions or foreign bodies
Breathing	Increased rate and depth
Circulation	Radial pulses, weak and rapid; skin is hot and moist; no gross bleeding

Your partner applies high-flow oxygen via a nonrebreathing mask, and the patient's wife tells you that when she went to check on him, she found him sitting under a tree; initially, he did not respond to her. She further tells you that he has hypertension and angina, for which he takes furosemide (Lasix), potassium chloride (K-Dur), lisinopril (Prinivil), and nitroglycerin as needed.

3. What risk factors does this patient have that predispose him to a heat emergency?

4. What type of heat emergency do you suspect he is experiencing? Why?

Communicate all of the information you have gathered to the receiving facility, which may be essential in evaluating and treating your patient in the hospital. Your documentation should always include the patient's physical status, the conditions at the scene, information gathered from bystanders, and any changes in the patient's mental status during treatment and transport.

General Management of Cold Emergencies

In most cases, move the patient from the cold environment to prevent further heat loss. To prevent further damage to the feet, do not allow the patient to walk. Remove any wet clothing, and place dry blankets over and under the patient **Figure 32-5**. If available, give the patient warm, humidified oxygen if you have not already done so as part of the primary assessment.

Always handle the patient gently so that you do not cause any pain or further injury to the skin. Rough handling of a patient with moderate to severe hypothermia may cause the heart to go into ventricular fibrillation, which may not respond to defibrillation. Do not massage the extremities. Do not allow the patient to eat or to use any stimulants, such as coffee, tea, soda, or tobacco products. Stimulants are vasoconstrictors, which may further impair circulation to affected areas.

Figure 32-5 Place dry blankets over and under the patient with hypothermia; give warm, humidified oxygen, if available; assess the pulse for up to 60 seconds before considering CPR.

If the patient is alert, shivering, responds appropriately, and the core body temperature is between 90°F to 95°F (32.2°C to 35°C), then the hypothermia is mild. Begin passive rewarming slowly, which includes placing the patient in a warm environment, removing wet clothing, and applying heat packs or hot water bottles to the groin, axillary, and cervical regions. Turn the heat up high in the patient compartment of the ambulance. To avoid burns, do not place heat packs directly on the skin. If possible, you may give warm fluids by mouth, as allowed by local protocols, assuming that the patient is alert and can swallow without difficulty.

However, when the patient has moderate or severe hypothermia, active rewarming is best accomplished in the emergency department (ED) utilizing aggressive strategies to introduce heat into the body's core. Such therapies might include warm intravenous fluids, lavage with warm fluids, and rewarming blood outside the body before reintroducing it (extracorpeal rewarming). Rewarming the patient too quickly may cause a fatal cardiac dysrhythmia or other significant complications. For this reason, local protocols may dictate the appropriate type of rewarming strategies based on the patient's core body temperature.

With a patient with moderate or severe hypothermia, your goal is to prevent further heat loss. Remove the patient immediately from the cold environment, place the patient in the ambulance, remove wet clothing, cover the patient with blankets, and transport. Remember to handle the patient gently to decrease the risk of ventricular fibrillation.

If you cannot get the patient out of the cold immediately, move the patient out of the wind and away from contact with any object that will conduct heat away from the body. Place blankets and a waterproof protective cover on the patient. Remember that body heat loss easily occurs around the head and neck, both of which can be covered with a towel. Regardless of the nature or severity of the cold injury, remember that even an unresponsive patient may be able to hear you. Some patients have reported hearing a provider pronounce them dead—a provider who forgot the saying: "No one is dead unless they are warm and dead."

▶ Emergency Care of Local Cold Injuries

The emergency treatment of local cold injuries in the field should include the following steps:

1. Remove the patient from further exposure to the cold.
2. Handle the injured part gently, and protect it from further injury.
3. Remove any wet or restricting clothing from the patient, especially over the injured part.

If there is no chance of reinjury or if transport to the ED will be significantly delayed, consider active rewarming if local protocols allow. Consult medical control, if available. With frostnip, contact with a warm object may be all that the patient needs; you can use your hands or the patient's own body (for example, have the patient tuck his or her hands into the armpits). During rewarming, the affected part will often tingle and become red in light-skinned people. With immersion foot, remove wet shoes, boots, and socks, and rewarm the foot gradually, protecting it from further cold exposure. Next splint the extremity, and cover it loosely with a dry, sterile dressing. Never rub or massage injured tissues, which could cause further damage. Do not reexpose the injury to cold.

With a late or deep cold injury, such as frostbite, remove any jewelry from the injured part and cover the injury loosely with a dry, sterile dressing. Do not break blisters or rub or massage the area. Do not apply heat or rewarm the part. Unlike frostnip and trenchfoot, rewarming of the frostbitten extremity is best accomplished in the ED. You can cause further injury to fragile tissues by attempting to rewarm a frostbitten part. Never apply something warm or hot, such as the exhaust from the ambulance engine or, even worse, an open flame. Do not allow the patient to stand or walk on a frostbitten foot. Splinting a frostbitten extremity may also help prevent secondary injury by limiting use. Evaluate the patient's general condition for the signs or symptoms of systemic hypothermia. Support the vital functions as necessary, and provide rapid transport to the hospital.

If prompt hospital care is unavailable and medical control instructs you to begin rewarming in the field, use a warm-water bath. Immerse the frostbitten part in water with a temperature between 102°F and 104°F (38.9°C and 40°C). Check the water temperature with a thermometer before immersing the limb, and recheck it frequently during the rewarming process. The water temperature should never exceed 105°F (40.6°C). Stir the water continuously. Keep the frostbitten part in the water until it feels warm and sensation has returned to the skin. Dress the area with dry, sterile dressings, placing them also between injured fingers or toes. Expect the patient to report severe pain.

Never attempt rewarming if there is any chance that the part may freeze again before the patient reaches the hospital. Some of the most severe consequences of frostbite, including gangrene and amputation, have occurred when parts were thawed and then refrozen.

Cover the frostbitten part with soft, padded, sterile cotton dressings. If blisters have formed, do not break them. Remember, you cannot accurately predict the outcome of a case of frostbite early in its course. Even body parts that appear gangrenous may recover following proper treatment.

Cold Exposure and You

As an EMT, you are also at risk for hypothermia if you work in a cold environment. If cold weather search-and-rescue operations are a possibility in your assigned areas, you should receive survival training and precautionary tips. Become familiar with local conditions. Be aware of existing and potential weather conditions, and monitor changes that are forecast for the area. Make sure to wear proper clothing whenever appropriate. Your vehicle, too, must be properly equipped and maintained for a cold environment. You cannot help others if you do not protect yourself. Never allow yourself to become a victim!

Heat Exposure

Recall that normal body temperature is 98°F (36.7°C). In a hot environment or during vigorous physical activity, the body will try to rid itself of the excess heat. The two most efficient methods to decrease heat are sweating (and evaporation of the sweat) and dilation of skin blood vessels, which brings blood to the skin surface to increase the rate of heat radiation. In addition, a person who becomes overheated can remove clothing and seek a cooler environment.

Ordinarily, the heat-regulating mechanisms of the body work well, and people are able to tolerate significant temperature changes. When heat gain exceeds heat loss, hyperthermia can result. **Hyperthermia** is a high core temperature, usually 101°F (38.3°C) or higher.

Words of Wisdom

It is important to keep yourself hydrated while on duty, especially during periods of heavy exertion or when working in the heat. The color of urine (usually darker with dehydration) and frequency of urination correlate directly with the body's hydration status.

When the body's mechanisms to decrease body heat are overwhelmed and the body is unable to tolerate the excessive heat, a heat emergency develops in the patient. High air temperature can reduce heat loss by radiation; high humidity reduces heat loss through evaporation. The inability to acclimate (adjust) to the heat is a risk factor. Another risk factor is vigorous exercise, during which sweat loss can exceed one liter an hour, causing loss of fluid and electrolytes.

A heat emergency can take the following three forms:

- Heat cramps
- Heat exhaustion
- Heat stroke

All three forms may be present in the same patient because untreated heat exhaustion may progress to heatstroke. Heatstroke is life threatening.

People at greatest risk for a heat emergency are children; geriatric patients; patients with heart disease, COPD, diabetes, dehydration, and obesity; and those with limited mobility. Older people, newborns, and infants exhibit poor thermoregulation. Newborns and infants often wear too much clothing. Alcohol and certain drugs, including medications that dehydrate the body or decrease the ability of the body to sweat, also make a person more susceptible to heat emergencies. When you are treating someone for a heat emergency, always obtain a medication history.

Heat Cramps

Heat cramps are painful muscle spasms that occur after vigorous exercise. They do not occur only when it is hot outdoors. They may be seen in factory workers and even well-conditioned athletes. The exact cause of heat cramps is not well understood. It is known that sweat produced during strenuous exercise, particularly in a warm environment, causes a change in the body's electrolyte balance. The result may be a loss of essential electrolytes from the cells. Dehydration may also play a role in the development of muscle cramps. Large amounts of water loss can result from excessive sweating. This loss of water may affect muscles that are being stressed and cause them to spasm.

Heat cramps usually occur in the leg or abdominal muscles. When the abdominal muscles are involved, the pain and muscle spasm may be so severe that the patient appears to have an acute abdominal condition. If a patient with a sudden onset of abdominal cramps has been exercising vigorously in a hot environment, suspect heat cramps.

Heat Exhaustion

Heat exhaustion, also called heat prostration or heat collapse, is the most common heat emergency. Heat exposure, stress, and fatigue are causes of heat exhaustion, which is caused by hypovolemia as the result of the loss of water and electrolytes from heavy sweating. Recall that for sweating to be an effective cooling mechanism, the sweat must be able to evaporate from the body. Otherwise, the body will continue to produce sweat, with further loss of body water. People standing in the hot sun and particularly those wearing several layers of clothing, such as sports fans or parade watchers, may sweat profusely but experience little body cooling. High humidity will also decrease the amount of evaporation that can occur.

People working or exerting themselves in poorly ventilated areas are unable to release heat through convection. Thus, people who work or exercise vigorously and those who wear heavy clothing in a warm, humid, or poorly ventilated environment are particularly prone to heat exhaustion.

The signs and symptoms of heat exhaustion and those of associated hypovolemia are as follows:

- Dizziness, weakness, or syncope signifying a change in level of consciousness with accompanying nausea, vomiting, or headache. Muscle cramping may also be present, including abdominal cramping.
- Onset while working vigorously or exercising in a hot, humid, or poorly ventilated environment and sweating heavily.
- Onset, even at rest, in the older and infant age groups in hot, humid, and poorly ventilated environments or extended time in hot, humid environments. People who are not acclimatized to the environment may also experience onset at rest.
- Cold, clammy skin with ashen pallor.
- Dry tongue and thirst.
- Normal vital signs, although the pulse is often rapid and weak (an indication for use of pulse oximetry) and the diastolic blood pressure may be low.
- Normal or slightly elevated body temperature; on rare occasions, as high as 104°F (40°C).

Heat Stroke

Heat stroke, the least common but most serious heat emergency, occurs when the body is subjected to more heat than it can handle and normal mechanisms for getting rid of the excess heat are overwhelmed. The body temperature then rises rapidly to the level at which tissues are destroyed. Untreated heat stroke always results in death.

Heat stroke can develop in patients during vigorous physical activity or when they are outdoors or in a closed, poorly ventilated, humid space. It also occurs during heat waves among people (particularly geriatric patients) who live in buildings with no air conditioning or with poor ventilation. It may also develop in children who are left unattended in a locked vehicle on a hot day.

Many patients with heat stroke have hot, dry, flushed skin because their sweating mechanism has been overwhelmed. However, in the course of heat stroke, the skin may be moist or wet due to exertion by the patient. Keep in mind that a patient can have heat stroke even if he or she is still sweating. This presentation is often seen in endurance athletes, military personnel, or emergency providers who wear personal protective equipment, such as firefighters, SWAT team members, or HazMat workers. The body temperature rises rapidly in patients with heat stroke. It may rise to 106°F (41.1°C) or more. As the body core temperature rises, the patient's level of consciousness decreases, resulting in unconsciousness.

Often, the first sign of heat stroke is a change in behavior. However, the patient becomes unresponsive very quickly and seizures may occur. The pulse is usually rapid and strong at first, but as the patient becomes increasingly unresponsive, the pulse becomes weaker and the blood pressure falls. The respiratory rate increases as the body attempts to compensate. One of the telltale signs of heat stroke is when your patient no longer perspires, which means the body has lost its thermoregulatory mechanisms. If you are perspiring in the environment, your patient should also be perspiring.

Assessment of Heat Emergencies

Scene Size-up

As part of your scene size-up, perform an environmental assessment. How hot is it outside? How hot is it in the room where your patient is located? How well is the patient tolerating the heat? Dispatch may report the call initially as a medical or trauma emergency. The heat emergency may be secondary. Always look for hazards as well as clues as to what may have caused your patient's emergency. If the patient is unconscious, has an altered mental status, or requires intravenous fluids to treat shock, consider calling for ALS assistance.

As you observe the scene, look for indicators of the MOI. For example, you arrive on the scene at a shopping mall to find an older man with a decreased level of consciousness inside a parked vehicle on a warm, humid, sunny day. The MOI for this patient is sitting in a warm environment under direct sunlight with no ventilation.

Heat emergencies commonly occur in the context of athletic events and practices, often with athletic trainers present. In those instances, you may find the patient submerged in a cold-water immersion bath inside the athletic training room. It is harmful to allow heat to persist for any amount of time; therefore, cooling prior to transport is indicated if facilities such as an ice bath are available. If the patient is placed in a cold-water immersion bath upon your arrival, monitor the patient in the water and assist as necessary. Do not remove the patient until the temperature has normalized to the appropriate level, between 101°F and 102°F (38.3°C and 38.9°C). Do not overcool the patient. Overcooling can lead to shivering, which generates more heat. Monitor the patient closely.

Finally, if you anticipate a prolonged scene time, protect yourself from the heat and remember to stay hydrated. Use appropriate standard precautions, including gloves and eye protection. Long-sleeved shirts and long pants may be uncomfortable in warm weather; however, they can help protect you from being splashed by blood or other body fluids.

Primary Assessment

As you approach your patient, observe how the patient interacts with you and the environment. This will help identify the patient's degree of distress. Introduce yourself and ask about the chief complaint. A heat emergency may be the primary problem or it may simply be aggravating a medical or trauma condition. Remember, prolonged heat exposure may stress the heart, causing a heart attack. Use this initial interaction to guide you in assessing for immediate life threats and related problems. Perform a rapid scan and avoid tunnel vision.

Table 32-2 Skin Condition

Skin Condition	Indicates
Moist, pale, cool skin	Excessive fluid and salt loss
Hot, dry skin	Body is unable to regulate core temperature
Hot, moist skin	Body is unable to regulate core temperature

Assess the patient's mental status using the AVPU scale. Heat stroke is a life-threatening emergency. Gather clues about his or her mental status to identify the severity of your patient's condition. The more altered the patient's mental status is, the more serious the heat emergency.

Assess the patient's airway and breathing and treat any life threats. Unless the patient is unresponsive, the airway should be patent. Nausea and vomiting, however, may occur. Position the patient to protect the airway as necessary. If the patient is unresponsive, be cautious of how you open the airway; consider spinal immobilization if trauma is a possibility. If your patient is unresponsive, insert an airway and provide BVM ventilations.

If circulation is adequate, assess the patient for perfusion and bleeding. Assess the patient's skin condition carefully Table 32-2. Treat the patient aggressively for shock by removing the patient from the heat and positioning the patient to improve circulation. If the patient is bleeding, bandage according to protocol.

If your patient has any signs of heat stroke, provide rapid transport.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint. Obtain a medical history and be alert for specific signs and symptoms such as the absence of perspiration, decreased level of consciousness, confusion, muscle cramping, nausea, and vomiting.

Obtain a SAMPLE history. Patients with inadequate oral intake, or who are taking diuretics, may have difficulty tolerating exposure to heat. Remember, many medications used by geriatric patients affect how well they tolerate heat. Be thorough in your questioning. Determine your patient's exposure to heat and humidity and activities prior to the onset of symptoms.

Secondary Assessment

The secondary assessment is used to uncover injuries that may have been missed during the primary assessment. In some instances, such as a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

If your patient is unresponsive, perform a secondary assessment of the entire body looking for problems or explanations as to what is wrong. Obtain the patient's vital signs to help understand the severity of the emergency.

If the patient is conscious, perform an assessment of specific areas of the body. Heat exposure has significant effects on the metabolism, muscles, and cardiovascular system. Assess the patient for muscle cramps or confusion. Examine the patient’s mental status and take the patient’s vital signs.

Perform a detailed examination if circumstances and time permit. Pay special attention to the patient’s skin temperature, **turgor**, and level of moisture. Skin turgor is the ability of the skin to resist deformation. It is tested by gently pinching skin on the forehead or back of the hand. Normally the skin will quickly flatten out. If the patient is dehydrated, the skin will remain tented (poor skin turgor). Perform a careful neurologic examination.

Patients with hyperthermia will often have tachycardia and tachypnea. As long as they maintain a normal blood pressure, their bodies will compensate for the fluid loss. Once their blood pressure begins to fall, it indicates they are no longer able to compensate for fluid loss and are going into shock. Your assessment of the patient’s skin will help determine the severity of the emergency. For example, in heat exhaustion, the skin temperature may be normal or may even be cool and clammy; however, in heat stroke, the skin is hot.

Check the patient’s body temperature with a thermometer, depending on protocol. Your unit equipment may include disposable or oral thermometers with disposable covers. Some agencies provide tympanic (ear) thermometers. You may not use these devices routinely, so become familiar with how they work. In patients with a heat-related emergency, monitoring of pulse oximetry is also useful.

Reassessment

Watch your patient’s condition carefully for deterioration. Remove your patient as quickly as possible from the hot environment. Patients with heat cramps or exhaustion usually respond well to passive cooling and fluids by mouth. Patients with symptoms of heat stroke should be transported immediately in a cool ambulance, passively cooled with clothing removal, and actively cooled by spraying the patient with water and fanning to enhance evaporation. Any decline in level of consciousness is an ominous sign. Monitor the patient’s vital signs at least every 5 minutes. Evaluate the effectiveness of your interventions. Be careful not to overcool a patient who is experiencing a heat emergency.

Inform the ED staff as soon as possible that your patient is experiencing heat stroke, because additional resources may be required. Document the environmental conditions and the activities the patient was performing prior to the emergency in your patient care report.

Management of Heat Emergencies

Heat Cramps

Take the following steps to treat heat cramps in the field **Figure 32-6**:

1. Promptly remove the patient from the hot environment, including direct sunlight. Loosen any tight clothing.

Figure 32-6 A patient with heat cramps should be moved to a cool environment as you begin your assessment and treatment.

2. Administer high-flow oxygen if indicated (the patient shows signs of hypoxia or respiratory distress), if this was not already done as part of the primary assessment.
3. Rest the cramping muscles. Have the patient sit or lie down until the cramps subside.
4. Replace fluids by mouth. Give water or a diluted (half-strength) balanced electrolyte solution, such as a sports drink. In most cases, plain water is the most useful. Do not give salt tablets or solutions that have a high salt concentration.
5. Cool the patient with cool water spray or mist, and add convection to the cooling method by manually or mechanically fanning the patient.

When the heat cramps are gone, the patient may resume activity. For example, an athlete can return to play once the heat cramps have disappeared. However, heavy sweating may cause the cramps to recur. The best preventive and treatment strategy is hydration by drinking sufficient quantities of water.

If the cramps do not go away after these measures, transport the patient to the hospital. If you are uncertain that the patient's cramps were caused by the heat or you note anything out of the ordinary, contact medical control or transport the patient to the hospital.

Heat Exhaustion

To treat the patient with heat exhaustion, follow the steps in Skill Drill 32-1:

1. Promptly remove the patient from the hot environment, preferably into the back of the air-conditioned ambulance. If outdoors, move out of direct sunlight. Remove any excessive layers of clothing, particularly around the head and neck Step 1.
2. Administer high-flow oxygen if indicated, if this was not already done as part of the primary assessment.
3. If the patient has an altered mental status, check the blood glucose level.
4. Cool the patient with misting and administration of ice packs to the trunk of the patient's body. If an ice bath or similar facility is available, provide cold-water immersion to the patient if allowed per local protocol. Cold-water (ice bath) immersion is recommended for patients with a core temperature of 104 degrees F (40 degrees C) or an altered

mental status.

5. Encourage the patient to lie down. Loosen any tight clothing and cool the patient by manually or mechanically fanning him or her **Step 2**.
6. If the patient is fully alert, encourage him or her to sit up and slowly drink up to a liter of water, as long as nausea does not develop. Never force fluids by mouth on a patient who is not fully alert, or allow drinking while supine, because the patient could aspirate the fluid into the lungs. If the patient does not become nauseated, transport the patient on the left side to prevent aspiration **Step 3**.

In most cases, these measures will reverse the symptoms, causing the patient to feel better within 30 minutes. Prepare to transport the patient to the hospital, and also consider a rendezvous with ALS for more aggressive treatment, such as IV fluid therapy and close monitoring, especially in the following circumstances:

- The symptoms do not clear up promptly.
- The level of consciousness decreases.
- The body temperature remains elevated.
- The person is very young, older, or has any underlying medical condition, such as diabetes or cardiovascular disease.

Skill Drill 32-1 Treating for Heat Exhaustion

Step 1

Move the patient to a cooler environment. Remove extra clothing.

Step 2

Give oxygen if indicated. Check the patient's blood glucose level if indicated. Perform cold-water immersion or other cooling measures as available. Place the patient in a supine position and fan the patient.

Step 3

If the patient is fully alert, give water by mouth.

Step 4

If nausea develops, secure and transport the patient on his or her left side.

7. Transport the patient on his or her left side if you think the patient may be nauseated, but make certain that the patient is secured **Step 4**.

Heat Stroke

Recovery from heat stroke depends on the speed with which treatment is administered, so you must identify this patient quickly. Emergency treatment has one objective: lower the body temperature by any means available. Take the following steps when treating a patient with heatstroke:

1. Move the patient out of the hot environment and into the ambulance.
2. Set the air conditioning to maximum cooling.
3. Remove the patient's clothing.

4. Administer high-flow oxygen if indicated, if this was not already done as part of the primary assessment. If needed, assist the patient's ventilations with a BVM and appropriate airway adjuncts as per your protocol. If the patient is unresponsive and unable to protect his or her airway, consider rapid transport and cooling en route. Consult medical control if available.
5. Provide cold-water immersion in an ice bath, if possible. Cooling should begin immediately and continue en route to the hospital **Figure 32-7**. If it is not possible to cool en route and cold-water immersion is available at the scene, continue cold-water immersion at the scene until the core body temperature is between 101°F and 102°F (38.3°C and 38.9°C).

Figure 32-7 As part of treatment of heat stroke, if available, immerse the patient in an ice water bath. If consistent with your local protocol.

YOU are the Provider — PART 3

You quickly place the patient onto the stretcher and load him into the ambulance. The air conditioner is on and set to high. You perform a secondary assessment, which does not reveal any gross signs of injury, while your partner assesses the patient's vital signs. You then depart the scene and begin further treatment en route to the hospital.

Recording Time: 6 Minutes	
Respirations	24 breaths/min; adequate depth
Pulse	130 beats/mm; weak and regular
Skin	Hot, flushed, and moist
Blood pressure	88/66 mm Hg
Oxygen saturation (Spo_2)	95% (on oxygen)

5. What specific treatment is required for this patient?
6. What is the most likely explanation for this patient's vital signs?

6. Cover the patient with wet towels or sheets, or spray the patient with cool water and fan him or her to quickly evaporate the moisture on the skin.
7. Aggressively and repeatedly fan the patient with or without dampening the skin.
8. Exclude other causes of altered mental status and check blood glucose level, if possible.
9. Provide rapid transport to the hospital.
10. Notify the hospital as soon as possible so that the staff can prepare to treat the patient immediately on arrival.
11. Do not overcool the patient. Call for ALS assistance if the patient begins to shiver.

Special Populations

Remember that the aging process alters the body's ability to compensate for its surroundings. Temperature-related emergencies can develop in older people over time, even in indoor environments that may not seem uncomfortable to you. Be vigilant for temperature-related illnesses.

Drowning

Drowning is the process of experiencing respiratory impairment from submersion or immersion in liquid. Some agencies may use the term "near drowning" to refer to a patient who survives at least temporarily (24 hours) after suffocation in water. According to the Centers for Disease Control and Prevention (CDC), an average of 10 people die from unintentional drownings per day. More than 25% are children younger than 14 years. Alcohol consumption, preexisting seizure disorders, geriatric patients with cardiovascular disease, and unsupervised access to water are among the major risk factors.

Drowning is often the last in a cycle of events caused by panic in the water. It can happen to anyone who is submerged in water for even a short period of time. Struggling toward the surface or the shore, the person becomes fatigued or exhausted, which leads him or her to sink even deeper. However, drowning also occurs in buckets, puddles, bathtubs, and other places where the person is not completely submerged. Young children can drown in as little as 1 inch (3 cm) of water if left unattended.

Inhaling very small amounts of either fresh water or salt water can severely irritate the larynx, sending the muscles of the larynx and the vocal cords into spasm, called laryngospasm. The average person experiences this to a mild degree when a small amount of liquid is inhaled and the patient coughs and seems to be choking for a few seconds. This is the body's attempt at self-preservation; laryngospasm prevents more water from entering the lungs. In severe cases such as water submersion, however, the patient's lungs cannot be ventilated because significant laryngospasm is present. Instead, progressive hypoxia occurs until the patient becomes unconscious. At this point, the spasm relaxes, making rescue breathing possible. Of course, if the patient has not already been removed from the water, the patient may now inhale deeply, and more water may enter the lungs.

Spinal Injuries in Submersion Incidents

Submersion incidents may be complicated by spinal fractures and spinal cord injuries. Assume that spinal injury exists with the following conditions:

- The submersion has resulted from a diving mishap or fall from a significant height.
- The patient is unconscious, and no information is available to rule out the possibility of a neck injury.
- The patient is conscious but reports weakness, paralysis, or numbness in the arms or legs.
- You suspect the possibility of spinal injury despite what witnesses say.

Most spinal injuries in diving incidents affect the cervical spine. When spinal injury is suspected, the neck must be protected from further injury. This means that you will have to stabilize the suspected injury while the patient is still in the water. To stabilize a suspected spinal injury in water, follow the steps in **Skill Drill 32-2**:

1. Turn the patient supine. Two rescuers are usually required to turn the patient safely, although in some cases one rescuer will suffice. Always rotate the entire upper half of the patient's body as a single unit. Twisting only the head, for example, may aggravate any injury to the cervical spine **Step 1**.
2. Restore the airway and begin ventilation. Immediate ventilation is the primary treatment of all drowning patients as

soon as the patient is faceup in the water. Use a pocket mask if it is available. Have the other rescuer support the head and trunk as a unit while you open the airway and begin artificial ventilation **Step 2**.

Safety Tips

You must ensure the safety of rescue personnel and request additional rescue resources, as appropriate, before a water rescue can begin. Water rescue is typically handled by specialized rescue personnel, but you may be involved if you arrive first or if water rescue is included in your scope of practice per local protocols. If the patient is conscious and still in the water, perform a water rescue. The saying: "Reach, throw, and row, and only then go" **Figure 32-8** sums up the basic rule of water rescue. First, try to reach for the patient. If that does not work, throw the patient a rope, a life preserver, or any floatable object that is available. For example, an inflated spare tire, rim and all, will float well enough to support two people in the water. Next, use a boat if one is available. Do not attempt a swimming rescue unless you are trained and experienced in the proper techniques. Even then, you should always wear a helmet and a personal flotation device **Figure 32-9**. Too many well-meaning rescuers have themselves become victims while attempting a swimming rescue. In cold climates or cold-water locations, rapid hypothermia is also a concern for rescuers. Be prepared for this potential event.

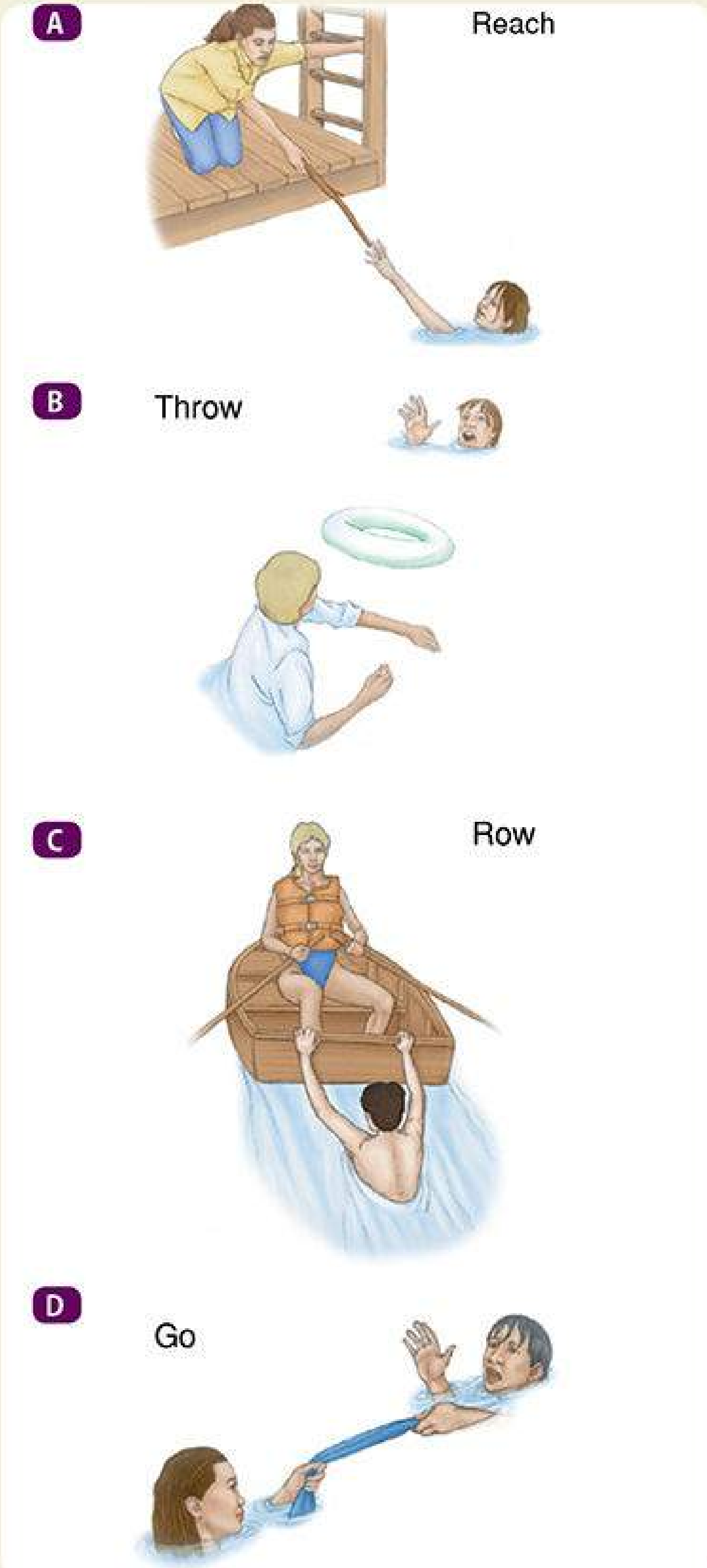


Figure 32-8 Basic rules of water rescue. **A.** Reach for the person from shore. If you cannot reach the person from shore, wade closer. **B.** If an object that floats is available, throw it to the person. **C.** Use a boat if one is available. **D.** If you must swim to the person, use a towel or board for him or her to hold onto. Do not let the person grab you.

The steps for ice rescue are similar and may involve reaching with a pole or ladder or throwing a rope or floatation device. A victim who has fallen through the ice may also be coached into placing his or her arms out of the water and onto the ice, kicking and rolling out of the water, and crawling to safety.

If you work in a recreation area near lakes, rivers, or the ocean, you should have a prearranged plan for water rescue. For colder areas, a plan for ice rescue is also necessary. This plan should include access to and cooperation with local providers who are trained and skilled in water rescue; these providers should help to develop the protocol for water rescue. Because the success of any water rescue depends on how rapidly the patient is removed from the water and ventilated, make sure you always have immediate access to personal flotation devices and other rescue equipment. Survival rates drastically decline the longer a victim is immersed. Cold-water drowning survival rates are somewhat higher.

Figure 32-9 When performing a water rescue, you must be properly trained and must wear proper personal protective equipment, including a personal flotation device.

Skill Drill 32-2 Stabilizing a Suspected Spinal Injury in the Water

Step 1

Turn the patient to a supine position by rotating the entire upper half of the body as a single unit.

Step 2

As soon as the patient is turned, begin artificial ventilation using the mouth-to-mouth method or a pocket mask.

Step 3

Float a buoyant backboard under the patient.

Step 4

Secure the patient to the backboard.

Step 5

Remove the patient from the water.

Step 6

Maintain the body's normal temperature and apply oxygen if the patient is breathing. Begin CPR if breathing and pulse are absent.

3. Float a buoyant backboard under the patient as you continue ventilation **Step 3**.
4. Secure the trunk and head to the backboard to immobilize the cervical spine. Do not remove the patient from the water until this is done **Step 4**.
5. Remove the patient from the water, on the backboard **Step 5**.
6. Cover the patient with a blanket. Give oxygen if the patient is breathing spontaneously. Begin CPR if there is no pulse. Effective cardiac compression or CPR is extremely difficult to perform when the patient is still in the water **Step 6**.

Recovery Techniques

On occasion, you may be called to the scene of a drowning and find that the patient is not floating or visible in the water. An organized rescue effort in these circumstances calls for providers who are experienced with recovery techniques and equipment, including snorkel, mask, and scuba gear. **Scuba gear** (self-contained underwater breathing apparatus) is a system that delivers air to the mouth and lungs at atmospheric pressures that increase with the depth of the dive.

Resuscitation Efforts

When a person is submerged in water that is colder than body temperature, heat will be conducted from the body to the water. The resulting hypothermia can protect vital organs from the lack of oxygen. In addition, exposure to cold water will occasionally activate certain primitive reflexes, which may preserve basic body functions for prolonged periods.

Also, whenever a person dives or jumps into very cold water, the **diving reflex**, slowing of the heart rate caused by submersion in cold water, may cause immediate bradycardia, a slow heart rhythm. Loss of consciousness and drowning may follow. However, the person may be able to survive for an extended period of time under water, thanks to a lowering of the metabolic rate associated with hypothermia. For this reason, local protocols often dictate that resuscitative efforts continue for up to one hour after submersion, while simultaneously rewarming the patient. Resuscitative efforts are not initiated for unwitnessed drowning victims who are found in a state of decomposition.

Diving Emergencies

Most serious water-related injuries are associated with dives, with or without scuba gear. Some of these injuries are related to the nature of the dive; others result from panic. Panic is not restricted to the person who is frightened by water. It can happen even to the experienced diver or swimmer.

There are more than 3,000,000 scuba sport divers in the United States, and approximately 200,000 new divers being trained annually. Medical emergencies relating to scuba diving techniques and equipment are becoming increasingly common. These injuries are separated into three phases of the dive: descent, bottom, and ascent.

Descent Emergencies

Descent problems are usually caused by the sudden increase in pressure on the body as the person dives deeper into the water. Some body cavities cannot adjust to the increased external pressure of the water; the result is severe pain. The usual areas affected are the lungs, the sinus cavities, the middle ear, the teeth, and the area of the face surrounded by the diving mask. Usually, the pain caused by these "squeeze problems" forces the diver to return to the surface to equalize the pressures, and the problem clears up by itself. A diver who continues to report pain, particularly in the ear, after returning to the surface should be transported to the hospital.

A special problem may develop in a person with a perforated tympanic membrane (ruptured eardrum) while diving. If cold water enters the middle ear through a ruptured eardrum, the diver may sustain a loss of balance and orientation. The diver may then shoot to the surface and experience ascent problems.

Emergencies at the Bottom

Problems related to the bottom of the dive are rarely seen. They include inadequate mixing of oxygen and carbon dioxide in the air the diver breathes and accidental feeding of poisonous carbon monoxide into the breathing apparatus. Both are the result of faulty connections in the diving gear. These situations can cause drowning or rapid ascent; they require emergency resuscitation and transport of the patient.

Ascent Emergencies

Most of the serious injuries associated with diving are related to ascending from the bottom and are referred to as ascent problems. These emergencies usually require aggressive resuscitation. Two particularly dangerous medical emergencies are air embolism and decompression sickness.

Air Embolism

The most dangerous, and most common, emergency in scuba diving is an **air embolism**, a condition involving bubbles of air in the blood vessels. An air embolism may occur on a dive as shallow as 6 feet (2 m). The problem starts when the diver holds his or her breath during a rapid ascent. The air pressure in the lungs remains at a high level while the external pressure on the chest decreases. As a result, the air inside the lungs expands rapidly, causing the alveoli in the lungs to rupture. The air released from this rupture can cause the following injuries:

- Air may enter the pleural space and compress the lungs (a pneumothorax).
- Air may enter the mediastinum (the space within the thorax that contains the heart and great vessels), causing a condition called pneumomediastinum.
- Air may enter the bloodstream and create bubbles of air in the vessels called air emboli.

Pneumothorax and pneumomediastinum both result in pain and severe dyspnea. An air embolus will act as a plug and prevent the normal flow of blood and oxygen to a specific part of the body. The brain and spinal cord are the organs most severely affected by air embolism because they require a constant supply of oxygen.

The following are potential signs and symptoms of an air embolism:

- Blotching (mottling of the skin)
- Froth (often pink or bloody) at the nose and mouth
- Severe pain in muscles, joints, or abdomen
- Dyspnea and/or chest pain
- Dizziness, nausea, and vomiting
- Dysphasia (difficulty speaking)
- Cough
- Cyanosis
- Difficulty with vision
- Paralysis and/or coma
- Irregular pulse and cardiac arrest

Decompression Sickness

Decompression sickness, commonly called the **bends**, occurs when bubbles of gas, especially nitrogen, obstruct the blood vessels. This condition results from too rapid an ascent from a dive, too long of a dive at too deep a depth, or repeated dives within a short period of time. During the dive, nitrogen that is being breathed dissolves in the blood and tissues because it is under pressure. When the diver ascends, the external pressure is decreased, and the dissolved nitrogen forms small bubbles within those tissues. These bubbles can lead to problems similar to those that occur in air embolism (blockage of tiny blood vessels, depriving parts of the body of their normal blood supply), but severe pain in certain tissues or spaces in the body is the most common problem.

Similarly, decompression sickness can occur even after a “safe dive” from driving a car up a mountain or flying in an unpressurized airplane that climbs too rapidly to a great height. However, the risk of this diminishes after 24 to 48 hours.

The most striking symptom is abdominal and/or joint pain so severe that the patient literally doubles up or “bends.” Dive tables and small diving computers are available to calculate and record the proper rate of ascent from a dive, including the number and length of pauses that a diver should make on the way up. However, even divers who stay within these limits can experience the bends.

You may find it difficult to distinguish between air embolism and decompression sickness. As a general rule, air embolism occurs immediately on return to the surface, whereas the symptoms of decompression sickness may not occur for several hours. The emergency treatment is the same for both. It consists of basic life support (BLS) followed by recompression in a hyperbaric chamber, a chamber or a small room that is pressurized to a level higher than atmospheric pressure **Figure 32-10**. Recompression treatment allows the bubbles of gas to dissolve into the blood and equalizes the pressures inside and outside the lungs. Once these pressures are equalized, gradual decompression can be accomplished under controlled conditions to prevent the bubbles from reforming.

Figure 32-10 A hyperbaric chamber, usually a small room, is pressurized to a level higher than atmospheric pressure and used in the treatment of decompression sickness and air embolism.

Courtesy of Perry Baromedical Corporation.

Assessment of Drowning and Diving Emergencies

Scene Size-up

In managing water emergencies, your standard precautions should include gloves and eye protection at a minimum. Check for hazards to your crew. Never drive through moving water—a small amount can cause the vehicle to be swept away. Use extreme caution when driving through standing water. Never attempt a water rescue without proper training and equipment. Call for additional resources early.

If your patient is still in the water, look for the best, safest means of removal. This may require additional help from search and rescue teams or special extrication equipment. Trauma and spinal immobilization must be considered when the scene is a recreational setting. Check for additional patients based on where and how the emergency occurred.

As you observe the scene, look for indicators of the MOI. As you put together information from dispatch and your observations of the scene, consider how the MOI produced the injuries expected.

Primary Assessment

Use your evaluation of the patient's chief complaint to guide you in your assessment of life threats and determine whether spinal immobilization is necessary. Pay particular attention to chest pain, dyspnea, and complaints related to sensory changes when a diving emergency is suspected. Determine the patient's level of consciousness using the AVPU scale. Be suspicious of drug and alcohol use and the effects on the patient's level of consciousness.

Standard measures should be taken for any patient found or injured while in the water. Begin with opening the airway and assessing breathing in unresponsive patients. Consider the possibility of spinal trauma and take appropriate actions. The airway may be obstructed with water. Suction according to protocol if the patient has vomited. Provide ventilations with a

BVM for inadequate breathing. Use an airway adjunct to facilitate BVM ventilations as necessary.

If the patient is responsive, provide high-flow oxygen with a nonrebreathing mask, and if there is no risk of spinal injury, position the patient to protect the airway from aspiration in the event of vomiting.

Auscultation and frequent reassessment of breath sounds in drowning patients is a key part of your assessment. You may hear diminished sounds or even gurgling sounds from the water that has been inhaled. Provide this information, and any changes in the patient's lung sounds, to the ALS providers who may rendezvous with your unit as well as to the receiving facility. Breath sounds are also particularly significant for patients with scuba diving injuries; while the patients ascended to the surface, a pneumothorax or tension pneumothorax may have developed.

Check for a pulse. It may be difficult to find a pulse because of constriction of the peripheral blood vessels and low cardiac output, resulting in cyanosis. Nevertheless, if the pulse is unmeasurable, the patient may be in cardiac arrest. Begin CPR and apply your AED according to BLS and the International Liaison Committee on Resuscitation (ILCOR) guidelines.

Evaluate the patient for adequate perfusion and treat for shock by maintaining normal body temperature and improving circulation through positioning. The patient's skin may be cold to the touch. If the MOI suggests trauma, assess for bleeding and treat appropriately.

Even if resuscitation in the field appears successful, always transport patients to the hospital. Inhalation of any amount of fluid can lead to delayed complications lasting for days or weeks. Patients with decompression sickness and air embolism must be treated in a recompression chamber. If you live in an area with a significant amount of scuba diving activity, you will have transport protocols in this regard. Usually, the patient will be stabilized in the nearest ED. Perform all interventions en route.

History Taking

After the life threats have been managed during the primary assessment, investigate the chief complaint. Obtain a medical history and be alert for injury-specific signs and symptoms as well as any pertinent negatives.

Obtain a SAMPLE history with special attention to the dive parameters, including depth, the length of time the patient was underwater, the time of onset of symptoms, and previous diving activity. Note any physical activity, alcohol or drug consumption, and other medical conditions. All of these factors may have an effect on the diving or drowning emergency.

Secondary Assessment

The secondary assessment is used to uncover injuries that may have been missed during the primary assessment. In some instances, such as a critically injured patient or a short transport time, you may not have time to conduct a secondary assessment.

If the patient is responsive, focus your physical examination on the basis of the chief complaint and the history obtained. This should include a thorough examination of the patient's lungs, including breath sounds.

Serious drowning situations typically result in an unresponsive patient. It is important to begin with a full-body scan in these situations to look for hidden life threats and potential trauma, even if trauma is not suspected. A scuba diver with problems should be assessed for indications of decompression sickness or an air embolism. Focus on pain in the joints and the abdomen. Pay attention to whether your patient is getting adequate ventilation and oxygenation, and check for signs of hypothermia.

Time and personnel permitting, complete a detailed assessment en route to the hospital. A careful examination may reveal additional injuries not initially observable. Examine the patient for respiratory, circulatory, and neurologic compromise. A careful distal circulatory, sensory, and motor function examination will be helpful in assessing the extent of the injury. Assess for peripheral pulses, skin color and discoloration, itching, pain, and paresthesia (numbness and tingling).

Check the patient's pulse rate, quality, and rhythm. Pulse and blood pressure may be difficult to palpate in a patient with hypothermia. Check carefully for both peripheral and central pulses, and listen over the chest for a heartbeat if pulses are weak. Check the respiratory rate, quality, and rhythm and listen for breath sounds. Assess and document pupil size and reactivity.

YOU are the Provider — PART 4

Your partner notifies the hospital and gives the hospital a patient report. You continue active cooling measures and initiate the appropriate shock treatment. When you reassess the patient, you note that his level of consciousness has decreased; he is responsive only to pain. His respirations are still rapid, but are now markedly shallow.

Recording Time: 11 Minutes	
Level of consciousness	Responsive only to pain
Respirations	26 breaths/min; shallow
Pulse	126 beats/min; weak and regular
Skin	Flushed, hot, and moist
Blood pressure	90/70 mm Hg
Spo_2	89% (on oxygen)

7. How should you adjust your treatment of this patient?
8. How will you know when you have adequately cooled the patient?

Although it is a valuable tool, oxygen saturation readings may produce a false low reading because of hypoperfusion of the patient's monitoring finger. Shivering also can interfere with obtaining an accurate reading because of excessive movement.

Reassessment

Repeat the primary assessment. Reassess vital signs and the chief complaint. Are the airway, breathing, and circulation still adequate? Recheck patient interventions. Are your treatments for problems with the ABCs still effective?

The condition of patients who have experienced submersion in water may deteriorate rapidly because of pulmonary injury, fluid shifts in the body, cerebral hypoxia, and hypothermia. Patients with pneumothorax, air embolism, or decompression sickness may decompensate quickly. Assess your patient's mental status constantly, and assess vital signs at least every 5 minutes. Pay particular attention to respirations and breath sounds.

Document the circumstances of the drowning and extrication. The receiving facility personnel will need to know how long the patient was submerged, the temperature of the water, the clarity of the water, and whether there was any possibility of cervical spine injury.

If you respond to a diving incident, the receiving facility personnel will also need a complete dive profile to properly treat your patient. This information may be available in a dive log, on a dive computer, or from the patient's diving partners. If possible, bring all of the diver's equipment to the hospital. It will be helpful in determining the cause of the incident. Be sure to document the disposition of this equipment.

Emergency Care for Drowning or Diving Emergencies

Treatment for drowning begins with rescue and removal from the water. Immobilize and protect the patient's spine when a fall from a significant height or suspected diving injury has occurred (or if this is a possibility when no information is provided). When necessary, begin artificial ventilation as soon as possible, even before the victim is removed from the water. Spinal immobilization must continue while artificial ventilation is performed. If the patient is not breathing, clear any vomit from the airway manually or with suction and assist ventilations with a BVM or pocket mask. Rolling patients onto their side or performing abdominal thrusts will not remove water from the lungs and should not be done unless the airway is obstructed. Frothy sputum in the patient's airway does *not* require removal with suctioning. When resuscitating a patient who has drowned, the usual CAB order (compressions, airway, breathing) is not used. Rather, address airway and breathing concerns first, then begin compressions and use the AED.

If the patient is breathing spontaneously, but has been submerged, administer oxygen (if this was not done as part of the primary assessment). Use pulse oximetry to titrate oxygen delivery, according to local protocols. Treat all drowning patients for hypothermia by removing wet clothing and wrapping them in warm blankets.

When treating conscious patients who are suspected of having an air embolism or decompression sickness from scuba diving, follow these accepted treatment steps:

1. Remove the patient from the water. Try to keep the patient calm.
2. Administer oxygen.
3. Consider the possibility of pneumothorax and monitor the patient's breath sounds for development of a tension pneumothorax.

4. Provide prompt transport to the ED or to the nearest recompression facility for treatment based on local protocols.

Injury from decompression sickness is sometimes reversible with proper treatment. However, if the bubbles block critical blood vessels that supply the brain or spinal cord, permanent central nervous system injury may result. Therefore, the key in emergency management of serious ascent problems is to recognize that an emergency exists and treat as soon as possible.

Other Water Hazards

Pay close attention to the body temperature of a person who is rescued from cold water. Treat hypothermia caused by immersion in cold water the same way you treat hypothermia caused by cold exposure. Prevent further heat loss from contact with the ground, stretcher, or air, and transport the patient promptly.

A person swimming in shallow water may experience **breath-holding syncope**, a loss of consciousness caused by a decreased stimulus for breathing. This happens to swimmers who breathe in and out rapidly and deeply before entering the water in an effort to expand their capacity to stay underwater. Whereas this technique increases the swimmer's oxygen level, the hyperventilation involved lowers the carbon dioxide level. Because an elevated level of carbon dioxide in the blood is the strongest stimulus for breathing, the swimmer may not feel the need to breathe even after using up all the oxygen in his or her lungs. This results in drowning. The emergency treatment for a patient with breath-holding syncope is the same as that for a drowning patient.

Prevention

Each year, many young children drown in residential pools. Appropriate precautions can prevent most immersion incidents. All swimming pools should be surrounded by a fence that is at least 6 feet (2 m) high, with slats no farther apart than 3 inches (8 cm), and self-closing, self-locking gates. The most common problem is a lack of adult supervision. An incident can occur when a child is unattended for only a few seconds. Half of all teenage and adult drownings are associated with alcohol use. As a health care professional, you should be involved in public education efforts to make people aware of the hazards of swimming pools and water recreation.

High Altitude

High altitudes can cause **dysbarism injuries**. Dysbarism injuries are any signs and symptoms caused by the difference between the surrounding atmospheric pressure and the total gas pressure in various tissues, fluids, and cavities of the body. Altitude illnesses occur when an unacclimatized person is exposed to diminished oxygen pressure in the air at high altitudes. These illnesses affect the central nervous system and pulmonary system, and range from common acute mountain sickness to high-altitude cerebral edema (HACE) and high-altitude pulmonary edema (HAPE).

Acute mountain sickness is caused by diminished oxygen pressure in the air at altitudes above 5,000 feet (1.5 km), resulting in diminished oxygen in the blood (hypoxia). It strikes those who ascend too high too fast and those who have not acclimatized to high altitudes. The signs and symptoms include a headache, light-headedness, fatigue, loss of appetite, nausea, difficulty sleeping, shortness of breath during physical exertion, and a swollen face. Treatment primarily consists of stopping the ascent and descending to a lower altitude. However, consider other possible causes for the same symptoms, such as hypoglycemia or carbon monoxide poisoning from a camping stove.

With HAPE, fluid collects in the lungs, hindering the passage of oxygen into the bloodstream. It can occur at altitudes of 8,000 feet (2 km) or greater. The signs and symptoms include shortness of breath, cough with pink sputum, cyanosis, and a rapid pulse.

HACE usually occurs in climbers and may accompany HAPE; it can quickly become life threatening. The signs and symptoms include a severe, constant, throbbing headache; ataxia (lack of muscle coordination and balance); extreme fatigue; vomiting; and loss of consciousness. The symptoms of HACE and HAPE may overlap.

In the field, treatment for HAPE and/or HACE consists of providing oxygen, descending to a lower altitude, and prompt transport. For inadequate respirations, provide positive-pressure ventilation with a BVM. If local protocols allow, continuous positive airway pressure (CPAP) may be very helpful for a patient with respiratory distress from HAPE.

Lightning

According to the National Weather Service, there are an estimated 25 million cloud-to-ground lightning flashes in the United States each year. On average, lightning kills between 60 and 70 people per year in the United States based on documented cases. While documented lightning injuries in the United States average about 300 per year, undocumented lightning injuries are likely much higher. Lightning is the third most common cause of death from isolated environmental phenomena.

The energy associated with lightning is comprised of direct current of up to 200,000 amps and a potential of 100 million volts or more. Temperatures generated from lightning vary between 20,000°F and 60,000°F (11,000°C and 33,000°C).

Most deaths and injuries caused by lightning occur during the summer months when people are enjoying outdoor activities, despite an approaching thunderstorm. Those most commonly struck by lightning include boaters, swimmers, and golfers. Any type of activity that exposes the person to a large, open area increases the risk of being struck by lightning.

Whether or not lightning injures or kills depends on whether a person is in the path of the lightning discharge. The current associated with the lightning discharge travels along the ground. Although some people are injured or killed by a direct lightning strike, many people are indirectly struck when standing near an object that has been struck by lightning, such as a tree (splash effect).

The cardiovascular and nervous systems are most commonly injured during a lightning strike; therefore, respiratory or cardiac arrest is the most common cause of lightning-related deaths. The tissue damage caused by lightning is different from that caused by other electric related injuries (ie, high-power line injuries) because the tissue damage pathway usually occurs over the skin, rather than through it. During your assessment, look for not only the entrance wound but also the exit wound. The exit wound does not necessarily occur on the same side of the body. Additionally, because the duration of a lightning strike is short, skin burns are usually superficial; full-thickness (third-degree) burns are rare. Lightning injuries are categorized as being mild, moderate, or severe:

- **Mild:** Loss of consciousness, amnesia, confusion, tingling, and other nonspecific signs and symptoms. Burns, if present, are typically superficial.
- **Moderate:** Seizures, respiratory arrest, dysrhythmias that spontaneously resolve, and superficial burns.
- **Severe:** Cardiopulmonary arrest. Because of the delay in resuscitation, often the result of occurrence in a remote location, many of these patients do not survive.

Emergency Medical Care

As with any scene response, your priority is safety. Take measures to protect yourself and your partner from being struck by lightning, especially if the thunderstorm is still in progress. Contrary to popular belief, lightning can, and does, strike in the same place twice. Move the patient to a place of safety, preferably in a sheltered area.

If you are in an open area and adequate shelter is unavailable, it is important to recognize the signs of an impending lightning strike and take immediate action to protect yourself. If you suddenly feel a tingling sensation or your hair stands on end, the area around you has become charged—a sure sign of an imminent lightning strike. Make yourself as small a target as possible by squatting down into a ball, close to—but not touching—the ground. If you are standing near a tree or other tall object, move away as fast as possible, preferably to a low-lying area. Lightning tends to strike objects that project from the ground (ie, trees, fences, buildings).

The process of triaging multiple victims of a lightning strike is different than the conventional triage methods used during a mass-casualty incident (see Chapter 39, *Incident Management*). When a person is struck by lightning, respiratory or cardiac arrest, if it occurs, usually occurs immediately. Delayed respiratory or cardiac arrest is much less likely to develop in those who are conscious following a lightning strike; most of these people will survive. Therefore, you should focus your efforts on those who are in respiratory or cardiac arrest. This process, called **reverse triage**, differs from conventional triage, where such patients would ordinarily be classified as deceased.

When a person is struck by lightning, it causes massive direct current shock, with the patient experiencing massive muscle spasms (tetany) that can result in fractures of long bones and spinal vertebrae. Therefore, manually stabilize the patient's head in a neutral in-line position and open the airway with the jaw-thrust maneuver. If the patient is in respiratory arrest with a pulse, begin immediate BVM ventilations with 100% oxygen. If the patient is in cardiac arrest, attach an AED as soon as possible and provide defibrillation if indicated. If severe bleeding is present, control it immediately.

Provide full spinal immobilization and transport the patient to the closest appropriate facility. If CPR or ventilations are not required, address other injuries (ie, splint fractures, dress and bandage burns) and provide continuous monitoring while en route to the hospital. A patient with signs and symptoms of a lightning strike, but no obvious life threats, should still be transported to the ED for evaluation.

Bites and Envenomations

This section discusses bites and stings from spiders, hymenoptera, snakes, scorpions, and ticks and injuries from marine animals.

Spider Bites

Spiders are numerous and widespread in the United States. Many species of spiders bite. However, only two, the female black widow spider and the brown recluse spider, are able to deliver serious, even life-threatening bites. When you care for a patient who has had some type of bite, be alert to the possibility that the spider may still be in the area, although it is unlikely. Remember that your safety is of paramount importance.

Black Widow Spider

The female black widow spider (*Latrodectus*) is fairly large, measuring approximately 2 inches (5 cm) long with its legs extended. It is usually black and has a distinctive, bright red-orange marking in the shape of an hourglass on its abdomen **Figure 32-11**. The female black widow spider is larger and more toxic than the male. Black widow spiders are found in every state except Alaska. They prefer dry, dim places around buildings, in woodpiles, and among debris.

The bite of the black widow spider is sometimes overlooked. If the site becomes numb right away, the patient may not even recall being bit. However, most black widow spider bites cause localized pain and symptoms, including agonizing muscle spasms. In some cases, a bite on the abdomen causes muscle spasms so severe that the patient may be thought to have an acute abdominal condition, possibly peritonitis. The main danger with this type of bite, however, is that the black widow's venom can damage nerve tissues (it is a neurotoxin). Other systemic symptoms include dizziness, sweating, nausea, vomiting, and rashes. Tightness in the chest and difficulty breathing develop within 24 hours, as well as severe cramps, with board-like rigidity of the abdominal muscles. Generally, these signs and symptoms subside over 48 hours.

Figure 32-11

Black widow spiders are distinguished by their glossy black color and bright red-orange hourglass marking on the abdomen.

If necessary, a physician can administer a specific **antivenin**, a serum containing antibodies that counteract the venom, but because of a high incidence of side effects, its use is reserved for very severe bites, for older or very feeble patients, and for children younger than 5 years. In children, these bites can be fatal. In general, emergency treatment of a black widow spider bite consists of BLS for the patient in respiratory distress. More often, the patient will only require pain relief. Transport the patient to the ED as soon as possible for treatment. If possible, safely bring the spider to the hospital or take a photo of the spider with a cell phone and send it to the hospital ahead of time so that it can be definitively identified.

Brown Recluse Spider

The brown recluse spider (*Loxosceles*) is dull brown and, at 1 inch (3 cm), smaller than the black widow Figure 32-12. The short-haired body has a violin-shaped mark, brown to yellow in color, on its back. Although the brown recluse spider lives mostly in the southern and central parts of the country, it may be found throughout the continental United States. The spider takes its name from the fact that it tends to live in dark areas—in corners of old, unused buildings, under rocks, and in woodpiles. In cooler areas, it moves indoors to closets, drawers, cellars, and clothing.

Figure 32-12

Brown recluse spiders are dull brown and have a dark, violin-shaped mark on the back.

Courtesy of Kenneth Cramer, Monmouth College.

In contrast to the venom of the black widow spider, the venom of the brown recluse spider is not neurotoxic but cytotoxic; that is, it causes severe local tissue damage. Typically, the bite is not painful at first but becomes so within hours. The area becomes swollen and tender, developing a pale, mottled, cyanotic center and possibly a small blister Figure 32-13. Over the next several days, a scab of dead skin, fat, and debris forms and digs down into the skin, producing a large ulcer that may not heal unless treated promptly. Transport patients with such symptoms as soon as possible.

Figure 32-13

The bite of a brown recluse spider is characterized by swelling, tenderness, and a pale, mottled, cyanotic center. There may also be a small blister on the bite.

Courtesy of Department of Entomology, University of Nebraska.

Brown recluse spider bites rarely cause systemic symptoms and signs. When they do, provide BLS and prompt transport to the ED. Again, it is helpful if you can identify the spider and either safely bring it to the hospital with the patient, or take a picture of the spider and send it to the hospital ahead of time.

Hymenoptera Stings

Typically **hymenoptera** (bees, wasps, yellow jackets, and ants) stings are painful but are not a medical emergency. Remove the stinger and, if still present, the venom sac. This is best done by using a firm-edged item such as a credit card to scrape the stinger and sac off the skin. Use ice packs to assist in controlling pain from a hymenoptera sting.

If the patient is allergic to the venom, then anaphylaxis may occur. The signs and symptoms of anaphylaxis are flushed skin, low blood pressure, difficulty breathing usually associated with reactive airway sounds such as wheezes, or in severe cases diminished or absent breath sounds. Hives (urticaria) may develop near the site of envenomation or centrally on the body. The patient can also have swelling to the throat and tongue. Anaphylaxis is a true emergency and can be fatal if not recognized and treated quickly. If anaphylaxis develops, be prepared to assist the patient in administering an epinephrine auto-injector (EpiPen). Also be prepared to support the airway and breathing should the patient experience significant respiratory compromise. Chapter 20, *Immunologic Emergencies*, has a detailed discussion on the treatment of anaphylaxis.

Snake Bites

Snake bites are a worldwide problem. According to the World Health Organization, more than 400,000 injuries from venomous snake bites occur annually, including at least 20,000 deaths. However, snake bite fatalities in the United States are extremely rare, about 15 a year for the entire country.

Figure 32-14 **A.** Rattlesnake. **B.** Copperhead. **C.** Cottonmouth (water moccasin). **D.** Coral snake.

A: © Photos.com; B: Courtesy of Ray Rauch/U.S. Fish & Wildlife Service; C: © SuperStock/Alamy; D: Courtesy of Luther C. Goldman/U.S. Fish & Wildlife Service.

Of the approximately 115 different species of snakes in the United States, only 19 are venomous. These include the rattlesnake (*Crotalus*), the copperhead (*Agkistrodon contortrix*), the cottonmouth, or water moccasin (*Agkistrodon piscivorus*), and the coral snakes (*Micrurus fulvius* and *Micruroides euryxanthus*) **Figure 32-14**. At least one of these venomous species is found in every state except Alaska, Hawaii, and Maine. As a general rule, these snakes are timid. They usually do not bite unless provoked or accidentally injured, as when they are stepped on. There are a few exceptions to these rules. Cottonmouths are often aggressive, and rattlesnakes are easily provoked. Coral snakes, in contrast, usually bite only when they are being handled.

Most snake bites occur between April and October, when the animals are active, and tend to involve young men who have been drinking alcohol. Texas reports the largest number of bites. Other states with a major concentration of snake bites are Louisiana, Georgia, Oklahoma, North Carolina, Arkansas, West Virginia, and Mississippi. If you work in one of these areas, you should be thoroughly familiar with the emergency handling of snake bites. Remember, almost any time you are caring for a patient with a snake bite, another snake may be in the area and create a second victim—you. Therefore, use extreme caution on these calls and be sure to wear the proper protective equipment for the area.

In general, only one-third of snake bites result in significant local or systemic injuries. Often, envenomation does not occur because the snake has recently struck another animal and exhausted its supply of venom for the time being.

Venomous snakes native to the United States all have hollow fangs in the roof of the mouth that inject the venom from two sacs at the back of the head. The classic appearance of the venomous snake bite, therefore, is two small puncture wounds, usually about 0.5 inch (1 cm) apart, with discoloration and swelling, and the patient usually reports pain surrounding the bite **Figure 32-15**. Fang marks are a clear indication of a venomous snake bite. A snake bite with other tooth marks may be from a nonvenomous snake. If you are unsure whether the snake was venomous, proceed as if it was, especially if the patient exhibits other signs and symptoms.

A person who has been bitten by any venomous snake needs prompt transport. Also, notify the hospital as soon as possible if a patient has been bitten by a pit viper or coral snake. Some venoms can cause paralysis of the nervous system, and hospitals may not have appropriate antivenin on hand.

Figure 32-15 A snake bite wound from a poisonous snake has characteristic markings: two small puncture wounds about 0.5 inch (1 cm) apart, discoloration, and swelling.

Pit Vipers

Rattlesnakes, copperheads, and cottonmouths are all pit vipers, with triangular-shaped, flat heads **Figure 32-16**. They take their name from the small pits located just behind each nostril and in front of each eye. The pit is a heat-sensing organ that allows the snake to strike accurately at any warm target, especially in the dark, when it cannot see through its vertical, slit-like pupils.

The fangs of the pit viper normally lie flat against the roof of the mouth and are hinged to swing back and forth as the mouth opens. When the snake strikes, the mouth opens wide and the fangs extend; in this way, the fangs penetrate whatever the mouth strikes. The fangs are actually special hollow teeth that act like hypodermic needles. They are connected to a sac containing a reservoir of venom, which in turn is attached to a poison gland. The gland itself is a specially adapted salivary gland, which produces enzymes that digest and destroy tissue. The primary purpose of the venom is to kill small animals and facilitate the digestive process.

In the United States, the most common form of pit viper is the rattlesnake. Several different species of rattlesnake can be identified by the rattle on the tail. The rattle is actually numerous layers of dried skin that were shed but failed to fall off, coming to rest against a small knob on the end of the tail. Rattlesnakes have many patterns of color, often with a diamond pattern. They can grow to 6 feet (2 m) or more in length.

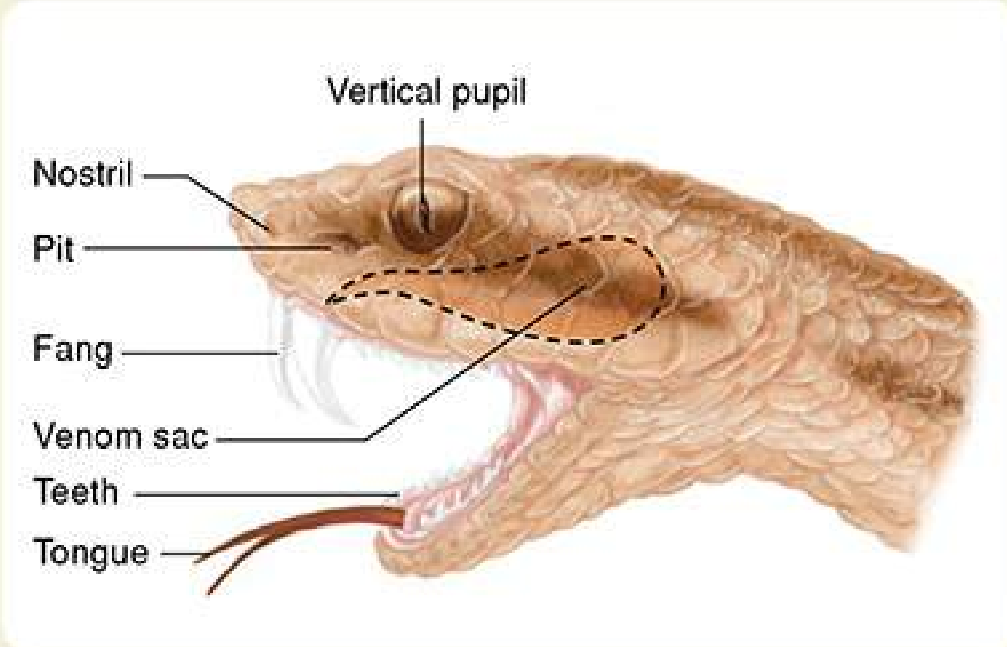


Figure 32-16 Pit vipers have small, heat-sensing organs (pits) located in front of their eyes that allow them to strike at warm targets, even in the dark.

Copperheads are smaller than rattlesnakes, usually 2 to 3 feet long (60 to 90 cm) with a red-copper color crossed with brown or red bands. These snakes typically inhabit woodpiles and abandoned dwellings, often close to areas of habitation. Although they account for most of the venomous snake bites in the eastern United States, copperhead bites are almost never fatal; however, note that the venom can cause significant damage to tissues in the extremities.

Cottonmouths grow to about 4 feet (1 m) in length. Also called water moccasins, these snakes are olive or brown, with black cross-bands and a yellow undersurface. They are water snakes and have a particularly aggressive pattern of behavior. Although fatalities from these snake bites are rare, tissue destruction from the venom may be severe.

The signs of envenomation by a pit viper are severe burning pain at the site of the injury, followed by swelling and a blue discoloration (ecchymosis) in light-skinned people that signals bleeding under the skin. These signs are evident within 5 to 10 minutes after the bite has occurred and last over the next 36 hours. In addition to destroying tissues locally, the venom of the pit viper can also interfere with the body's clotting mechanism and cause bleeding at various distant sites. This toxin affects the entire nervous system. Other systemic signs, which may or may not occur, include weakness, nausea, vomiting, sweating, seizures, fainting, vision problems, changes in level of consciousness, and shock. If swelling has occurred, use a pen to mark its edges on the skin. This will allow physicians to assess the timing and extent of the swelling with greater accuracy. If the patient has no local signs an hour after being bitten, it is safe to assume that envenomation did not take place.

The toxicity is related to the amount of toxin injected. A bite will affect children more than adults because there is less body mass to absorb the toxin. The same principle holds true for a small-statured adult.

In treating a snake bite from a pit viper, follow these steps:

1. Calm the patient; assure him or her that venomous snake bites are rarely fatal. Place the patient in a supine position and explain that staying still will slow the spread of any venom through the system. Determine the approximate time of the bite and document your time en route to a receiving facility. This time from onset to evaluation at the facility is one of the criteria used in grading the severity of the incident and in determining the amount of antivenin to be used.
2. Locate the bite area; clean it gently with soap and water or a mild antiseptic. Do not apply ice to the area.
3. If the bite occurred on an arm or leg, consider the use of a pressure immobilization bandage of the extremity (eg, 40 to

70 mm Hg in the arms and 55 to 70 mm Hg in the legs) and then place the affected extremity below the level of the heart.
4. Be alert for an anaphylactic reaction to the venom and treat with an epinephrine auto-injector, as appropriate.
5. Do not give anything by mouth, and be alert for vomiting.
6. If, as rarely happens, the patient was bitten on the trunk, keep him or her supine and quiet and transport as quickly as possible.
7. Monitor the patient's vital signs and mark the skin with a pen over the area that is swollen, proximal to the swelling, to note whether swelling is spreading.
8. If there are any signs of shock, place the patient supine and administer oxygen.
9. If the snake has been killed, as is often the case, be sure to bring it with you in a secure, hard-sided container so that physicians can identify it and administer the proper antivenin. Alternatively, take a picture of the snake with a cell phone and send it to the hospital ahead of time.
10. Notify the hospital that you are bringing in a patient who has a snake bite; if possible, describe the snake.
11. Transport the patient promptly to the hospital.

If the patient shows no sign of envenomation, provide BLS as needed, place a sterile dressing over the suspected bite area, and immobilize the injury site. All patients with a suspected snake bite should be taken to the ED, whether or not they show signs of envenomation. Treat the wound as you would any deep puncture wound to prevent infection.

Familiarize yourself with the venomous snakes in your region, as well as local protocols for handling snake bites. There may be specific hospitals where antivenin is more readily available, either in the facility or through zoos, health departments, or other services.

Coral Snakes

The coral snake is a small reptile with a series of bright red, yellow, and black bands completely encircling the body. Many harmless snakes have similar coloring, but only the coral snake has red and yellow bands next to one another, as this helpful rhyme suggests: "Red on yellow will kill a fellow; red on black, venom will lack."

A rare creature that lives in most southern states and in the Southwest, the coral snake is a relative of the cobra. It has tiny fangs and injects the venom with its teeth by a chewing motion, leaving behind one or more puncture or scratch-like wounds. Because of its small mouth and teeth and limited jaw expansion, the coral snake usually bites its victims on a small part of the body, such as a finger or toe.

Coral snake venom is a powerful toxin that causes paralysis of the nervous system. Within a few hours of being bitten, a patient will exhibit bizarre behavior, followed by progressive paralysis of eye movements and respiration. Often, there are limited or no local symptoms.

Successful treatment, either emergency or long-term, depends on positive identification of the snake and support of respiration. Antivenin is also available for coral snake bites, but most hospitals do not stock it. Therefore, you should notify the receiving hospital of the need for it as soon as possible. The steps for emergency care of a coral snake bite are the same as a pit viper bite.

Scorpion Stings

Scorpions are eight-legged arachnids from the biologic group *Arachnida* with a venom gland and a stinger at the end of their tail **Figure 32-17**. Scorpions are rare; they live primarily in the southwestern United States and in deserts. With one exception, a scorpion's sting is usually very painful but not dangerous, causing localized swelling and discoloration. The exception is the *Centruroi-des sculpturatus*. Although it is found naturally in Arizona and New Mexico, as well as parts of Texas, California, and Nevada, it may be kept as a pet by anyone. The venom of this particular species may produce a severe systemic reaction that leads to circulatory collapse, severe muscle contractions, excessive salivation, hypertension, convulsions, and cardiac failure. Antivenin is available but must be administered by a physician. If you are called to care for a patient with a suspected sting from *C. sculpturatus*, notify the receiving hospital as early as possible to facilitate the availability of this antivenin. Administer BLS and provide rapid transport to the ED.

Figure 32-17 The sting of a scorpion is usually more painful than it is dangerous, causing localized swelling and discoloration.

YOU are the Provider — PART 5

The patient's level of consciousness appears to have improved and he is now resisting your attempts to assist his ventilations. After reapplying the nonrebreathing mask, you reassess his vital signs and clinical condition. His skin, although still very warm, does not feel as hot as it did initially, and his skin appears less flushed. You will arrive at the hospital in approximately 5 minutes.

Recording Time: 16 Minutes	
Level of consciousness	Confused; somewhat combative
Respirations	22 breaths/min; depth has improved
Pulse	120 beats/min and regular; appears to be stronger
Skin	Less flushed, very warm to the touch, moist
Blood pressure	98/58 mm Hg
Spo_2	94% (on oxygen)

9. What other conditions should you consider as potential causes of the patient's altered mental status?

Tick Bites

Found most often on brush, shrubs, trees, sand dunes, or other animals, ticks usually attach themselves directly to the skin **Figure 32-18**. Only a fraction of an inch (about 3 mm) long, they can easily be mistaken for a freckle, especially since their bite is not painful. Indeed, the danger with a tick bite is not from the bite itself, but from the infecting organisms that the tick carries. Ticks commonly carry two infectious diseases, Rocky Mountain spotted fever and Lyme disease. Both are spread through the tick's saliva, which is injected into the skin when the tick attaches itself. The longer a tick stays embedded, the greater the chance that a disease will be transmitted.

Rocky Mountain spotted fever, which is not limited to the Rocky Mountains area, occurs within 7 to 10 days after a bite by an infected tick. Its symptoms include nausea, vomiting, headache, weakness, paralysis, and possible cardiorespiratory collapse.

Lyme disease has received extensive publicity. Lyme disease was originally seen only in Connecticut. According to the CDC, it has now been reported in all states with the exception of Hawaii. It occurs most commonly in the Northeast and the Great Lake states; Pennsylvania reported the largest number of cases from 2011 to 2013. The first symptoms are generally fever and flulike symptoms, sometimes associated with a bull's-eye rash that may spread to several parts of the body Figure 32-19. After a few days or weeks, painful swelling of the joints, particularly the knees, occurs. Lyme disease may be confused with rheumatoid arthritis and, like that disease, may result in permanent disability. However, if it is recognized and treated promptly with antibiotics, the patient may recover completely.

Figure 32-18

Ticks typically attach themselves directly to the skin.

© Joao Estevao A. Freitas (jefras)/ShutterStock.

Tick bites occur most commonly during the summer months, when people are out in the woods wearing little protective clothing. Do not attempt to suffocate the tick with gasoline or petroleum jelly, or burn it with a lighted match; you will only increase the risk of infection or burn the patient. For patients in conventional EMS settings with tick bites or signs and symptoms of Lyme disease, provide any necessary supportive emergency care and transport the patient for further evaluation. In a situation (such as wilderness EMS) where access to care is delayed, remove the tick from the patient. Using fine tweezers, grasp the tick by the head and pull gently but firmly straight up so that the skin is tented. Hold this position until the tick releases. Special tweezers are available for this, but are unnecessary. This method will usually remove the whole tick. (Partial removal can lead to infection.) Cleanse the area with antiseptic and save the tick in a glass jar or other container so that it can be identified. Do not handle the tick with your fingers. The patient should follow up with their health care provider as soon as possible.

Figure 32-19 The rash associated with Lyme disease has a characteristic bull's-eye pattern.

Injuries From Marine Animals

Coelenterates, including the fire coral, Portuguese man-of-war, sea wasp, sea nettles, true jellyfish, sea anemones, true coral, and soft coral, are responsible for more envenomations than any other marine animals **Figure 32-20**. The stinging cells of the coelenterate are called nematocysts, and large animals may discharge hundreds of thousands of them. Envenomation causes very painful, red lesions in light-skinned people extending in a line from the site of the sting. Systemic symptoms include headache, dizziness, muscle cramps, and fainting.

To treat a sting from the tentacles of a jellyfish, a Portuguese man-of-war, various anemones, corals, or hydras, remove the patient from the water and remove the tentacles by scraping them off with the edge of a stiff object, such as a credit card. Do not try to manipulate the remaining tentacles; this will only cause further discharge of the nematocysts. On very rare occasions, a patient may have a systemic allergic reaction to the sting of one of these animals. Treat such a patient for anaphylactic shock and provide rapid transport to the hospital.

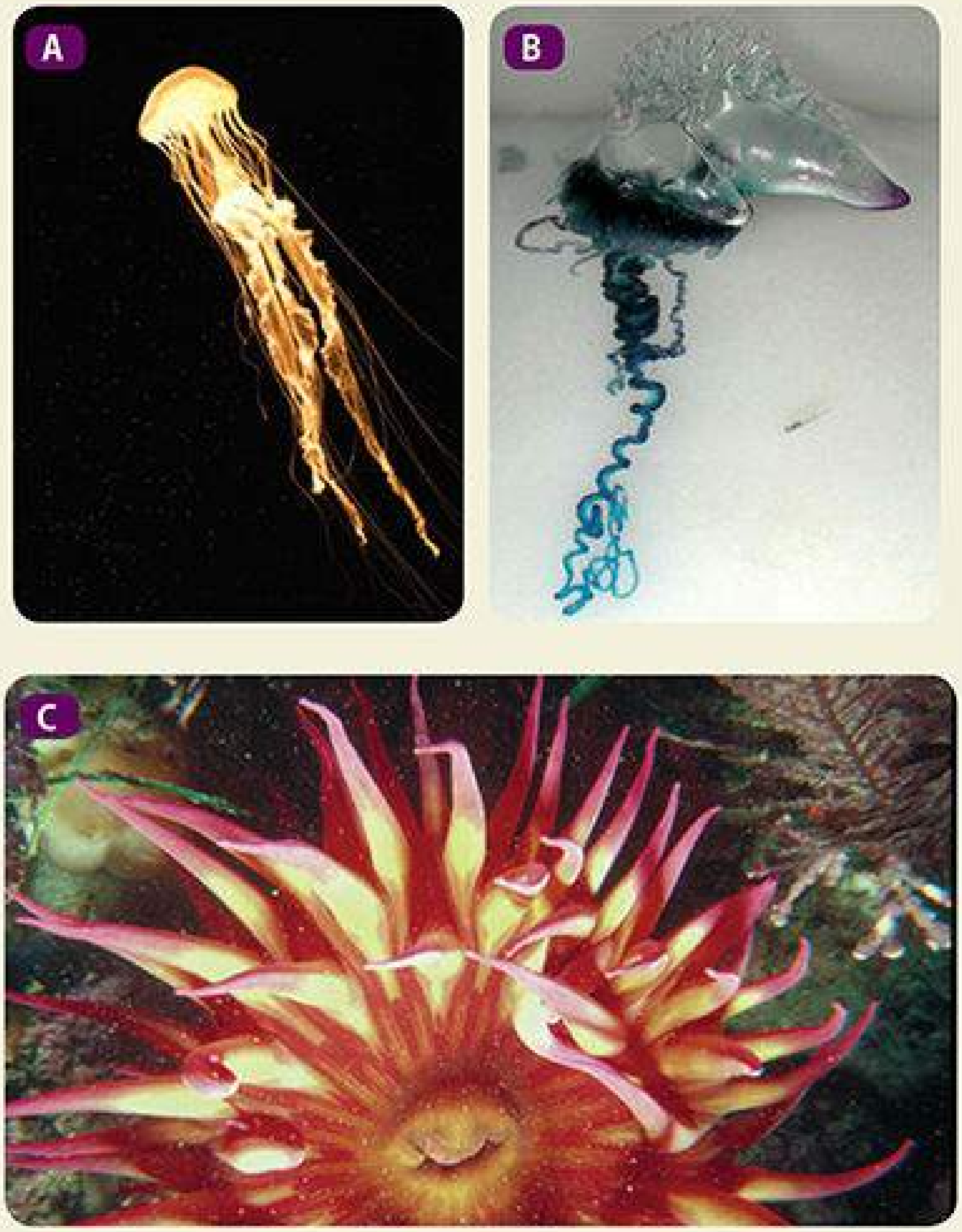


Figure 32-20 Coelenterates are responsible for many marine envenomations. **A.** Jellyfish. **B.** Portuguese man-of-war. **C.** Sea anemone.

A: © Creatas/Alamy; B: Courtesy of NOAA; C: Photos.com.

Toxins from the spines of urchins, stingrays, and certain spiny fish such as the lionfish, scorpion fish, or stonefish are also heat sensitive Table 32-3. Therefore, the best treatment for such injuries is also to soak the affected extremity in hot water for 30 minutes. This will often provide dramatic relief from local pain. However, the patient still needs to be transported to the ED because an allergic reaction or infection, including tetanus, could develop.

If you work near the ocean, you should be familiar with the marine life in your area. The emergency treatment of common coelenterate envenomations consists of the following steps:

1. Limit further discharge of nematocysts by avoiding fresh water, wet sand, showers, or careless manipulation of the tentacles. Keep the patient calm, and reduce motion of the affected extremity.

2. Remove the remaining tentacles by scraping them off with the edge of a stiff object such as a credit card. Do not use your ungloved hand to remove the tentacles, because self-envenomation will occur. Persistent pain may respond to immersion in hot water (110°F to 115°F [43.3°C to 46.1°C]) for 30 minutes. If available, immersion in vinegar may also help alleviate the symptoms.
3. Provide transport to the ED.

Table 32-3 Common Marine Envenomations

Dogfish	Marine snail	Starfish
Dragonfish	Portuguese man-of-war	Stingray
Fire coral	Ratfish	Stonefish
Hydroids	Scorpion fish	Tiger fish
Jellyfish	Sea anemone	Toadfish
Lionfish	Sea urchins	Weever fish

YOU are the Provider SUMMARY

1. How does the body normally balance heat production and elimination?

Normal core temperature—the temperature of the heart, lungs, and other vital organs—is usually around 98°F (36.7°C). A series of regulatory mechanisms keep this internal temperature constant, regardless of the ambient temperature (the temperature of the surrounding environment). However, heat elimination must balance heat production; if it does not, a temperature-related emergency occurs.

There are several ways the body removes excess heat, the most efficient of which are sweating (and evaporation of sweat) and dilation of the blood vessels. Ordinarily, the heat-regulating mechanisms of the body work very well and people are able to tolerate significant temperature changes.

2. What factors can decrease the body's ability to eliminate excess heat?

A number of factors can decrease a person's ability to eliminate excess heat. If air temperature is high, heat loss by radiation is reduced. Heat travels from a warmer place to a cooler place; if the ambient temperature is higher than body temperature, heat will move from the environment and into the body. If the relative humidity, the amount of moisture in the air, is high, heat loss by evaporation is reduced. Heat elimination is impaired the greatest when both the air temperature and relative humidity are high.

Vigorous exercise causes a loss of fluids and electrolytes, resulting in dehydration. Dehydration decreases heat loss through sweating and evaporation.

Small children and older patients exhibit poor thermoregulation; therefore, they are less able to eliminate excess body heat. The body's water content decreases with age, which reduces the ability to sweat.

Certain medical conditions, such as heart disease, chronic obstructive pulmonary disease, diabetes, dehydration, and obesity, interfere with the process of body heat elimination. In addition, alcohol and certain drugs, including medications that dehydrate the body (ie, diuretics) or decrease the ability of the body to sweat, also reduce heat elimination from the body.

3. What risk factors does this patient have that predispose him to a heat emergency?

Your patient has several risk factors for a heat emergency, the single most significant of which is prolonged exertion in a hot, humid environment. Also, the patient has not been drinking any water. In combination with profuse sweating that occurs during exposure to a hot environment, you should suspect that he is dehydrated.

The patient's past medical history also predisposes him to a heat emergency. Diabetes is a systemic condition that impairs many body functions, including thermoregulation. The patient also has hypertension, for which diuretics are often prescribed. Diuretics promote urination, further contributing to his dehydration.

4. What type of heat emergency do you suspect that he is experiencing? Why?

There are several clinical findings that indicate your patient is experiencing the most serious heat illness, heatstroke. Unlike other less severe forms of heat illness (eg, heat cramps, heat exhaustion), patients with heatstroke have an altered level of consciousness, ranging from confusion to coma, and flushed, hot skin. *Your patient has both of these*. Untreated heatstroke will cause permanent brain and tissue damage; in most cases, it causes death.

5. What specific treatment is required for this patient?

Immediate treatment of heatstroke includes moving the patient to a cool environment and administering oxygen. Further treatment is aimed at actively cooling the patient. Unless there are extenuating circumstances that will delay your transport, active cooling measures should be performed en route to the hospital. Heatstroke is a true emergency; it requires rapid cooling and rapid transport. Any delays in providing treatment increase the potential for permanent brain and tissue damage or death.

Remove the patient's clothes because they can trap heat. Place cold packs at the patient's groin and axillae and behind the neck. Spray or pour saline on the patient and aggressively fan him; this measure, in conjunction with the air conditioner, will facilitate heat loss through convection and evaporation.

Continue to actively cool the patient and notify the receiving facility early so the facility can continue treatment immediately on your arrival.

6. What is the most likely explanation for this patient's vital signs?

Your patient's vital signs—tachypnea, tachycardia, and hypotension—indicate shock. This is because heatstroke is associated with a severe loss of fluids and electrolytes, which results in hypovolemia. You should expect that patients with heatstroke will be tachypneic and tachycardic because of all the heat energy they have in their body. This response alone may enable patients to compensate for the severe fluid loss that occurs with heatstroke. The presence of hypotension, however, indicates that the body's compensatory mechanisms have failed (decompensated shock).

Patients with hypovolemic shock associated with heatstroke will need intravenous fluids and other treatment aimed at correcting electrolyte abnormalities at the hospital. Consider an ALS intercept, but do not delay transport to do this. AEMTs and paramedics are able to establish IV lines and administer fluids. Otherwise, continue high-flow oxygen and closely monitor him.

7. How should you adjust your treatment of this patient?

Your patient's level of consciousness has deteriorated, and his respirations are now shallow. Furthermore, his oxygen saturation level has decreased to 89%. These clinical signs indicate that your patient is no longer breathing adequately. This can result in hypoxia and a decreased ability to remove heat from the body.

Patients with inadequate breathing need assisted breathing with a BVM and high-flow oxygen. In addition to actively cooling the patient, ensure that oxygenation and ventilation remain adequate. Consider inserting an airway adjunct to assist in maintaining airway patency. In this case, a nasal airway is the best choice because the patient is not completely unconscious and likely has an intact gag reflex.

8. How will you know when you have adequately cooled the patient?

Ideally, you should monitor the patient’s core body temperature (CBT); this is most reliably obtained by assessing the patient’s rectal temperature, if local protocols allow. It is important to note that the CBT increases rapidly in patients with heatstroke, but does not decrease as quickly, even with aggressive cooling measures. Therefore, you will likely have to actively cool the patient throughout the entire transport, unless the destination hospital is a great distance away.

Follow your local protocols or contact online medical control regarding the “target temperature” that you should attempt to achieve. If your protocols do not allow you to monitor a patient’s CBT rectally, an axillary temperature should be assessed, although it is less accurate.

If you are unable to monitor the patient’s CBT, frequently reassess his skin temperature during the cooling process. Does it feel as hot as it was initially, or does it seem to be cooler than it was before? It is important to frequently assess the effectiveness of your interventions.

When actively cooling a patient with heatstroke, do not cool him or her to the point of shivering. Shivering generates more heat and can occur when cooling is not monitored closely.

9. What other conditions should you consider as potential causes of the patient’s altered mental status?

Altered mental status may be associated with heatstroke solely or could be the result of a completely different problem. An increase in heat energy causes the body to expend a lot of glucose; therefore, consider the possibility of hypoglycemia. You should also consider the possibility of a head injury. Recall that the patient apparently fainted. When this occurred, he may have fallen and struck his head, resulting in a concussion or intracranial hemorrhage. Do not rule out an occult head injury in the absence of obvious signs of trauma.

EMS Patient Care Report (PCR)

Date: 8-11-16	**Incident No.:** 013010	**Nature of Call:** Fainting		**Location:** 1102 Rosewood Avenue	
Dispatched: 1415	**En Route:** 1415	**At Scene:** 1422	**Transport:** 1430	**At Hospital:** 1443	**In Service:** 1450

Patient Information

Age: 55 **Sex:** M **Weight (in kg [lb]):** 75 kg (165 lb)	**Allergies:** Penicillin, erythromycin **Medications:** Lasix, K-Dur, Prinivil, nitroglycerin **Past Medical History:** Hypertension, angina **Chief Complaint:** Heat exposure; confused

Vital Signs

Time: 1428	**BP:** 88/66	**Pulse:** 130	**Respirations:** 24	**Spo_2:** 95%
Time: 1433	**BP:** 90/70	**Pulse:** 126	**Respirations:** 26	**Spo_2:** 89%
Time: 1438	**BP:** 98/58	**Pulse:** 120	**Respirations:** 22	**Spo_2:** 94%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Rapid cooling measures

Narrative

Medic 4 was dispatched to a residence for a man who fainted after working outside in the heat for a prolonged period of time. Arrived on scene and found the patient, a 55-year-old man, sitting under a tree in his garden. He was conscious but confused. His airway was patent and his breathing, although increased in rate, was producing adequate depth. Applied high-flow oxygen via nonrebreathing mask and quickly moved the patient to the air-conditioned ambulance. Secondary assessment was performed, but did not reveal any gross signs of injury. Patient's skin was flushed, hot, and moist. According to the patient's wife, he would not come out of the heat to take a break and drink some water. When she found him, he did not respond to her initially. Patient's past medical history includes hypertension and angina; medications listed above. Initial axillary temperature read 104.5°F (40.3°C). Removed patient's clothing and began rapid cooling measures by placing cold packs to his groin, axillae, and behind his neck. Began transport and continued cooling by spraying the patient with saline and fanning him. Vital signs indicated shock, so high-flow oxygen therapy was continued. Reassessment revealed that patient's mental status had markedly diminished; he was responsive only to pain. His respirations remained rapid, but were markedly decreased in depth. Inserted nasal airway and began assisting patient's ventilations with a BVM and high-flow oxygen. After cooling measures, reassessment revealed that the patient's skin, although very warm, did not feel as hot as it was initially; he also appeared less flushed. Patient became somewhat combative and would no longer tolerate assisted ventilation. Reapplied nonrebreathing mask and reassessed his axillary temperature; it read 102.5°F (39.2°C). Continued to reassess patient's vital signs as indicated and monitored him for signs of overcooling. Remainder of transport was uneventful; patient was delivered to the emergency department and verbal report was given to attending physician. Medic 4 cleared the hospital and returned to service at 1450.**End of report**

Prep Kit

Ready for Review

- Cold-related emergencies can be either a local or a systemic problem.
- Local cold injuries include frostbite, frostnip, and immersion foot. Frostbite is the most serious because tissues actually freeze. All patients with a local cold injury should be removed from the cold and protected from further exposure.
- If instructed to do so by medical control, rewarm frostbitten parts by immersing them in water at a temperature between 100°F and 112°F (37.8°C and 44.4°C).
- The key to treating patients with hypothermia is to stabilize vital functions and prevent further heat loss. Do not attempt to rewarm patients who have moderate to severe hypothermia because they are prone to dysrhythmias developing.
- Do not consider a patient dead until they are "warm and dead." Local protocols will dictate whether or not such patients receive CPR or defibrillation in the field.
- The body's regulatory mechanisms normally maintain body temperature within a very narrow range around 98°F (36.7°C). Body temperature is regulated by heat loss to the atmosphere via conduction, convection, evaporation, radiation, and respiration.
- Heat emergencies can take three forms: heat cramps, heat exhaustion, and heatstroke.
  - Heat cramps are painful muscle spasms that occur with vigorous exercise. Treatment includes removing the patient from the heat, resting the affected muscles, and replacing fluid loss.
  - Heat exhaustion is essentially a form of hypovolemic shock caused by dehydration. Symptoms include cold and clammy skin, weakness, confusion, headache, and rapid pulse. Body temperature can be high, and the patient may or may not still be sweating. Treatment includes removing the patient from the heat and treating for mild hypovolemic shock.
  - Heat stroke is a life-threatening emergency, usually fatal if untreated. Patients with heat stroke are usually dry and will have high body temperatures, typically greater than 104°F (40°C). Patients who have heat stroke due to exertion will have wet skin. Changes in mental status can include coma. Rapid lowering of the body temperature in the field is critical.
- The first rule in caring for drowning victims is to be sure not to become a victim yourself. Protect the spine when removing patients from the water because spinal cord injuries often occur in drownings. Be alert for hypothermia.
- Injuries associated with scuba diving may be immediately apparent or may show up hours later. Patients with an air embolism or decompression sickness may have pain, paralysis, or an altered mental status. Be prepared to transport such patients to a recompression facility with a hyperbaric chamber.
- Venomous spiders include the black widow spider and the brown recluse spider.
- Venomous snakes include pit vipers and coral snakes.
- A person who has been bitten by a venomous snake needs prompt transport; clean the bite area and keep the patient calm to slow the spread of venom.
- Notify the hospital as soon as possible if a patient has been bitten by a pit viper or coral snake. Some venoms can cause paralysis of the nervous system, and hospitals may not have appropriate antivenin on hand.
- Patients who have been bitten by ticks may be infected with Rocky Mountain spotted fever or Lyme disease and should see a doctor within a day or two. Remove the tick using tweezers, and save it for identification.
- Always provide prompt transport to the hospital for any patient who has been bitten by a venomous insect or animal. Remember that vital signs can deteriorate rapidly. Carefully monitor the patient's vital signs en route, especially for airway compromise.

Vital Vocabulary

air embolism Air bubbles in the blood vessels.

ambient temperature The temperature of the surrounding environment.

antivenin A serum that counteracts the effect of venom from an animal or insect.

bends A common name for decompression sickness.

breath-holding syncope Loss of consciousness caused by a decreased breathing stimulus.

conduction The loss of heat by direct contact (eg, when a body part comes into contact with a colder object).

convection The loss of body heat caused by air movement (eg, a breeze blowing across the body).

core temperature The temperature of the central part of the body (eg, the heart, lungs, and vital organs).

decompression sickness A painful condition seen in divers who ascend too quickly, in which gas, especially nitrogen, forms bubbles in blood vessels and other tissues; see *bends*.

diving reflex The slowing of the heart rate caused by submersion in cold water.

drowning The process of experiencing respiratory impairment from submersion or immersion in liquid.

dysbarism injuries Any signs and symptoms caused by the difference between the surrounding atmospheric pressure and the total gas pressure in various tissues, fluids, and cavities of the body.

evaporation The conversion of water or another fluid from a liquid to a gas.

frostbite Damage to tissues as the result of exposure to cold; frozen body parts.

heat cramps Painful muscle spasms usually associated with vigorous activity in a hot environment.

heat exhaustion A heat emergency in which a significant amount of fluid and electrolyte loss occurs because of heavy sweating; also called heat prostration or heat collapse.

heat stroke A life-threatening condition of severe hyperthermia caused by exposure to excessive natural or artificial heat, marked by warm, dry skin; severely altered mental status; and often irreversible coma.

homeostasis A balance of all systems of the body.

hymenoptera A family of insects that includes bees, wasps, ants, and yellow jackets.

hyperthermia A condition in which the body core temperature rises to 101°F (38.3°C) or more.

hypothermia A condition in which the body core temperature falls below 95°F (35°C) after exposure to a cold environment.

radiation The transfer of heat to colder objects in the environment by radiant energy; for example, heat gain from a fire.

respiration The loss of body heat as warm air in the lungs is exhaled into the atmosphere and cooler air is inhaled.

reverse triage A triage process used in treating multiple victims of a lightning strike, in which efforts are focused on those who are in respiratory and cardiac arrest. Reverse triage is different from conventional triage where such patients would be classified as deceased.

scuba gear A system that delivers air to the mouth and lungs at various atmospheric pressures, increasing with the depth of the dive; stands for self-contained underwater breathing apparatus.

turgor The ability of the skin to resist deformation; tested by gently pinching skin on the forehead or back of the hand.

Assessment *in Action*

You and your partner are called for a 25-year-old man who was found unresponsive by two hikers in a remote area of a national forest. On arrival, you observe a young man lying supine on the ground with a liquor bottle nearby. Despite near-freezing temperatures, he is dressed in a T-shirt and jeans.

1. After establishing unresponsiveness, what should be your next step in patient management?

   A. Provide manual in-line stabilization.
   B. Open the airway.
   C. Check for a pulse.
   D. Measure the core body temperature.

2. Hypothermia is diagnosed when the core body temperature falls below what temperature?

   A. 98°F (36.7°C)
   B. 95°F (35°C)
   C. 92°F (33.3°C)
   D. 90°F (32.2°C)

3. The patient has a respiratory rate of 4 breaths per minute. Your partner assists ventilations with a BVM while you perform a pulse check. How long should you assess for a carotid pulse?

   A. 5 to 10 seconds
   B. 15 to 30 seconds
   C. 30 to 45 seconds
   D. 45 to 60 seconds

4. The patient's core body temperature is 80°F (26.7°C). At this temperature, the patient's hypothermia would be classified as:

   A. mild.
   B. moderate.

C. severe.
D. extreme.

5. Your partner observes a medical alert bracelet on the patient's wrist. It says that the patient has diabetes. Other risk factors for hypothermia include all the following EXCEPT:

A. burns.
B. head injury.
C. shock.
D. acclimatization to cold.

6. Shivering stops and muscle activity ceases once the body core temperature reaches:

A. 95°F (35°C).
B. 90°F (32.2°C).
C. 85°F (29.4°C).
D. 80°F (26.7°C).

7. Rough handling of a patient with severe hypothermia may cause which of the following dysrhythmias?

A. Ventricular fibrillation
B. Sinus bradycardia
C. Asystole
D. Sinus tachycardia

8. Appropriate treatment of this patient includes all of the following EXCEPT:

A. removing wet clothing.
B. wrapping the patient in warm blankets.
C. placing the patient in a heated ambulance.
D. placing heat packs on the patient's extremities.

9. Discuss the controversy regarding performing CPR in a patient with severe hypothermia.

10. Why are children and infants at a greater risk of hypothermia developing than adults?

SECTION
8

Special Patient Populations

CHAPTER 33

Obstetrics and Neonatal Care

National EMS Education Standard Competencies

Special Patient Populations

Applies a fundamental knowledge of growth, development, and aging and assessment findings to provide basic emergency care and transportation for a patient with special needs.

Obstetrics

› Recognition and management of:
- Normal delivery (pp 1191–1201)
- Vaginal bleeding in the pregnant patient (pp 1187–1189, 1191, 1193)

› Anatomy and physiology of normal pregnancy (pp 1183–1186)

› Pathophysiology of complications of pregnancy (pp 1186–1189)

› Assessment of the pregnant patient (pp 1191–1193)

› Management of
- Normal delivery (pp 1194–1201)
- Abnormal delivery (pp 1206–1209)
  - Nuchal cord (p 1200)
  - Prolapsed cord (pp 1207–1208)
  - Breech delivery (pp 1206–1207)
- Third trimester bleeding (pp 1187–1189)
  - Placenta previa (pp 1187–1188)
  - Abruptio placenta (pp 1187–1189)
- Spontaneous abortion/miscarriage (pp 1187–1188)
- Ectopic pregnancy (pp 1187–1188)
- Preeclampsia/Eclampsia (pp 1187–1188)

Neonatal care

Assessment and management

› Newborn care (pp 1201–1206)
› Neonatal resuscitation (pp 1202–1206)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Special Considerations in Trauma

› Recognition and management of trauma in the:
  • Pregnant patient (pp 1189–1190)
  • Pediatric patient (Chapter 34, *Pediatric Emergencies*)
  • Geriatric patient (Chapter 35, *Geriatric Emergencies*)
› Pathophysiology, assessment, and management of trauma in the:
  • Pregnant patient (pp 1189–1190)
  • Pediatric patient (Chapter 34, *Pediatric Emergencies*)
  • Geriatric patient (Chapter 35, *Geriatric Emergencies*)
  • Cognitively impaired patient (Chapter 36, Patients With Special Challenges)

Knowledge Objectives

1. Identify the anatomy and physiology of the female reproductive system. (pp 1183–1185)
2. Explain the normal changes that occur in the body during pregnancy. (pp 1185–1186)
3. Recognize complications of pregnancy including abuse, substance abuse, hypertensive disorders, bleeding, spontaneous abortion (miscarriage), and gestational diabetes. (pp 1186–1189)
4. Discuss the need to consider two patients—the woman and the unborn fetus—when treating a pregnant trauma patient. (pp 1189–1190)
5. Discuss special considerations involving pregnancy in different cultures and with teenage patients. (pp 1190–1191)
6. Explain assessment of the pregnant patient. (pp 1191–1193)
7. Explain the significance of meconium in the amniotic fluid. (p 1192)
8. Differentiate among the three stages of labor. (pp 1193–1194)
9. Describe the indications of an imminent delivery. (p 1195)
10. Explain the steps involved in normal delivery management. (pp 1194–1201)
11. List the contents of an obstetrics kit. (p 1195)
12. Explain the necessary care of the fetus as the head appears. (p 1200)
13. Describe the procedure followed to clamp and cut the umbilical cord. (pp 1199–1201)
14. Describe delivery of the placenta. (pp 1201–1202)
15. Explain the steps to take in neonatal assessment and resuscitation. (pp 1202–1206)
16. Recognize complicated delivery emergencies including breech presentations, limb presentations, umbilical cord prolapse, spina bifida, multiple gestation, premature newborns, postterm pregnancy, fetal demise, and delivery without sterile supplies. (pp 1206–1209)
17. Describe postpartum complications and how to treat them. (pp 1209–1210)

Skills Objectives

1. Demonstrate the procedure to assist in a normal cephalic delivery. (pp 1197–1200, Skill Drill 33-1)
2. Demonstrate care procedures of the fetus as the head appears. (p 1200)
3. Demonstrate how to clamp and cut the umbilical cord. (pp 1199–1201)
4. Demonstrate the steps to follow in postdelivery care of the newborn. (pp 1201–1202)
5. Demonstrate how to assist in delivery of the placenta. (pp 1201–1202)
6. Demonstrate the postdelivery care of the woman. (pp 1201–1202)
7. Demonstrate procedures to follow for complicated delivery emergencies including vaginal bleeding, breech presentation,

limb presentation, and prolapsed umbilical cord. (pp 1206–1208)

Introduction

According to the Centers for Disease Control and Prevention (CDC), although there has been a recent trend of women choosing to give birth at home, most deliveries in the United States still occur in a hospital, with doctors and nurses in attendance. Occasionally, the birth process moves faster than the pregnant woman expects, or she is unable to get to a hospital, and you will find yourself needing to make a decision: Should you assist the delivery on the scene or transport the patient to the hospital? Are there other factors that affect this decision, such as trauma, weather, and distance to the hospital? This chapter explains how to make this decision and how to proceed if on-scene delivery is necessary. It describes the anatomy and physiology of a normal pregnancy and the normal process of childbirth. Also discussed are common complications, including trauma in a pregnant patient, so that you will be prepared to handle normal and abnormal deliveries. Finally, the chapter discusses the evaluation and care of the newborn and neonatal resuscitation.

Anatomy and Physiology of the Female Reproductive System

The female reproductive system includes the ovaries, fallopian tubes, uterus, cervix, vagina, and breasts. The ovaries are two glands, one on each side of the uterus, that are similar in function to the male testes. Each ovary contains thousands of follicles, and each follicle contains an egg (the female contribution to conception). Females are born with all the eggs they will release in their lifetime.

Once puberty is reached, the monthly process of the menstrual cycle begins. During each menstrual cycle, only one follicle (out of 10 to 20 that attempt the process each month) will be successful at maturing and releasing an egg. The remaining follicles die and are reabsorbed by the body. The processes that the follicle goes through and the actual release of the egg (ovulation) are stimulated by the release of specific hormones in the female body. Ovulation occurs approximately 2 weeks prior to menstruation. Immediately following ovulation, the **endometrium** (the lining of the inside of the uterus) begins to thicken in preparation for the potential implantation of a fertilized egg. If the egg is not fertilized within 36 to 48 hours after it has been released from the follicle, it will simply die, and the thickened endometrium will be shed because it is not needed. This shedding is the menstrual flow that occurs around the 28th day of a woman's cycle.

The fallopian tubes extend out laterally from the uterus, with one tube associated with each ovary. When an egg is released from the ovary, it travels through the fallopian tube to the uterus. Fertilization, which occurs when a sperm meets an egg, usually takes place when the egg is inside the fallopian tube. The fertilized egg then continues to the uterus where, if implantation occurs, the fertilized egg develops into an **embryo** (the stage from 0 to 10 weeks after fertilization) and then a **fetus** (the stage from 10 weeks until delivery) and grows until the time of delivery at approximately 9 months (40 weeks) of gestation **Figure 33-1**. The uterus is a muscular organ that encloses and protects the developing fetus. During labor, it produces contractions and ultimately helps to push the fetus through the **birth canal**. The birth canal is made up of the vagina and the lower third, or neck, of the uterus, called the **cervix**. During pregnancy, the cervix contains a mucous plug that seals the uterine opening, preventing contamination from the outside. When the cervix begins to dilate, this plug is discharged into the vagina as pink-tinged mucus, sometimes called **bloody show**. This small amount of bloody discharge often signals the beginning of labor.

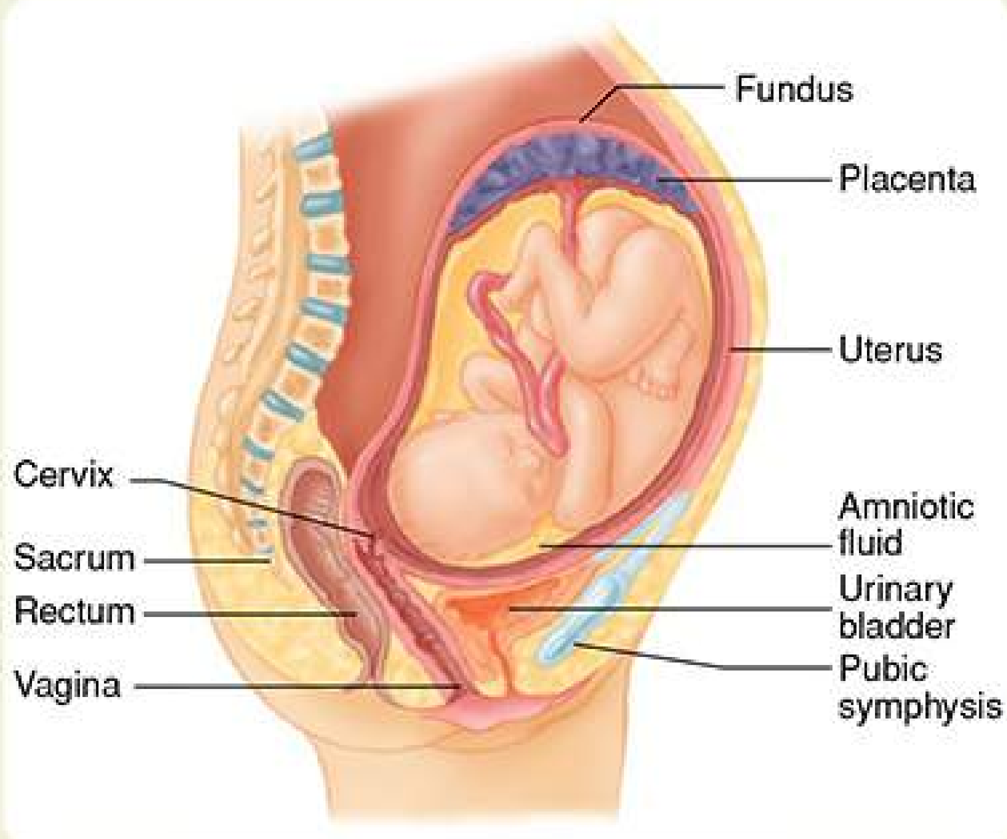


Figure 33-1 Anatomic structures of the pregnant woman.

The vagina is the outermost cavity of the female reproductive system and forms the lower part of the birth canal. It is about 3 to 5 inches (8 to 12 cm) in length, beginning at the cervix and ending as an external opening of the body. The vagina completes the passageway from the uterus to the outside world for the newborn. The area between the vagina and the anus is called the **perineum**.

The breasts (mammary glands) are also a part of the female reproductive system. In a pregnant woman, the breasts produce milk that is carried through small ducts to the nipples to provide nourishment for the newborn. Early signs of pregnancy include increased size and tenderness in the breasts.

As the fetus continues to develop, it requires increasingly more nourishment and support. The **placenta**, a disk-shaped structure attached to the uterine wall that provides nourishment to the fetus, develops while attached to the inner lining of the wall of the uterus and is connected to the fetus by the umbilical cord. Blood normally does not mix between the fetus and the pregnant woman because of the placental barrier **Figure 33-2**. This consists of two layers of cells, keeping the circulation of the woman and fetus separated but allowing nutrients, oxygen, waste, carbon dioxide, and, unfortunately, many toxins and most medications to pass between the fetus and woman. Anything ingested by a pregnant woman therefore has the potential to affect the fetus. After delivery of the newborn, the placenta separates from the uterus and is delivered. The **umbilical cord** is the lifeline of the fetus, connecting the woman and fetus through the placenta. The umbilical cord contains two arteries and one vein. The umbilical vein carries oxygenated blood from the placenta to the heart of the fetus, and the umbilical arteries carry deoxygenated blood from the heart of the fetus to the placenta. Oxygen and other nutrients cross from the woman's circulation through the placenta and then through the umbilical cord to support the fetus as it grows.

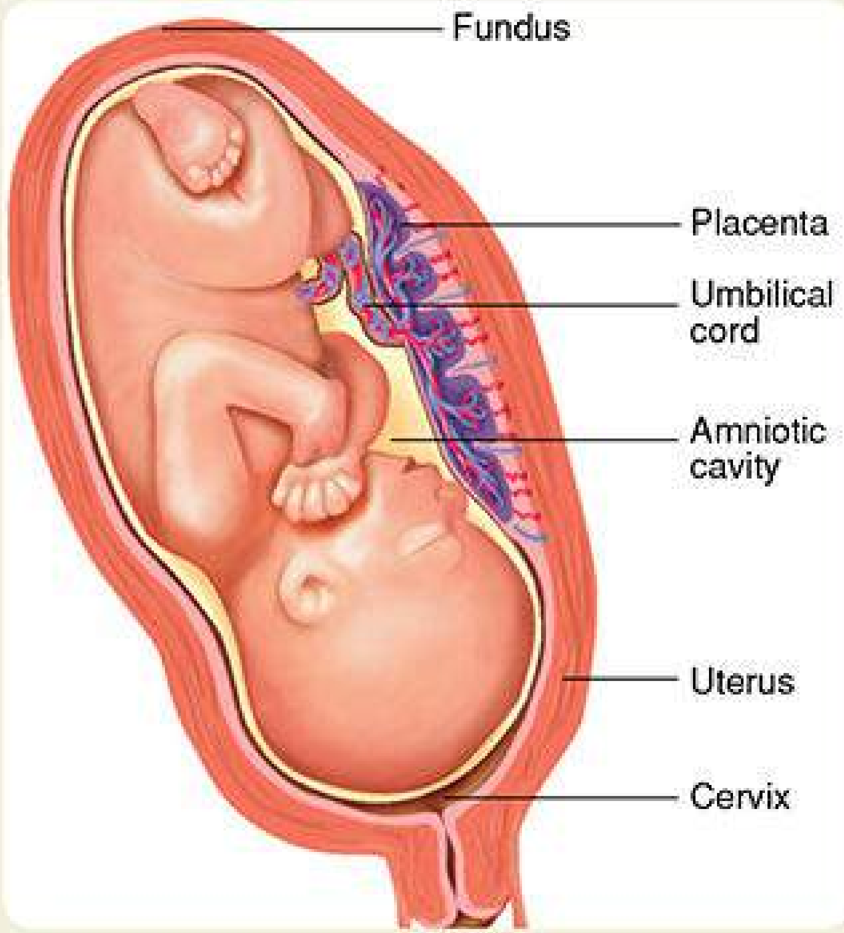


Figure 33-2 The placental barrier keeps the maternal and fetal blood separate but allows nutrients, oxygen, waste, carbon dioxide, toxins, and most medications to pass between the fetus and pregnant woman.

YOU are the Provider — PART 1

At 0625 hours, you are dispatched to a residence at 2505 Landa Park Boulevard for a woman in labor. You and your partner proceed to the scene, which is located a short distance away. While en route, dispatch advises you that the patient is 38 weeks pregnant and her contractions are 3 minutes apart.

1. What anatomic and physiologic changes occur during pregnancy? How will they affect your assessment of the patient?
2. How will you determine if delivery is imminent or if there is enough time to transport the pregnant patient?

Words of Wisdom

Predicting the due date is not an exact science and a due date is not a guarantee that a birth will occur on that day. Many factors influence when a baby is delivered, and neither the patient nor EMTs have much control over this. One point of confusion is that most medical models base the due date on the first day of the last menstrual cycle. That adds approximately 2 weeks to the actual pregnancy because conception occurs sometime after ovulation, which occurs approximately 2 weeks after the beginning of the last menstrual cycle. Most women have a general idea of the date their last menstrual cycle began, but young women, women who have very irregular cycles, and women who did not think they were pregnant are especially likely to have inaccurate due dates. Also, some women calculate their due date by counting the number of weeks from conception instead of menstruation. The important thing to remember is that a due date is not a good predictor of when a woman will deliver.

The fetus develops inside a fluid-filled, bag-like membrane called the **amniotic sac**, or bag of waters. The sac contains about 500 to 1,000 mL of amniotic fluid, which helps insulate and protect the fetus. When the sac ruptures, usually at the beginning of labor, the amniotic fluid is released in a gush. It is typical for the patient to tell you that her “water broke.” Some women may experience a small leak rather than a gush of fluid. This fluid helps to lubricate the birth canal and remove any bacteria.

A pregnancy is considered full term once it reaches 39 weeks but has not gone beyond 40 weeks, 6 days. A pregnancy that has reached full term is referred to as **term gestation**.

Normal Changes in Pregnancy

In addition to changes in the reproductive system, many other body systems undergo normal changes during pregnancy. It is important to understand these changes as you assess and treat a pregnant patient. The primary systems involved are the respiratory, cardiovascular, and musculoskeletal systems.

In the reproductive system, hormone levels increase to support fetal development and prepare the body for childbirth. These increased hormone levels also put the pregnant woman at an increased risk for complications from trauma, bleeding, and some medical conditions. As the fetus develops, the uterus grows, stretching to accommodate a full-term fetus. As the size of the uterus increases, so does the amount of fluid it contains. These factors eventually result in displacement of the uterus out of its well-protected position within the pelvic area and may expose it to injury. By the 20th week of pregnancy, the top of the uterus is at or above the belly button. This increases the chance of direct fetal injury in trauma.

Rapid uterine growth occurs during the second trimester of pregnancy. The increased size of the uterus directly affects the respiratory system. As the uterus grows, it pushes up on the diaphragm, displacing it from its normal position. As the pregnancy continues, respiratory capacity changes, with increased respiratory rates and decreased minute volumes. This is a normal change. You may observe that a pregnant patient has an increased breathing rate and a decreased ability to breathe deeply. These changes result in a less-than-normal respiratory reserve. The pregnancy also increases the patient’s overall demand for oxygen as her metabolic demands and workload increase to support the developing fetus.

Changes also occur in the cardiovascular system. Overall blood volume gradually increases throughout the pregnancy to allow for adequate perfusion of the uterus as the fetus grows and to prepare for the blood loss that will occur during childbirth. Blood volume may increase by as much as 50% by the end of the pregnancy. The number of red blood cells also increases, which increases the woman’s need for iron. Pregnant women often take prenatal vitamin supplements containing iron to avoid becoming **anemic**, a condition in which a person has too few red blood cells, resulting in a decreased ability to transport oxygen throughout the body. Blood clotting factors also change as the woman’s body prepares for childbirth. The speed of clotting increases to protect against excessive bleeding during delivery. By the end of the pregnancy (third trimester), the pregnant patient’s heart rate increases up to 20% (about 20 more beats per minute) to accommodate the increase in blood volume. Cardiac output is significantly increased by the end of the pregnancy.

A woman in the third trimester of pregnancy has an increased risk of vomiting and potential aspiration following trauma because of changes in the gastrointestinal tract. The filling and emptying of the stomach into the small intestine is under the control of key hormones and the nervous system. Changes in these systems and the displacement of the stomach upward because of the increased size of the uterus significantly increase the chance that a pregnant trauma patient will vomit and aspirate. You should be prepared to quickly manage the patient’s airway if needed.

Changes in the cardiovascular system and the increased demands of supporting the fetus significantly increase the workload of the heart. A healthy woman’s body can handle the increased workload and demand. Not all pregnant women are healthy when they begin their pregnancy, however. Cardiac compromise is a life-threatening possibility.

Weight gain during pregnancy is normal; however, the increase in body weight eventually challenges the heart and impacts the musculoskeletal system. Increased hormones affect the musculoskeletal system by making the joints “looser,” or less stable. Women in the third trimester of pregnancy also experience a change in the body’s center of gravity, making them prone to slipping and falling.

Complications of Pregnancy

Although most pregnant women are healthy, some may be ill when they conceive or become ill during pregnancy. You may safely administer oxygen to treat any heart or lung disease in a pregnant patient without harm to the fetus.

Diabetes

Diabetes develops during pregnancy in many women who have not had diabetes previously. This condition, called **gestational diabetes**, resolves in most women after delivery. Treatment of a pregnant woman with diabetes is the same as treatment for any patient who has diabetes. A pregnant woman may control her blood glucose level with diet and exercise or may take medication. In some cases, the woman will have to manage her condition with insulin injections. A pregnant woman experiencing hyperglycemia or hypoglycemia should be cared for in the same manner as any patient with diabetes. If a pregnant woman has an altered level of consciousness, your assessment should include determining if she has a history of diabetes, and you should check the blood glucose level if local protocols permit.

YOU are the Provider — PART 2

When you arrive at the scene, you are greeted at the door by the patient's husband. He is obviously anxious and tells you, "She's having the baby! I thought I could get her to the hospital in time, but I was wrong." You find the patient, a 28-year-old woman, lying supine in her bed. You introduce yourself and your partner and perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Diaphoretic; in obvious pain
Level of consciousness	Conscious and alert
Airway	Open; clear of secretions and foreign bodies
Breathing	Increased rate; adequate depth
Circulation	Pulse rate is increased; strong and regular; no gross bleeding

The patient tells you that she feels like she needs to move her bowels and that her contractions are now about 2 minutes apart and last about 45 seconds. A brief visual examination of her perineum does not reveal crowning. According to the patient's husband, this is her third delivery, and she has had gestational diabetes and preeclampsia with this pregnancy. Her amniotic sac ruptured about 5 hours ago.

3. What are gestational diabetes and preeclampsia? How can they affect this delivery?
4. Is there time to transport this patient, or should you prepare for imminent delivery?

Many women experience nausea before labor and may not have eaten recently. These factors can lead to hypoglycemia and weakness in the woman and fetus. Consult with medical control if delivery is imminent.

Hypertensive Disorders

As delivery nears, complications can occur. One complication of pregnancy that occasionally occurs, typically in patients who are pregnant for the first time, is **preeclampsia**, or **pregnancy-induced hypertension**. This condition can develop after the 20th week of gestation and is characterized by the following signs and symptoms:

- Severe hypertension
- Severe or persistent headache
- Visual abnormalities such as seeing spots, blurred vision, or sensitivity to light
- Swelling in the hands and feet (edema)
- Anxiety

A related condition, **eclampsia**, is characterized by seizures that occur as a result of hypertension. To treat a patient having seizures caused by eclampsia, lay the patient on her left side, maintain her airway, and administer supplemental oxygen, if necessary. If vomiting occurs, suction the airway. Provide rapid transport for a pregnant patient having seizures, and call for an advanced life support (ALS) intercept, if available.

Transporting the patient on her left side can also prevent **supine hypotensive syndrome**. This condition is caused by compression of the inferior vena cava by the pregnant uterus when the patient lies supine, reducing the amount of blood that is returned to the heart. Hypotension (low blood pressure) may result from this compression. Any patient in the third trimester of pregnancy should always be positioned on her left side during transport except during delivery.

Bleeding

An **ectopic pregnancy** is when an embryo develops outside of the uterus, most often in a fallopian tube. A patient with an ectopic pregnancy may present with signs of internal bleeding when the fallopian tube ruptures **Figure 33-3**. An ectopic pregnancy occurs about once in every 300 pregnancies. The leading cause of maternal death in the first trimester of pregnancy is internal hemorrhage into the abdomen following rupture of an ectopic pregnancy. For this reason, consider the possibility of an ectopic pregnancy in a woman who has missed a menstrual cycle and reports sudden, severe, usually unilateral pain in the lower abdomen. A history of pelvic inflammatory disease, tubal ligation, or previous ectopic pregnancies should heighten your suspicion of a possible ectopic pregnancy.

Hemorrhage from the vagina that occurs before labor begins may be very serious. If you see this, call for ALS backup. In early pregnancy, it may be a sign of a spontaneous abortion, or **miscarriage**. In the later stages of pregnancy, vaginal hemorrhage may indicate a serious condition involving the placenta. In **abruptio placenta**, the placenta separates prematurely from the wall of the uterus **Figure 33-4**. The most common causes are hypertension and trauma. A patient with abruptio placenta often reports severe pain; however, vaginal bleeding may not be heavy. She may also present with signs of shock such as weak, rapid pulse and pale, cool, diaphoretic skin. In **placenta previa**, the placenta develops over and covers the cervix **Figure 33-5**. When early labor begins and the cervix begins to dilate, the pregnant woman may experience heavy vaginal bleeding, often without significant pain. Both abruptio placenta and placenta previa are life-threatening conditions and require immediate rapid transport.

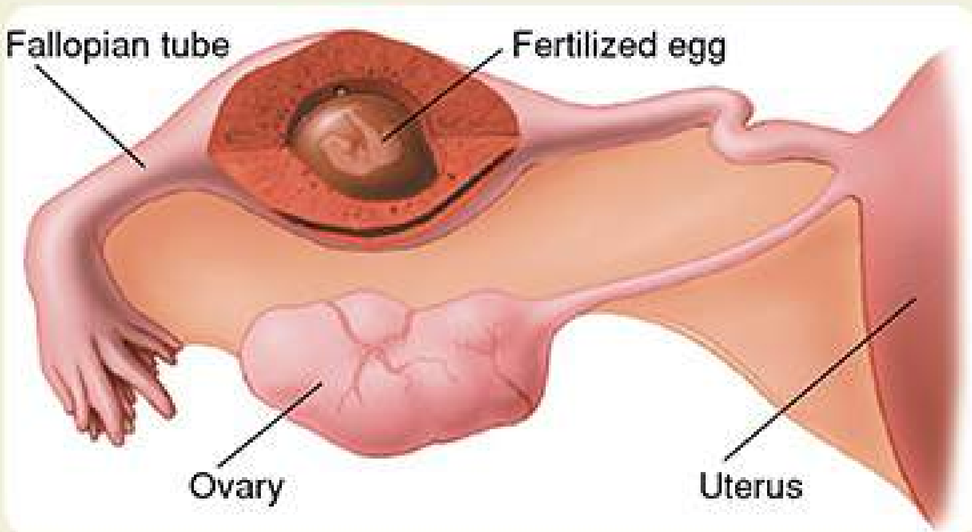


Figure 33-3 In an ectopic pregnancy, a fertilized egg implants somewhere other than in the uterus. Here, it is implanted in one of the fallopian tubes.

Figure 33-4 In abruptio placenta, the placenta separates prematurely from the wall of the uterus.

Regardless of the cause of the bleeding, the pregnant patient may be emotional and very concerned about her baby. Your professional approach in communicating with the patient will play a crucial part in calming her emotions and gaining control of the situation. Decreasing the patient's anxiety can impact how she and the fetus respond during this emergency.

Any bleeding from the vagina in a pregnant woman is a serious sign and should be treated promptly in the hospital. If the patient shows signs of shock, position her on her left side and administer high-flow oxygen per local protocols. Place a sterile pad or sanitary pad over the vagina, and replace it as often as necessary. Save the pads so that hospital personnel can estimate how much blood loss the patient experienced. Also save any tissue that may be passed from the vagina. Do not put anything into the vagina to control bleeding.

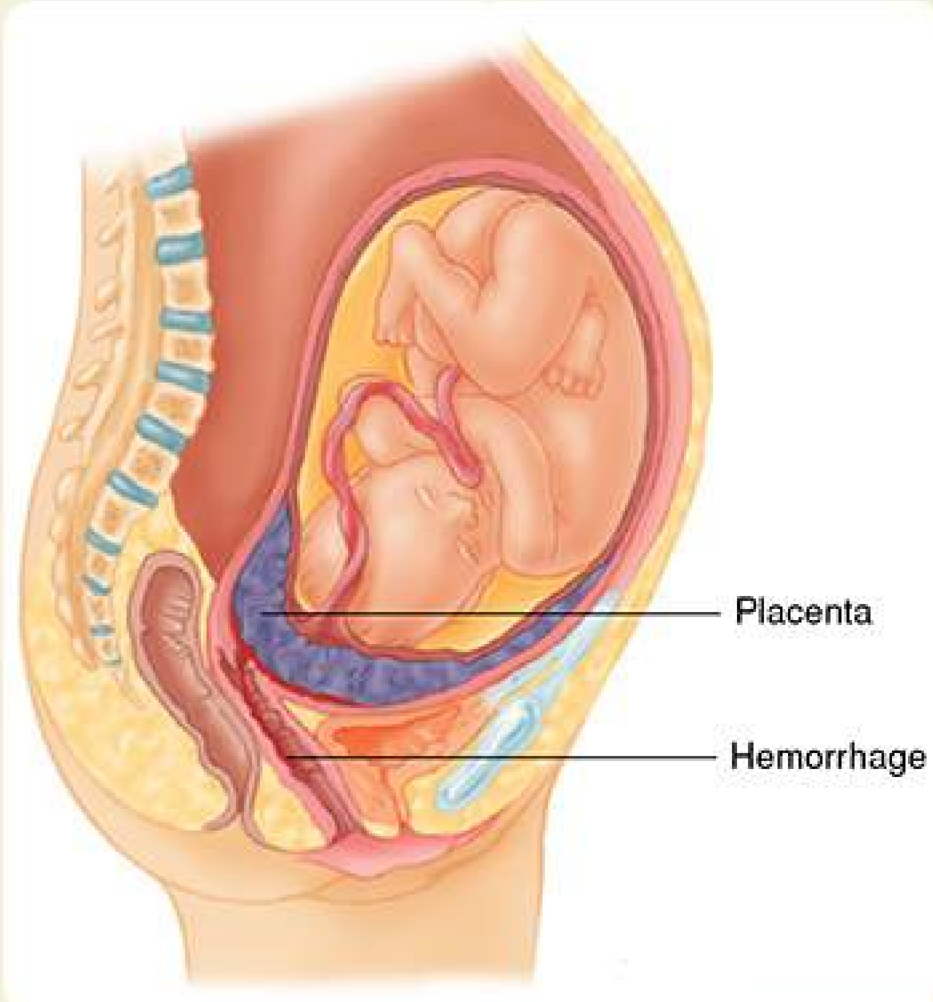


Figure 33-5 In placenta previa, the placenta develops over and covers the cervix.

Abortion

Passage of the fetus and placenta before 20 weeks is called abortion. Abortions may be spontaneous (commonly called miscarriage), often without any obvious known cause, or induced. Deliberate abortions may be self-induced, by the pregnant woman herself or by someone else, or planned and performed in a hospital or clinic. Regardless of the reason or the cause of the abortion, complications are possible.

The most serious complications of abortion are bleeding and infection. Bleeding can result when portions of the fetus or placenta are left in the uterus (incomplete abortion) or when the wall of the uterus is injured (perforation of the uterus and possibly the adjacent bowel or bladder). Infection can result from perforation and from the use of nonsterile instruments. If the patient is in shock, treat and transport her promptly to the hospital. Collect and bring to the hospital any tissue that passes through the vagina. Never try to pull tissue out of the vagina. Place a sterile pad or sanitary pad on the vagina. In rare cases, massive bleeding may occur and cause severe hypovolemic or hemorrhagic shock. In these cases, treat for shock and provide immediate transport.

Abuse

Pregnant women have an increased chance of being victims of domestic violence and abuse. Abuse is a common cause of complications in pregnancy and may harm the woman or the fetus. Abuse during pregnancy increases the chance of spontaneous abortion, premature delivery, and low birth weight. The woman is at risk of bleeding, infection, and uterine rupture. A calm, professional approach is especially important if you suspect your patient has been abused. Pay attention to the environment for any signs of abuse. Your attention to detail will be helpful in your documentation and in informing the physicians and staff who will be caring for the patient at the hospital.

Pregnant patients who are abused are often afraid to explain how their injuries occurred. If possible, talk to the patient in a private area, away from the potential abuser. Suspect abuse when the story of how an injury happened does not make sense. An abused patient who is pregnant will be concerned about her baby. The best way for you to care for the fetus is to treat the pregnant woman. Reassure the patient as you provide treatment. Support the patient's ABCs, control any bleeding, stabilize extremity injuries, treat for shock, and keep her warm.

Words of Wisdom

By 20 weeks of gestation, the top of the uterus has grown to the level of the patient's belly button. That position makes the fetus more prone to injury. This is important to remember when managing a pregnant patient who has sustained trauma and to aid in your assessment of a pregnant patient's abdomen.

Substance Abuse

Some pregnant women are addicted to alcohol or other drugs. These women often have had little or no prenatal care. The effects of the addiction on the fetus can include prematurity, low birth weight, and severe respiratory depression. Some of these infants will die. **Fetal alcohol syndrome** is a condition seen in infants born to women who have abused alcohol.

If you are called to handle a delivery of an addicted woman, pay special attention to your own safety. Follow standard precautions. Wear eye protection, a face mask, and gloves at all times. Clues that you may be dealing with an addicted patient include the presence of drug paraphernalia, empty wine or liquor bottles, and statements made by family or bystanders or by the patient herself. The newborn of an addicted woman will probably need immediate resuscitation. Assist with the delivery, and be prepared to support the newborn's respirations and administer oxygen during transport. Do not judge or lecture the patient. Your job is to help with the delivery, provide treatment to the mother and the newborn, and transport both to the hospital.

Special Considerations for Trauma and Pregnancy

When you are dispatched to a trauma call that involves a pregnant woman, you have two patients to consider—the woman and the unborn fetus. Trauma to a pregnant woman may have a direct effect on the condition of the fetus. Pregnant women may be victims of many types of trauma, including assaults, motor vehicle crashes, and shootings.

Pregnant women also have an increased risk of falling compared with nonpregnant women. Contributing factors include hormonal changes that loosen the joints and the increased weight of the uterus and displacement of abdominal organs, which can affect the woman's balance. Pregnant women have an increased overall total blood volume and an approximate 20% increase in their heart rate by the third trimester of pregnancy. Therefore, a pregnant trauma patient may experience a significant amount of blood loss before you detect signs of shock. The fetus also may be in trouble well before signs of shock are present in the pregnant woman. The body of a woman who has sustained serious trauma often reduces the blood supply to the fetus so that the woman receives an adequate amount of blood.

When called to a trauma patient who is pregnant, be alert to additional concerns and be ready to assess and manage unique types of injuries. For example, as a pregnancy progresses, the uterus enlarges substantially, making it especially vulnerable to penetrating trauma and blunt injuries. The fetus may be injured directly from penetrating types of trauma such as gunshot wounds and stabbings. A traumatic injury to the abdomen can be life threatening to the woman and fetus because the pregnant uterus has a rich blood supply. If the woman is hypoxic, is in shock, or has hypovolemia, the fetus will be in distress. In most cases, the only chance to save the fetus is to adequately resuscitate the woman.

When a pregnant woman is involved in a motor vehicle crash or a similarly violent mechanism of injury (MOI), severe hemorrhage may result from injuries to the pregnant uterus. Trauma is one of the leading causes of abruptio placenta, which results in significant intrauterine hemorrhage that can cause life-threatening hypovolemic shock in the woman and also increases the chance of fetal death. In a pregnant trauma patient, suspect abruptio placenta when the MOI is blunt trauma to the abdomen and the patient's signs and symptoms suggest shock. Common symptoms include vaginal bleeding and severe abdominal pain. In this situation, quickly assess and transport the patient, support the airway, administer high-flow oxygen, place sanitary pads on the vagina, position the patient on her left side, and call for ALS backup.

Improper positioning of the seat belt can result in injury to a pregnant woman and the fetus if they are involved in a motor vehicle crash. The lap belt should be placed under the abdomen and over the pelvic bones (iliac crests), and the shoulder belt should be positioned between the breasts. Carefully assess a pregnant woman's abdomen and chest for seat belt marks, bruising, and obvious trauma. Maintain a high index of suspicion for internal abdominal bleeding in the woman and possible direct injury to the fetus, regardless of seat belt placement.

Maternal Cardiac Arrest

Occasionally a pregnant woman will go into cardiac arrest, often as the result of trauma. If the woman dies, the fetus will most certainly die as well, so resuscitation efforts need to be aggressively geared toward saving the woman. Perform cardiopulmonary resuscitation (CPR) and provide transport to the hospital according to local protocol.

Treatment of cardiac arrest in a pregnant patient is no different than in the nonpregnant patient, with a few minor exceptions. If a woman is in the last month or two of pregnancy, compressions may need to be applied a little higher on the sternum than usual. In addition, if possible, one provider should be assigned to manually displace the uterus toward the patient's left side to facilitate blood return to the right side of the heart. See Chapter 13, *BLS Resuscitation*, for how to perform this procedure.

Notify the receiving facility personnel as soon as possible that you are en route with a pregnant trauma patient in cardiac arrest so they will have time to prepare. It is possible that upon arrival at the hospital, if the woman cannot be saved, a cesarean section may be performed to save the fetus. Performing a cesarean section is not within the scope of practice for EMS providers.

Assessment and Management

Although you have two patients to care for when your patient is pregnant, your focus should be on the assessment and management of the woman. It is difficult to assess the extent of internal blood loss in a pregnant patient. The MOI should be the basis of suspicion of shock because the physiologic changes that occur with pregnancy can obscure the typical signs and symptoms of shock. As you assess and treat the patient, be prepared for vomiting, and anticipate the need to manage the airway to protect the patient from aspirating. Attempt to determine the gestational age (in number of weeks). This will help you determine the size of the fetus and the position of the uterus in the patient's abdominal cavity. It is nearly impossible for you to accurately assess or determine the status of the fetus, so you should aggressively provide emergency medical care to the woman to provide the best possible outcome for the fetus.

Follow these guidelines when treating a pregnant trauma patient:

1. **Maintain an open airway.** A pregnant patient has an increased risk of vomiting and aspiration. Be prepared for and anticipate vomiting; keep your suction unit readily available.
2. **Administer high-flow oxygen.** Remember that the patient's body is also supplying oxygen to the fetus. Keep the oxygen saturation level high and administer high-flow, 100% oxygen by nonrebreathing mask.
3. **Ensure adequate ventilation.** Listen to breath sounds, and confirm that bilateral breath sounds are present. If the patient's ventilations are inadequate, provide or assist ventilation with a bag-valve mask (BVM) and 100% oxygen.
4. **Assess circulation.** Control any external bleeding with direct pressure. Maintain a high index of suspicion for internal bleeding and shock based on the MOI. Keep the patient warm.
5. **Transport considerations.** Transport the patient on her left side. If the patient is on a backboard because spinal injury is suspected, tilt the backboard 30 degrees to the left. Call early for ALS assistance or a medical helicopter for significant MOIs or major traumatic injuries. Transport the patient to a trauma center if one is available in your area; give early notification that you have a pregnant trauma patient in transport.

Cultural Value Considerations

Cultural sensitivity is important when you are assessing and treating a pregnant patient from a culture different from yours. Women of some cultures may have a value system that will affect the choice of how they care for themselves during pregnancy and how they have planned the childbirth process. Some cultures may not permit a male health care provider, especially in the prehospital setting, to assess or examine a female patient. Some cultures may view pregnancy differently than you do in terms of social, psychologic, and emotional issues. Some may see pregnancy as a means of achieving status and recognition within the family unit, whereas others may experience a drop in self-esteem. Respect these differences and honor requests from the patients. Always remember that your responsibility is to the patient and is limited to providing care and transport, and keep in mind that a competent, rational adult has the right to refuse all or any part of your assessment or care.

Teenage Pregnancy

The United States has one of the highest teenage pregnancy rates among developed countries. It is likely that at some point you will respond to a pregnant teenager who may or may not be in labor. A pregnant teenager may not know that she is pregnant, or she may be in denial about her pregnancy. As you begin to assess any female teenager, you should remember that pregnancy is a possibility. The pregnancy itself may not be related to the nature of the call, but consider the possibility when assessing the patient, talking to the patient, obtaining a history, and providing treatment. Respect the teenager's privacy and need for independence. If possible, perform your assessment and obtain the history away from the teenager's parents. Be aware that in most states, once a teenager becomes pregnant, she is considered emancipated, or having the rights of an adult, at least as it relates to giving or refusing consent for medical treatment. Become familiar with the laws in your state so that you will know when pregnant teenagers can give or refuse consent for themselves.

Patient Assessment

Childbirth is seldom an unexpected event, but there are occasions when it becomes an emergency. Dispatch protocols usually include the dispatcher asking simple questions to determine whether birth is imminent. Some of this information may be passed on to you to help you prepare for the situation. Trauma or medical conditions may cause premature contractions, or your patient may be full term and experiencing contractions because it is time to deliver.

Scene Size-up

Take standard precautions—gloves and eye and face protection are a minimum if delivery has already begun or is complete. If the call is going to result in a field delivery and if time allows, a gown should also be used. Do not be lax in your safety observations and precautions because a delivery is in progress or the family is anxious. Rushing may endanger not only you but also the fetus and pregnant woman. Remain calm and professional. Consider calling for additional or specialized resources.

Not every call to a pregnant patient will be because she is in labor, of course, so it is important to determine the MOI or nature of illness in a pregnant patient. Do not develop tunnel vision during a call, assuming that because the patient is pregnant, that is the reason for the call! Because a pregnant woman's balance may be altered, trauma from falls and the necessity of spinal immobilization must be considered.

Primary Assessment

Form a general impression as to whether the patient is in active labor and, if so, whether you have time to assess for imminent delivery and address other possible life threats. Perform a rapid examination of the patient to assess for airway, breathing, or circulation problems. The chief complaint may be, "The baby is coming!" Take a moment to confirm whether the fetus will be delivered in the next few minutes or whether you have time to continue to evaluate the situation. When trauma or medical problems such as vaginal bleeding or seizures are the presenting complaint, evaluate these first and then assess the impact of these problems on the fetus.

During an uncomplicated birth, life-threatening conditions involving the woman's airway and breathing are not usually an issue. However, a motor vehicle crash, an assault, or any number of medical conditions in a pregnant woman may cause a life threat to exist and may result in a complicated delivery. In these situations, assess the airway and breathing to ensure they are adequate. If needed, provide airway management and administer high-flow oxygen.

External and internal bleeding are potential life threats to the patient and should be assessed early. Blood loss after delivery is expected, but significant bleeding is not. Recall that normal changes in pregnancy result in increased overall blood volume, increased heart rate, and changes in blood clotting. These changes can have a significant impact on a pregnant patient who is bleeding, regardless of the cause. Quickly assess for any potential life-threatening bleeding, and begin treatment immediately. Assess the skin for color, temperature, and moisture, and check the pulse to determine if it is too fast or too slow. If there are signs of shock, control the bleeding, administer oxygen, and keep the patient warm.

If delivery is imminent, you must prepare to deliver at the scene. The ideal place to deliver is in the security of your ambulance or the privacy of the woman's home. The area should be warm and private, with plenty of room to move around.

If the delivery is not imminent, prepare the patient for transport and perform the remainder of the assessment en route to the emergency department. Administer oxygen. Women in the second and third trimesters of pregnancy should be transported lying on the left side when possible to prevent supine hypotensive syndrome. If spinal immobilization is indicated, secure the woman to the backboard and elevate the right side of the board with rolled towels or blankets **Figure 33-6**. Provide rapid transport for pregnant patients who have significant bleeding and pain, are hypertensive, are having a seizure, or have an altered mental status.

Figure 33-6 Place a blanket under the right side of the backboard to prevent supine hypotensive syndrome in pregnant patients.

History Taking

Regardless of whether the patient is in active labor, is having an obstetric emergency, or is a pregnant patient with another complaint (eg, trauma), obtain a thorough history that includes her expected due date, any complications she is aware of, if she has been receiving prenatal care, and a complete medical history. Obtain a SAMPLE history. Some pregnant women will have a history of medical problems for which they take prescription medications. Some women with no history of medical problems require medications during pregnancy. Pertinent history should include questions related specifically to prenatal care. Identify any complications the patient may have had during the pregnancy or potential complications during delivery that her physician has identified. These complications may include the size or position of the fetus or the position and health of the placenta. Determine the due date, fetal movement, frequency of contractions, and history of previous pregnancies and deliveries and their complications, if any. Determine whether there is a possibility of multiples. Ask whether the woman has taken any drugs or medications during the pregnancy. If her water has broken, ask whether the fluid was green. Green fluid is due to **meconium** (fetal stool). The presence of meconium can indicate newborn distress, and it is possible for the fetus to aspirate meconium during delivery.

YOU are the Provider — PART 3

Shortly after your partner assesses the patient's vital signs and administers supplemental oxygen you observe the fetus's head crowning at the vaginal opening. As the head delivers, you can feel the umbilical cord wrapped around the fetus's neck.

Recording Time: 7 Minutes	
Respirations	24 breaths/min; adequate depth
Pulse	110 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	122/82 mm Hg
Oxygen saturation (Spo_2)	98% (on oxygen)

5. How should you manage the umbilical cord situation?
6. What would you do if the amniotic sac were still intact?

Secondary Assessment

Perform a complete assessment of the major body systems as needed, with emphasis on the patient's chief complaint. Assess for fetal movement by asking the patient whether she can feel the fetus moving. If the patient is in labor, the physical examination should focus on contractions and possible delivery. Assess the length and frequency of contractions by asking the patient and by placing your hand on the abdomen. Compare what you feel with the patient's experience during each contraction. If at any point you suspect that delivery is imminent, check for crowning. This assessment should be performed only when appropriate and according to local protocol. If you do not suspect an imminent delivery and the patient reports other problems unrelated to delivery, you should not visually inspect the vaginal area. Be sure to protect the woman's privacy during the physical examination.

The secondary assessment of a pregnant patient should include a complete set of vital signs and pulse oximetry. Vital signs should include pulse; respirations; skin color, temperature, and condition; and blood pressure. Be especially alert for tachycardia and hypotension (which could mean hemorrhage or compression of the vena cava) or hypertension (possibly indicating preeclampsia). A woman's blood pressure typically drops slightly during the first two trimesters of pregnancy but returns to normal during the third trimester. Compare your findings with previous blood pressure readings the patient may know of from prenatal visits. Hypertension, even when mild, may indicate more serious problems.

Reassessment

As time allows, repeat the primary assessment with a focus on the patient's ABCs and vaginal bleeding, particularly after delivery. Obtain another set of vital signs and compare the results with those obtained earlier. Frequent reassessment of vital signs may identify hypoperfusion from excessive blood loss as a result of delivery. Recheck interventions and treatments to see whether they were effective. For example, is the vaginal bleeding slowing with uterine massage? Uterine massage, discussed later in this chapter, can slow vaginal bleeding after delivery.

In most cases, childbirth is a natural process that does not require your assistance. When childbirth is complicated by trauma or other conditions, however, any interventions you provide for the patient will benefit the fetus. For example, if a pregnant patient has a pulse oximetry level of 94% or lower, the fetus will be hypoxic, too. Administering oxygen to the patient will improve the oxygen level of the fetus. Administer oxygen if the assessment findings indicate a need, even in the absence of pulse oximetry readings.

If your assessment determines that delivery is imminent, notify staff at the receiving hospital. Provide an update on the status of the woman and newborn after delivery. On the rare occasion that the delivery of the placenta does not occur within 30 minutes or you determine that a complication is occurring that cannot be treated in the field, notify the hospital staff of your findings and provide rapid transport. Be sure to notify staff at the receiving hospital of all relevant information so they have time to prepare. The information you provide may help the hospital staff determine whether the patient will be seen in the emergency department or the labor and delivery unit. For a pregnant patient with problems unrelated to childbirth (such as trauma or difficulty breathing), be sure to include the pregnancy status of your patient in your radio report. The hospital staff will want to know the number of weeks of gestation, her due date, and any known complications of the pregnancy.

Thorough documentation is essential, especially in the case of a newborn where delivery occurred in the field. In this situation, you will have two patient care reports to complete. Obstetrics is among the most litigated specialties in medicine; therefore, scrupulous documentation is essential.

Stages of Labor

The three stages of labor are (1) dilation of the cervix, (2) delivery of the fetus, and (3) delivery of the placenta. The first stage begins with the onset of contractions and ends when the cervix is fully dilated. Because the cervix has to be stretched thin by uterine contractions until the opening is large enough for the fetus to pass through into the vagina, the first stage of labor is usually the longest, lasting an average of 16 hours for a first delivery. You will usually have time to transport the woman if she is in the first stage of labor.

The onset of labor starts with contractions of the uterus. Other signs of the beginning of labor are the bloody show (blood-streaked mucus) and the rupture of the amniotic sac (water breaking). These events usually occur near the first contraction or early in the first stage of labor. Initially, the uterine contractions may not occur at regular intervals. The woman may think that she simply has a nagging backache. In true labor, the frequency and intensity of contractions increase with time. The uterine contractions become more regular and last about 30 to 60 seconds each. The length of labor varies greatly. As a general rule, labor is longer in a **primigravida**, a woman who is experiencing her first pregnancy, and shorter in a **multigravida**, a woman who has experienced previous pregnancies.

Table 33-1 False Labor Versus True Labor

False Labor (Braxton-Hicks Contractions)	True Labor
Contractions are not regular and do not increase in intensity or frequency. Contractions come and go.	Contractions, once started, consistently get stronger and closer together.
Pain and contractions start and stay in the lower abdomen.	Pain and contractions may start in the lower back and "wrap around" to the lower abdomen.
Physical activity or a change in position may alleviate the pain and contractions.	Physical activity may intensify the contractions. A change in position does not relieve contractions.
Bloody show, if present, is brownish.	The bloody show is pink or red and generally accompanied by mucus.
If leakage of fluid occurs, it is usually urine. It will be in small amounts and smell of ammonia.	The amniotic sac may have broken just before the contractions started or it may break during contractions. A moderate amount of fluid that may smell sweet will be present, and fluid will continue to leak.

Table 33-1 lists characteristics of true labor versus false labor, or Braxton-Hicks contractions. With false labor, you should provide transport for the patient. With true labor, you may need to prepare for a delivery, depending on the stage of labor, the patient's condition, and transport time.

Some women experience a premature rupture of the amniotic sac, before the fetus is ready to be born. When this occurs, the patient may or may not go into labor. Some patients may experience this premature rupture of the membranes as long as several months before they are due to deliver. In this situation, you will need to provide supportive care and transport to the hospital. These patients are usually placed on bed rest and followed up closely by an obstetrician.

Toward the end of the third trimester of pregnancy, the head of the fetus normally descends into the woman's pelvis as the fetus positions for delivery. This movement down into the pelvis is called **lightening**. Your patient may tell you that she has felt this. Some women describe this as a relief because once the fetus has moved from under their rib cage, breathing becomes easier. Lightening may also occur gradually and not be noticed by some patients.

The second stage of labor begins when the fetus enters the birth canal, and it ends with delivery of the newborn (spontaneous birth). During this stage, you will have to make a decision about whether to help the woman deliver at the scene or provide transport to the hospital. Because the fetus goes through positional changes as it moves through the birth canal during this stage, the uterine contractions are usually closer together and last longer. Pressure on the rectum may make the woman feel as if she needs to have a bowel movement. Under no circumstances should you let the woman sit on the toilet. She may also have the uncontrollable urge to push down. The perineum will begin to bulge significantly. When the top of the fetus's head begins to appear at the vaginal opening, this is called crowning.

The third stage of labor begins with the birth of the newborn and ends with the delivery of the placenta. During this stage, the placenta must separate completely from the uterine wall. Contractions continue, assisting the separation process and clamping down and closing the blood vessels that connected the placenta to the uterine lining. This may take up to 30 minutes.

Normal Delivery Management

Preparing for Delivery

Consider delivery at the scene when delivery is imminent (will occur within a few minutes) or when a natural disaster, inclement weather, or other environmental factor makes it impossible to reach the hospital. If the patient has delivered before, she may be able to tell you whether she is about to deliver. Otherwise, her answers to the following questions will help you determine whether delivery is imminent:

- How long have you been pregnant?
- When are you due?
- Is this your first pregnancy?
- Are you having contractions? How far apart are the contractions? How long do the contractions last?
- Have you had any spotting or bleeding?
- Has your water broken?
- Do you feel as though you need to have a bowel movement?
- Do you feel the need to push?

Ask these questions to help determine any potential complications:

- Were any of your previous deliveries by cesarean section?
- Have you had any problems in this or any previous pregnancy?
- Do you use drugs, drink alcohol, or take any medications?
- Is there a chance you will have multiple deliveries (having more than one baby)?
- Does your physician expect any other complications?

If the patient says that she is about to deliver, says she has to move her bowels, or feels the need to push, immediately prepare for a delivery and consider calling for additional resources. The fetus's head is probably pressing on the rectum, and delivery is about to occur. Otherwise, does she have an extremely firm abdomen? Visually inspect the vagina to check for crowning. Crowning is an indication that the delivery is occurring. Do not touch the vaginal area until you have determined that delivery is imminent. In general, you should touch the vaginal area only during the delivery (under certain circumstances) and when your partner is present. Gently spread the pregnant woman's legs apart, explaining that you are doing so to decide whether the baby should be delivered immediately or whether she should be transported to the hospital for the delivery.

Once labor has begun, it cannot be slowed or stopped. Never attempt to hold the patient's legs together, because this will only complicate the delivery. Do not let her go to the bathroom. Instead, reassure her that the sensation of needing to move her bowels is normal and that it means she is about to deliver.

If your decision is to deliver at the scene, remember that you are only assisting the woman with the delivery. Your part is to help, guide, and support the baby as it is born. Use standard precautions at all times. Administer oxygen to the patient if indicated. Limit distractions for yourself and the patient. You want to appear calm and reassuring while protecting the woman's privacy. Most important, recognize when the situation is beyond your level of training. If there is any doubt, contact medical control for further guidance. Always recognize your own limitations. If you are unsure about what to do, transport the patient even if delivery might occur during transport.

Your emergency vehicle should always be equipped with a sterile emergency obstetric (OB) kit containing the following items Figure 33-7:

- Surgical scissors or a scalpel
- Umbilical cord clamps
- A small rubber bulb syringe
- Towels, drapes, or sheets
- 4-inch × 4-inch (10-cm × 10-cm) gauze sponges and/or 2-inch × 10-inch (5-cm × 25-cm) gauze sponges

- Sterile gloves
- Infant blanket
- Sanitary pads
- An infant-sized BVM
- Goggles
- A plastic bag

Once you have determined that delivery is imminent, and you have positioned the patient in an acceptable location, open the OB kit and continue to prepare for the delivery.

Figure 33-7 Your unit should contain a sterile obstetric kit.

Patient Position

The patient's clothing and undergarments should be removed or pushed up to her waist. Preserve the patient's privacy as much as you can while helping her to move into position. If the emergency delivery is occurring at home, move the patient to a sturdy, flat surface or the floor if she will allow it. You will find it easier to work with the patient on a firm surface that is padded with blankets, folded sheets, or towels rather than on a bed. Put a pillow or blankets beneath her hips to elevate them about 2 to 4 inches (5 to 10 cm). It is sometimes more comfortable for the woman to put a pillow under one hip to allow her to turn to one side. Allow the patient to get comfortable. Support the patient's head, neck, and upper back with pillows and blankets. Have her keep her legs and hips flexed, with her feet flat on the surface beneath her and her knees spread apart. Women who have delivered before may prefer another delivery position, such as on the side. Another position is acceptable if both you and the patient are comfortable with it. You should also begin preparing for the newborn's arrival. Communicate with your crew, and have a plan for where you will place the newborn after delivery, who will be responsible for drying the newborn and keeping the newborn warm, and who will be responsible for caring for the mother and the newborn after delivery.

Track the progression of the delivery closely at all times. You do not want an explosive delivery to occur, when the crowning head pops out uncontrollably and too quickly.

Preparing the Delivery Field

Take the following steps to prepare the area where the delivery will occur:

1. Put on protective face shield and gown. As time allows, place towels or sheets on the floor around the delivery area to help soak up body fluids and to protect the woman and the newborn.
2. Carefully open the OB kit so its contents remain sterile.
3. Put on the sterile gloves. After this, handle only sterile materials.
4. Use the sterile sheets and drapes from the OB kit to make a sterile delivery field. Place one drape under the patient's buttocks, and unfold it toward her feet. Wrap another behind the patient's back and drape it over each thigh **Figure 33-8A**, and drape one sheet across her abdomen **Figure 33-8B**.

Figure 33-8 Preparing the delivery field. **A.** Use sterile sheets and drapes from the obstetric kit to make a clean delivery field. Place one sheet under the woman's buttocks. Wrap another sheet behind her back with either end draped over the thighs. **B.** Drape another sheet over the woman's abdomen.

The Delivery

Your partner should be at the patient's head to comfort, soothe, and reassure the woman during the delivery. If she will allow it, administer oxygen. The patient may want to grip someone's hand. She may yell, cry, or say nothing at all. It is common for patients to become nauseated during delivery, and some may vomit. If this occurs, have your partner assist her and ensure that her airway remains clear.

You must continually check for crowning. Some patients, especially those who have previously had children, may experience precipitous (fast) labor and birth. When labor is too fast, the tissues do not have time to stretch, and the patient is at risk for tears in the perineal area (see the section, *Delivering the Head* in this chapter). Position yourself so that you can see the perineal area at all times. Time the patient's contractions, starting at the beginning of one and ending with the beginning of the next, to determine the frequency of the contractions. In addition, time the duration of each contraction by feeling the patient's abdomen from the moment the contraction begins (uterus and abdomen tightening) to the moment it ends (uterus and abdomen relaxing). Remind the patient to take quick, short breaths during each contraction but not to strain. Encourage the patient to rest and breathe deeply through her mouth between contractions.

Follow the steps in **Skill Drill 33-1** to deliver the newborn:

1. Crowning is the definitive sign that delivery is eminent and transport should be delayed until after the child has been born **Step 1**.
2. Allow the woman to push the head out. Use your hands to support the bony parts of the head as it emerges. The child's body will naturally rotate to the right or left at this point in the delivery. Continue to support the head to allow it to turn in the same direction. Avoid the eyes and fontanelles (soft spots on the newborn's skull). Feel at the neck to see if the umbilical cord is wrapped around it. If it is, gently lift it over the head without pulling hard on the cord. **Step 2**.
3. Once the head is delivered, it will rotate on its own to one side. At the next contraction, the upper shoulder will be visible. Guide the head down slightly by applying gentle downward traction to help the upper shoulder deliver **Step 3**.
4. Support the head and upper body as the shoulders deliver. You may need to guide the head up slightly to help deliver the lower shoulder **Step 4**.
5. Once the body is delivered, support the newborn firmly but gently. The newborn will be very slippery. Support the newborn's head with the neck in a neutral position to keep the airway open **Step 5**.
6. If the mother is willing and able, place the newborn directly on the mother's abdomen, with the cord still intact. This skin-to-skin technique keeps the newborn warm and perfused; the mother's skin provides warmth while the placental perfusion continues until the pulsations in the cord stop.
7. After delivery and prior to cutting the cord, if the child is gurgling or shows other signs of respiratory distress, suction the mouth and oropharynx to clear any amniotic fluid and facilitate the infant's initiation of air exchange **Step 6**.

YOU are the Provider — PART 4

You have successfully removed the umbilical cord from around the neck and have completed delivery of the rest of the body. It is a girl! As you assess the newborn, your partner reassesses the patient's vital signs.

Recording Time: 12 Minutes	
Level of consciousness	Conscious and alert
Respirations	22 breaths/min; adequate depth
Pulse	114 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	130/60 mm Hg
Spo_2	98% (on oxygen)

After providing immediate postdelivery care to the newborn, you assess her and note that she is breathing; has a heart rate of 80 beats/min; and has cyanosis of her face, trunk, and extremities.

7. What is involved in the routine postdelivery care of a newborn?

8. What immediate treatment is indicated for this newborn?

Skill Drill 33-1 Delivering the Newborn

Step 1

Crowning is the definitive sign that delivery is imminent and transport should be delayed until after the child has been born.

Step 2

Use your hands to support the bony parts of the head as it emerges. The child's body will naturally rotate to the right or left at this point in the delivery. Continue to support the head to allow it to turn in the same direction.

Step 3

As the upper shoulder appears, guide the head down slightly by applying gentle downward traction to deliver the shoulder.

Step 4

Support the head and upper body as the lower shoulder delivers, guide the head up if needed.

Step 5

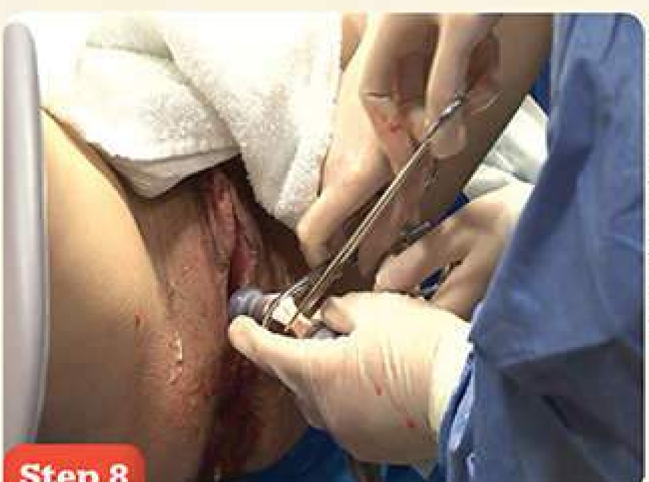
Handle the newborn firmly but gently, support the head and keep the neck in a neutral position to maintain the airway. Consider placing the newborn on the mother's abdomen with the umbilical cord still intact, allow skin-to-skin contact to warm the newborn. Otherwise, keep the newborn approximately at the level of the vagina until the cord has been cut.

Step 6

After delivery and prior to cutting the cord, if the child is gurgling or shows other signs of respiratory distress, suction the mouth and oropharynx to clear any amniotic fluid and ease the infant's initiation of air exchange.

Step 7

Wait for the umbilical cord to stop pulsing. Place a clamp on the cord. Milk the blood from a small section of the cord on the placental side of the clamp. Place a second clamp 2 to 3 inches away from the first.



Step 8

Cut between the clamps.

Step 9

Allow the placenta to deliver itself. Do not pull on the cord to speed delivery.

8. Place a clamp on the umbilical cord. Milk the blood from a small section of the cord on the placental side of the clamp. This prevents the cord blood located between the clamps from spilling onto the floor when you eventually cut the cord. Then place a second clamp 2 to 3 inches away from the first **Step 7**.
9. Cut between the two clamps **Step 8**.
10. The placenta will deliver itself, usually within 30 minutes of birth. Never pull on the end of the umbilical cord in an attempt to speed delivery of the placenta **Step 9**.

Words of Wisdom

When a fetus is positioned head first in the birth canal, this is called the *cephalic presentation*. Most births are cephalic presentation.

Delivering the Head

Observe the head as it begins to exit the vagina so you can provide support as it emerges. It may take many contractions from the time the head begins to crown until the head delivers. Once it is obvious that the head is coming out farther with each contraction, place your sterile gloved hand over the emerging bony parts of the head, avoid the eyes and fontanelles, and, by exerting minimal pressure, control the delivery of the head. This will allow the head to come out smoothly and prevent it and the rest of the newborn from suddenly popping out during a strong contraction, possibly causing injury to the patient's perineal area and/or to the newborn. Continue to support the head as it rotates.

The risk of perineal tearing during labor can be reduced by applying gentle pressure across the perineum with a sterile gauze pad. Also be prepared for the possibility of the patient having a bowel movement because of the increased pressure on the rectum.

As you assist with the delivery of the head, be careful that you do not poke your fingers into the newborn's eyes or the fontanelles. The fontanelles are soft spots on the newborn's skull that will eventually become covered with bone. At birth, the brain is covered only with skin and membranes at these areas. There are two primary fontanelles, one on the top of the head and one near the back of the head.

Unruptured Amniotic Sac. The amniotic sac will usually rupture at the beginning of labor; if not, it may rupture during contractions. If the amniotic sac has not ruptured by the time the fetal head is crowning, it will appear as a fluid-filled sac (like a water balloon) emerging from the vagina. This situation is potentially life threatening for the fetus because the sac will suffocate the fetus if it is not removed. If the sac has not ruptured spontaneously, you may puncture it with a clamp or tear it by twisting it between your fingers. Make sure that the puncture site is away from the fetus's face, and perform this procedure only as the head is crowning. Do not puncture the sac if the fetus's head is not crowning. As the sac is punctured, amniotic fluid will gush out. Push the ruptured sac away from the fetus's face as the head is delivered. Clear the newborn's mouth and nose, using the bulb syringe if required by your protocols, and wipe the mouth and nose with gauze. If the amniotic fluid is greenish (indicating meconium staining) instead of clear or has a foul odor, make sure you notify the receiving hospital. Meconium in the amniotic fluid may result in respiratory distress or an airway obstruction in the newborn.

Umbilical Cord Around the Neck. As soon as the head is delivered, use one finger to feel whether the umbilical cord is wrapped around the neck. This commonly is called a **nuchal cord**. A nuchal cord that is wound tightly around the neck could strangle the fetus, so it must be released immediately from the neck. Usually, you can slip the cord gently over the delivered head (or over the shoulder, if necessary). If this is not possible, you must cut the cord by placing two clamps about 2 inches apart on the cord and cutting between the clamps. Once the cord is cut, you must attempt to speed the delivery by encouraging the woman to push harder and possibly more often because the fetus will now have no oxygen supply until it is delivered and breathing spontaneously. In the rare case of the cord being wrapped more than once around the neck, you will need to clamp and cut only once; then you can unwrap the cord from around the neck. Handle the cord very carefully; it is fragile and easily torn. Fortunately, the cord is usually not wrapped around the fetus's neck and does not have to be cut until after the entire newborn has been delivered and pulsations have stopped. However, you must always check for a nuchal cord.

Delivering the Body

Once the head has been delivered, it usually rotates to one side or the other. This rotation places the body in a better position for delivery. By this time, the woman will most likely be ready to push again, and the upper shoulder will be visible in the vagina. The head is the largest part of the fetus. Once it is delivered, the body usually delivers easily. Support the head and upper body as the shoulders deliver. Make sure to always support the head with one hand. Lower the head a little to deliver the upper shoulder, and then very gently raise it to deliver the lower shoulder. Do not pull the fetus from the birth canal.

Once the shoulders deliver, the abdomen and hips will appear and will slide out easily. The newborn will be extremely slippery, so make sure to support the body with your other hand as it delivers. The newborn may be covered with a white, cheesy substance called **vernix caseosa**. Support and hold the newborn with both of your hands. Handle the newborn firmly but carefully.

Words of Wisdom

With the delivery of a newborn, you must divide your attention between two patients. This can keep two EMTs busy, even when things go well. To ensure that possible special care needs do not result in neglect of one of the patients, designate one member of the crew to pay primary attention to each patient. Call for additional help early if you suspect that both will need special care or that one will require resuscitation.

Postdelivery Care

As soon as the newborn is delivered, if the mother is able and willing, hand the newborn to the mother or place the newborn on her abdomen so skin-to-skin contact can begin immediately. As described earlier, this helps keep the newborn warm and may improve perfusion. Dry the newborn, then wrap him or her in a clean blanket or towel to maintain warmth. Newborns are very sensitive to temperature, so keep the blanket or towel warm, if possible, before you use it. Wrap the newborn so that only the face is exposed, making sure that the top of the head is covered. Keep the neck in a neutral position so the airway remains open. Consider placing the newborn on one side, with the head slightly lower than the rest of the body. If circumstances prevent placing the newborn on the mother, cradle the newborn in your arms, but always keep the head slightly downward to help prevent aspiration. Use a sterile gauze pad to wipe the newborn's mouth and nose as needed. If your local protocols specify, keep the newborn at the same level as the woman's vagina until the umbilical cord has been cut.

Postdelivery care of the umbilical cord is important because infection is easily transmitted through the cord to the newborn. Once the cord has stopped pulsating, using the two clamps in the OB kit, clamp the cord between the woman and the newborn, preferably 6 inches (15 cm) from the newborn's body. Place the clamps about 2 to 4 inches (5 to 10 cm) apart. When they are firmly in place, carefully cut the cord between them with sterile scissors or a scalpel. Remember, the cord is fragile; if handled roughly, it could be torn from the newborn's abdomen, resulting in a fatal hemorrhage. Once the clamps are in place, there is no need to rush.

Words of Wisdom

Recording the time of birth is important because this information is needed for the birth certificate. It also provides you with a starting point from which to time the intervals for Apgar scores. This is even more important with multiple births. You will be busy, so you might consider asking a family member to act as "timekeeper." Use two hands to support the infant's entire body including the head while holding him or her. One hand should support the back, chest, and head without squeezing or otherwise placing excess pressure on the neck. The second hand should support the buttocks.

By now, the newborn should be pink and breathing on his or her own **Figure 33-9**. At this time, evaluate the newborn for term gestation, good muscle tone, and breathing/crying; also obtain the 1-minute Apgar score (see the section, *The Apgar Score* in this chapter). If the mother is alert and in stable condition and you have not done so already, hand the newborn to her so that skin-to-skin contact can begin while you dry and wrap the newborn. If this is not possible, give the newborn, wrapped in a warm blanket, to your partner; he or she can monitor the newborn and complete the initial care. You need to return your attention to the woman and the delivery of the placenta.

Delivery of the Placenta

The placenta is attached to the end of the umbilical cord, which is coming out of the woman's vagina. The placenta will deliver itself, usually within a few minutes of the birth, although it may take as long as 30 minutes, so do not delay transport waiting for the placenta to deliver. Again, your job is only to assist. Never pull on the end of the umbilical cord in an attempt to speed delivery of the placenta. You may tear the cord, the placenta, or both and cause serious, perhaps life-threatening hemorrhage in the patient. Some bleeding, usually less than 500 mL, occurs before the placenta delivers and is normal and expected.

Figure 33-9 Use two hands to support the infant's entire body including the head while holding him or her. One hand should support the back, chest, and head without squeezing or otherwise placing excess pressure on the neck. The second hand should support the buttocks.

The normal placenta is round, about 7 inches (18 cm) in diameter, and about 1 inch (2.5 cm) thick. One surface is smooth and covered with a shiny gray membrane. The other surface is rough, divided into lobes, and is a dark reddish-brown color similar to raw liver. Wrap the entire placenta and cord in a towel, place them into a plastic bag, and take them to the hospital. Hospital personnel will examine the placenta and the cord to make certain that the entire placenta has been delivered. If a piece of the placenta has been retained inside the woman, it could cause persistent bleeding or infection.

After delivery of the placenta and before transport, place a sterile pad or sanitary pad over the vagina and straighten the woman's legs. You can help to slow bleeding by massaging the woman's abdomen with a firm, circular, kneading motion **Figure 33-10**. The abdominal skin will be wrinkled and very soft. You should be able to feel a firm, grapefruit-sized mass in the lower abdomen; this is called the **fundus**. The fundus is the upper end of the uterus. As you massage the fundus, the uterus will contract and become firmer. This may be uncomfortable for the woman. Reassure her and explain that it is necessary to help control the bleeding. Breastfeeding also stimulates the uterus to contract because, like massaging the uterus, it causes the production of oxytocin, a hormone that helps to contract the uterus and slow bleeding. Take a minute to congratulate the new mother and thank anyone who assisted. Be sure to record the time of birth in your patient care report.

Figure 33-10 After delivery, massage the woman's abdomen in a firm, circular motion.

The following are emergency situations:

- The placenta has not delivered after 30 minutes.
- More than 500 mL of bleeding occurs before delivery of the placenta.
- Significant bleeding occurs after delivery of the placenta.

If any of these events occur, promptly transport the woman and newborn to the hospital. Never put anything into the vagina. Place a sterile pad or sanitary pad over the woman's vagina, administer oxygen, keep her and the newborn warm by preventing any heat loss, and monitor her vital signs closely.

Neonatal Assessment and Resuscitation

To determine whether the newborn requires resuscitation, begin by assessing for term gestation, good muscle tone, and breathing/crying. Follow standard precautions, and always put on gloves before handling a newborn. The normal respiratory and cardiovascular physiologic responses expected are that the newborn will begin breathing spontaneously within 15 to 30 seconds after birth, and the heart rate will be 120 beats/min or higher. If you do not observe these responses, gently tap or flick the soles of the newborn's feet or rub the back to stimulate breathing. Many newborns require some form of stimulation that will encourage them to breathe air and begin circulating blood through the lungs Table 33-2. These measures include positioning of the airway, drying, warming, suctioning, and tactile stimulation. To maximize the effects of these measures, follow these tips:

- Position the newborn on his or her back with a towel or blanket under the shoulders so that the head is down and the neck is slightly extended.
- If necessary, suction the mouth and then the nose using a bulb syringe or suction device with an 8- or 10-French catheter. Suction both sides of the back of the mouth, where secretions tend to collect, but avoid deep suctioning of the mouth and

throat; this can cause the heart rate to slow down. Aim blow-by oxygen at the newborn's mouth and nose during resuscitation.

- In addition to vigorously drying the newborn's head, back, and body with dry towels, you may rub the newborn's back and gently flick or slap the soles of his or her feet. If the newborn does not breathe after 10 to 15 seconds of stimulation, begin resuscitation efforts.

Table 33-2 Resuscitation for a Newborn Who Is Not Breathing

Assess and support	▪ Temperature (warm and dry) ▪ Airway (position and suction) ▪ Breathing (stimulate to cry) ▪ Circulation (heart rate and skin color)
Basic life support interventions	▪ Dry and warm the newborn. ▪ Clear the airway with a bulb syringe if needed. ▪ Stimulate the newborn if he or she is unresponsive. ▪ Use a BVM to ventilate the newborn if needed. This is seldom required. ▪ Perform chest compressions if there is no pulse or if the heart rate is < 60 after 30 seconds of ventilation and heart rate is not increasing.

You should be properly equipped for resuscitation measures in case the newborn is in distress. Most of the equipment and supplies needed to resuscitate a newborn can be found in your OB kit. Other items you may need are clean, dry towels; an infant blanket; a BVM with a 450-mL reservoir; and masks in both newborn and premature sizes.

Additional Resuscitation Efforts

Observe the newborn for spontaneous respirations, skin color, and movement of the extremities. If the respiratory effort appears appropriate, evaluate the heart rate by palpating the pulse at the brachial artery or listening to the newborn's chest with a stethoscope. The heart rate is the most important measure in determining the need for further resuscitation Table 33-3.

If chest compressions are required, use the hand-encircling technique for two-person resuscitation Figure 33-11. Perform BVM ventilation during a pause after every third compression. Avoid giving a compression and a ventilation simultaneously, because one will decrease the effectiveness of the other. Cardiac arrest in neonates is nearly always the result of ventilation compromise. Use a compression-to-ventilation ratio of 3:1, which will yield a total of 120 "actions" per minute (90 compressions and 30 ventilations). Remember that adequate ventilation is absolutely critical to the successful resuscitation of the neonate.

YOU are the Provider PART 5

You reassess the newborn and find that she is breathing adequately and has a heart rate of 120 beats/min. Her body is pink except for her hands and feet, which remain slightly cyanotic. You hand the newborn to the mother, placing her on the mother's abdomen while you dry and wrap the newborn. Once the umbilical cord stops pulsing, you clamp and cut the umbilical cord. The placenta delivers and is appropriately cared for. You reassess the mother's vital signs and then prepare for transport.

Recording Time: 20 Minutes	
Level of consciousness	Conscious and alert
Respirations	20 breaths/min; adequate depth
Pulse	98 beats/min; strong and regular
Skin	Pink, warm, and moist
Blood pressure	126/60 mm Hg
Spo_2	97% (on oxygen)

En route to the hospital, you reassess the newborn and mother. The mother remains conscious and alert and has mild vaginal bleeding. The newborn's body is pink, but her hands and feet remain blue; her heart rate is 130 beats/min, and her respirations are rapid; she pulls her foot away when you flick the sole; and she resists your attempts to straighten her knees. You call the receiving hospital and give your radio report; your estimated time of arrival is 6 minutes.

9. What further treatment is indicated for the mother?
10. What Apgar score should you assign to this newborn?

Table 33-3 Additional Neonatal Resuscitation Efforts

If the Heart Rate Is …	More Than 100 Beats/Min	60 to 100 Beats/Min	Fewer Than 60 Beats/Min
Do this:	Keep the newborn warm. Transport the newborn. Assess the newborn continuously.	Begin assisted ventilation with a BVM and room air. Reassess the newborn after 90 seconds and if the heart rate and respirations are not normal, begin to ventilate with 100% oxygen. Continue to reassess the newborn. Call for ALS backup if available. Keep the newborn warm.	Begin assisted ventilation with a BVM and 100% oxygen. Reassess the newborn every 90 seconds until heart rate and respirations are normal. Begin chest compressions. Call for ALS backup if available. If the heart rate does not increase, medication and ALS will be needed.

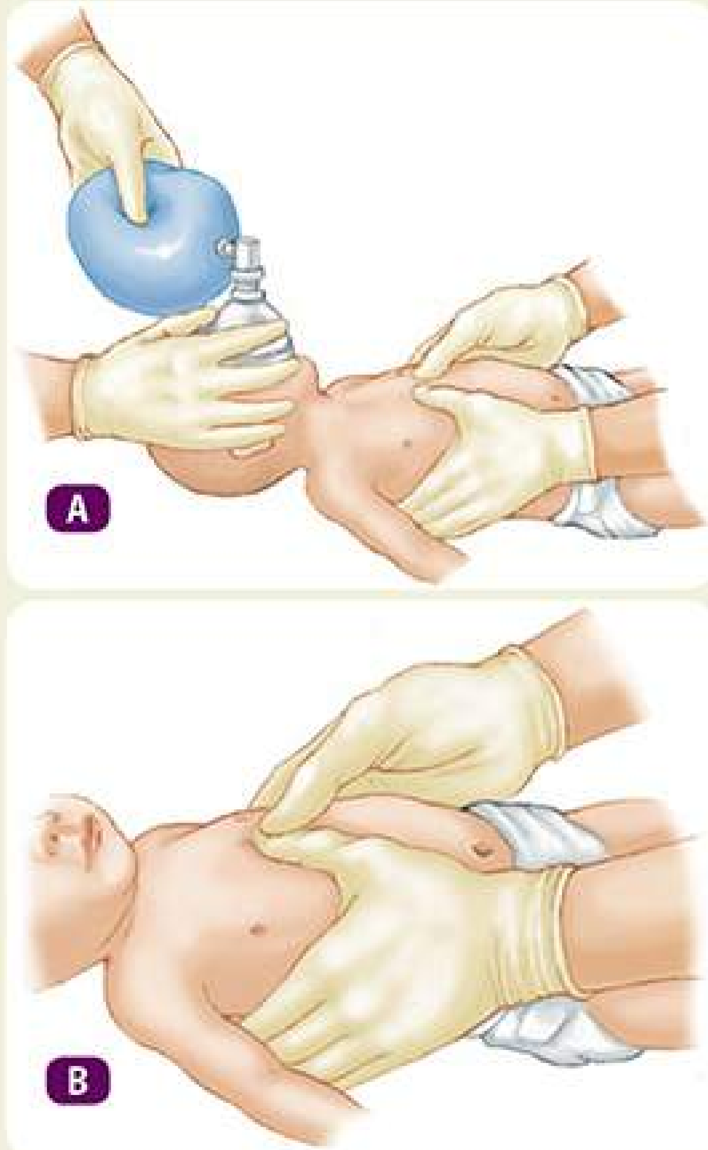


Figure 33-11 **A.** Chest compressions should be given with the hands encircling the newborn and thumbs side by side. **B.** In very small newborns, you may need to overlap the thumbs.

A, B: © Jones & Bartlett Learning.

Transport any newborn who requires more than routine resuscitation to a hospital with a level III neonatal intensive care unit, if available in your area. This type of unit is designed for newborns who require specialized care. If a level III neonatal intensive care unit is not available in your area, provide rapid transport to the closest appropriate facility.

About 12% to 16% of deliveries are complicated by the presence of meconium in the amniotic fluid. Meconium can be thick or thin. If the newborn aspirates thick meconium, significant lung disease and even death can occur. If you see meconium in the amniotic fluid or meconium staining and the newborn is not breathing adequately, consider quickly suctioning the newborn's mouth then nose after delivery before providing rescue ventilations.

▶ The Apgar Score

The **Apgar score** is the standard scoring system used to assess the status of a newborn. This system assigns a numeric value

(0, 1, or 2) to five areas of activity of the newborn:

- **Appearance.** Shortly after birth, the skin of a light-skinned newborn and the mucous membranes of a dark-skinned newborn should turn pink. Newborns often have cyanosis of the extremities for a few minutes after birth, but hands and feet should “pink up” quickly. Blue skin all over or blue mucous membranes signal a central cyanosis.
- **Pulse.** Measure the pulse by chest auscultation. If a stethoscope is not available, you can measure pulsations with your fingers at the brachial pulse. A newborn with no pulse requires immediate CPR.
- **Grimace or irritability.** Grimacing, crying, or withdrawing in response to stimuli is normal and indicates that the newborn is doing well. Test this by snapping a finger against the sole of the newborn’s foot.
- **Activity or muscle tone.** The degree of muscle tone indicates the oxygenation of the tissues. Normally, the hips and knees are flexed at birth, and, to some degree, the newborn will resist attempts to straighten them. A newborn should not be floppy or limp.
- **Respirations.** Normally, a newborn’s respirations are regular and rapid, with a good strong cry. If the respirations are slow, shallow, or labored, or if the cry is weak, the newborn may have respiratory insufficiency and need assistance with ventilation. Complete absence of respirations or crying is obviously a very serious sign; in addition to assisted ventilation, CPR may be necessary.

The total of the five numbers is the Apgar score. A perfect score is 10. The Apgar score should be calculated at 1 minute and again at 5 minutes after birth. Most newborns will have a score of 7 or 8 at 1 minute and a score of 8 to 10 at 5 minutes. Table 33-4 shows the Apgar scoring system. Figure 33-12 shows a photo of a newborn with an Apgar score of less than 9.

Follow these steps when assessing a newborn:

1. Quickly calculate the Apgar score to establish a baseline on the newborn’s status.
2. Stimulation should result in an immediate increase in respiration rate. If not, you must begin ventilations with a BVM. Unlike adults, in whom sudden cardiac arrest may precede respiratory arrest, newborns who are in cardiac arrest usually have had a respiratory arrest first. Therefore, it is essential to keep the newborn ventilating and oxygenating well.

Figure 33-12 Newborns who have blue extremities immediately after delivery would receive only 1 of 2 points for "Appearance" on the Apgar scale.

Table 33-4 Apgar Scoring System

	Score		
Area of Activity	**2**	**1**	**0**
Appearance	Entire newborn is pink.	Body is pink, but hands and feet remain blue.	Entire newborn is blue or pale.
Pulse	More than 100 beats/min	Fewer than 100 beats/min	Absent pulse
Grimace or irritability	Newborn cries and tries to move foot away from finger snapped against sole of foot.	Newborn gives a weak cry in response to stimulus.	Newborn does not cry or react to stimulus.
Activity or muscle tone	Newborn resists attempts to straighten hips and knees.	Newborn makes weak attempts to resist straightening.	Newborn is completely limp, with no muscle tone.
Respiration	Rapid respirations	Slow respirations	Absent respirations

3. If the newborn is breathing well, check the pulse rate by feeling the brachial pulse or auscultating the chest with a stethoscope. The pulse rate should be at least 100 beats/ min. If it is not, begin ventilations with a BVM. This alone may increase the newborn's heart rate. Reassess respirations and heart rate at least every 30 seconds to make sure that the pulse rate is increasing and respirations are becoming spontaneous.
4. Assess the newborn's oxygenation via pulse oximetry and observe for central cyanosis. If central cyanosis is present or the oxygen saturation does not improve, administer blow-by oxygen by holding oxygen tubing or an oxygen mask close to the newborn's face. Set the oxygen flow rate at 5 L/min.
5. Remember that you now have two patients. Request a second unit as soon as possible if you determine that the newborn is in any distress and will require resuscitation.

In situations where assisted ventilation is required, you should use a newborn BVM. Cover the newborn's mouth and nose with the mask, and begin ventilation with high-flow oxygen at a rate of 40 to 60 breaths/ min. Make sure you have a good mask-to-face seal. Use gentle pressure to make the chest rise with each ventilation. You may need to bypass the pop-off valve to accomplish this, especially during the first few breaths.

Special Populations

Current information on neonatal resuscitation may vary from what you learned in your class on CPR, which usually does not differentiate between CPR for an infant and CPR for a neonate (newborn). Be sure to know your specific local protocols on neonatal resuscitation.

If the newborn does not begin breathing on his or her own or does not have an adequate heart rate, continue CPR and rapidly transport. Once CPR has been started, do not stop until the newborn responds with adequate respirations and heart rate or is pronounced dead by a physician. Do not give up! Many newborns have survived without brain damage after prolonged periods of effective CPR. If the newborn presents in distress, do not take time to assess the Apgar score—begin resuscitation immediately.

Complicated Delivery Emergencies

Breech Delivery

The position in which an infant is born or the body part that is delivered first is called the **presentation**. Most infants are born head first, in what is called a **vertex presentation**. Occasionally, the buttocks are delivered first. This is called a **breech presentation** **Figure 33-13**. With a breech presentation, the fetus is at great risk for trauma from the delivery. In addition, a prolapsed cord is more common in a breech delivery. Breech deliveries are usually longer than a normal delivery, so there is time to get the pregnant woman to the hospital. If the buttocks have already passed through the vagina, however, the delivery has begun. You should provide emergency care and call for ALS backup if available. In general, if the woman does not deliver within 10 minutes of the buttocks presentation, provide prompt transport. Consult medical control to guide you in this difficult situation.

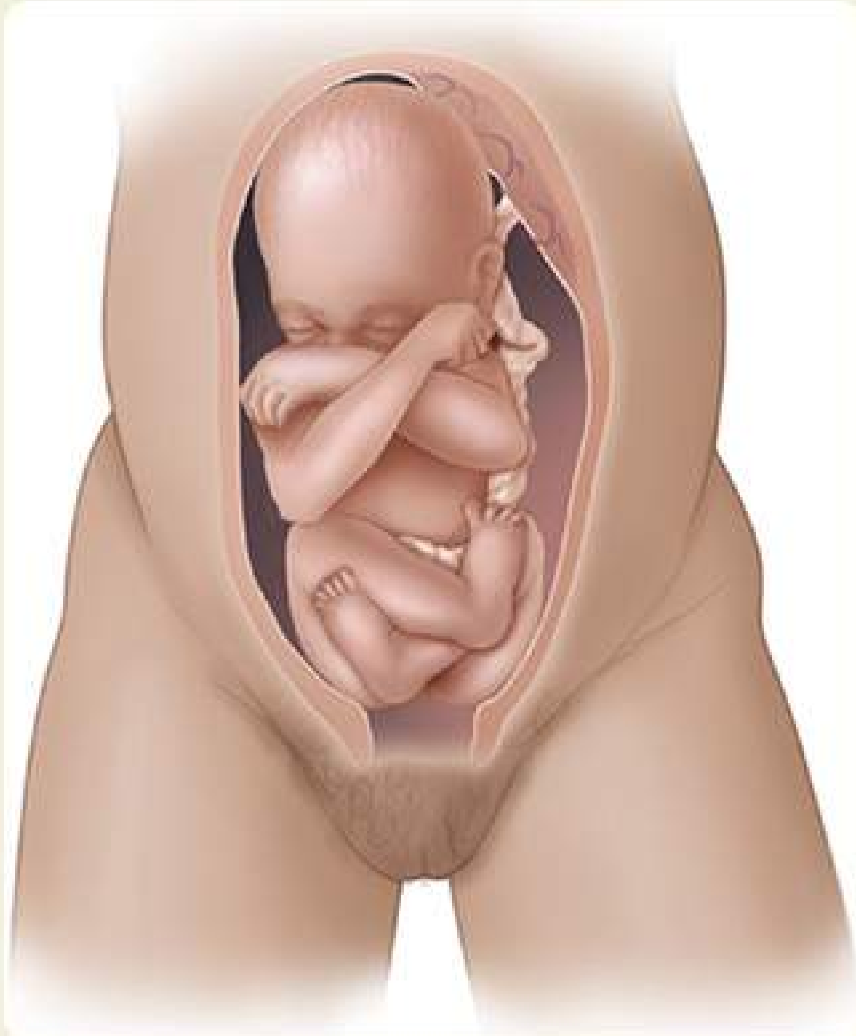


Figure 33-13 In a breech presentation, the buttocks are delivered first. Breech deliveries are usually slow, so you will often have time to transport the woman to the hospital.

Preparing for a breech delivery is the same as for a normal childbirth. Position the pregnant woman, prepare the OB kit, and place yourself and your partner as you would for a normal delivery. Allow the buttocks and legs to deliver spontaneously, supporting them with your hand to prevent rapid expulsion. The buttocks will usually come out easily. Let the legs dangle on either side of your arm while you support the trunk and chest as they are delivered. The head is almost always facedown and should be allowed to deliver spontaneously. As the head is delivering, you will need to perform a potentially lifesaving procedure to manage the newborn's airway. Make a "V" with your gloved fingers and position them in the vagina to keep the walls of the vagina from compressing the fetus's airway. This situation, and a prolapsed cord are the only two circumstances in which you should insert your fingers into the vagina.

Presentation Complications

On rare occasions, the presenting part of the fetus is neither the head nor the buttocks but a single arm or leg. This is called a **limb presentation** **Figure 33-14**. You cannot successfully deliver a fetus with a limb presentation in the field. These fetuses usually must be delivered surgically. If you are faced with a limb presentation, you must transport the patient to the hospital immediately. If a limb is protruding, cover it with a sterile towel. Never try to push it back in, and never pull on it. Place the patient on her back, with her head down and pelvis elevated. Because the woman and fetus are likely to be physically stressed, remember to administer high-flow oxygen to the woman

Figure 33-14 In rare cases, a limb, usually a single arm or leg, presents first. This is a life-threatening situation, and you must provide prompt transport for hospital delivery.

Prolapse of the umbilical cord, a situation in which the umbilical cord comes out of the vagina before the fetus **Figure 33-15**, is another rare presentation that must be treated in the hospital. This situation is dangerous because the fetus's head will compress the cord during birth and cut off circulation, depriving the fetus of oxygenated blood. Do not attempt to push the cord back into the vagina. Prolapse of the umbilical cord usually occurs early in labor when the amniotic sac ruptures. There is usually time to get the patient to the hospital. Your job is to try to keep the fetus's head from compressing the cord.

Place the pregnant woman supine with the foot end of the cot raised 6 to 12 inches (15 to 30 cm) higher than the head, with her hips elevated on a pillow or folded sheet. Alternatively, the woman may be placed in the knee-chest position: kneeling and bent forward, facedown. Either of these positions will help keep the weight of the fetus off the prolapsed cord. Carefully insert your sterile gloved hand into the vagina, and gently push the fetus's head away from the umbilical cord. Note that this is one of only two situations (the other being a breech presentation) in which you should place a hand or finger into the vagina. Maintain this position and continue to keep the pressure off of the cord continuously throughout the transport to the hospital and possibly until the patient is in the operating room. Wrap a sterile towel, moistened with saline, around the exposed cord. Administer high-flow oxygen, and transport rapidly.

Figure 33-15 A prolapsed umbilical cord is a life-threatening situation for the fetus and must be treated at the hospital.

▶ Spina Bifida

Spina bifida is a developmental defect in which a portion of the spinal cord or meninges may protrude outside of the vertebrae and possibly outside of the body. When it protrudes outside the body, the protrusion is seen on the newborn's back, usually in the lumbar area. It is important to cover the open area of the spinal cord with a moist, sterile dressing and then an occlusive dressing to seal the area immediately after birth to help prevent a potentially fatal infection. This treatment will have a positive impact on the newborn's outcome. Maintenance of the newborn's body temperature is important, so if you must use moist dressings, which can lower the body temperature, have someone hold the newborn against his or her body. Chapter 36, *Patients with Special Challenges*, discusses spina bifida in greater detail.

▶ Multiple Gestation

According to the CDC, twins occur about once in every 30 births; triplets or higher multiples occur much less frequently.

The woman will usually know if she is carrying multiple fetuses. Sometimes, there is a family history of twins or the woman suspects that she is having twins because she has an unusually large abdomen. Usually, however, multiple fetuses are diagnosed early in pregnancy with modern ultrasound techniques. With multiple fetuses, always be prepared for more than one resuscitation, and call for assistance.

Twins are usually smaller than single fetuses, and delivery is typically not difficult. Consider the possibility that you are dealing with twins any time the first newborn is small or the woman's abdomen remains fairly large and firm after the birth. You should also ask the patient about the possibility of multiples. If twins are present, the second one will usually be born within 45 minutes of the first. About 10 minutes after the first birth, contractions will begin again, and the birth process will repeat itself.

The procedure for delivering twins is the same as that for a single fetus; however, you will need some supplies from an additional OB kit. Clamp and cut the cord of the first newborn as soon as it has been delivered and before the second newborn is delivered. The second fetus may deliver before or after the first placenta. There may be only one placenta, or one for each fetus. When the placenta has been delivered, check whether there is one umbilical cord or two. If you see only one umbilical cord coming out of the first placenta, another placenta is still to be delivered. If both cords are attached to one placenta, the delivery is complete. Identical twins are always the same sex; fraternal twins may be the same or different sexes.

Record the time of birth of each twin separately. Twins may be so small that they look premature; handle them carefully, and keep them warm. Identify the first newborn delivered as "Baby A." With the delivery of two or more newborns, you can indicate the order of delivery by writing on a piece of tape and placing it on the blanket or towel that is wrapped around each newborn.

Premature Birth

Full-term gestation is considered to be between 39 weeks and 40 weeks, 6 days, approximately 9 calendar months. A normal, full term, single newborn will weigh approximately 7 pounds (3 kg) at birth. Any newborn who delivers before 8 months (36 weeks of gestation) or weighs less than 5 pounds (2 kg) at birth is considered premature. This determination is not always easy to make. Often, the exact gestation time cannot be determined. A premature newborn is smaller and thinner than a full-term newborn, and the head is proportionately larger in comparison with the rest of the body **Figure 33-16**. The vernix caseosa will be absent or minimal on a premature newborn. There will also be less body hair.

Figure 33-16 Premature newborns (right) are smaller and thinner than full-term newborns.

© American Academy of Orthopaedic Surgeons.

Premature newborns need special care to survive. They often require resuscitation, which should be performed unless physically impossible. With such care, premature newborns as small as 1 pound (0.5 kg) have survived.

Postterm Pregnancy

Approximately 10% of pregnancies are postterm, meaning that the gestation period is longer than 42 weeks. Sometimes, however, a pregnancy is incorrectly believed to be postterm because the due date was miscalculated.

A true postterm pregnancy can lead to problems with both the woman and fetus. Postterm fetuses can be larger than a typical 40-week fetus, sometimes weighing more than10 pounds (5 kg), which can lead to a more difficult labor and delivery and an increased chance of injury to the fetus as it travels through the birth canal. The likelihood of a cesarean section being required is increased. The woman is also at increased risk for perineal tears and infection. Postterm newborns have an increased risk of meconium aspiration, infection, and being stillborn and may not have developed normally because of the restricted size of the uterus. Be prepared to resuscitate the newborn, as respiratory and neurologic functions may have been affected. The larger size of the fetus causes it to take up more space inside the uterus, resulting in compression of the structures, including the blood vessels of the placenta and the umbilical cord.

Fetal Demise

Unfortunately, you may find yourself delivering a fetus that died in the woman's uterus before labor began. This situation will test your medical, emotional, and social abilities. Grieving parents will be emotionally distraught and may be hostile, requiring all your professionalism and support skills. Chapter 34, *Pediatric Emergencies*, discusses how to handle the death of a child in detail.

The onset of labor may be premature, but labor will otherwise progress normally in most cases. If an intrauterine infection has caused the demise, you may note an extremely foul odor. Depending on the stage of decomposition, the delivered fetus may have skin blisters, skin sloughing, and a dark discoloration. The head will be soft and perhaps grossly deformed.

Do not attempt to resuscitate an obviously dead neonate. However, do not confuse this situation with that in which a newborn is in cardiopulmonary arrest as a complication of the birthing process. You must attempt to resuscitate normal-appearing newborns.

Delivery Without Sterile Supplies

On rare occasions, you may have to deliver a newborn without a sterile OB kit. Even if you do not have an OB kit, you should always have eye protection, gloves, and a protective mask with you. Carry out the delivery as if sterile supplies were available. If possible, use freshly laundered sheets and towels. As soon as the newborn is delivered, wipe the inside of the mouth with your finger to clear away blood and mucus. Without the OB kit, you should not cut or clamp the umbilical cord. Instead, as soon as the placenta delivers, wrap it in a clean towel or put it in a plastic bag and transport it with the newborn and mother to the hospital. Always keep the placenta and the newborn at the same level. Be sure to keep the newborn warm.

Postpartum Complications

Some bleeding always occurs with delivery, but bleeding that exceeds approximately 500 mL is considered excessive. If bleeding continues after delivery of the placenta, continue to massage the uterus, but check your technique and hand placement. If the woman appears to be in shock, treat her accordingly and transport, massaging the uterus en route. Excessive bleeding after birth is usually caused by the muscles of the uterus not fully contracting. This can be from delivering more than one infant, a long labor process so the uterus is too "tired" to contract, or parts of the placenta still being inside the uterus. This condition is potentially life threatening for the woman. Cover the vagina with a sterile pad, changing the pad as often as necessary. Do not discard any blood-soaked pads; hospital personnel will use them to estimate the amount of blood loss. Also save any tissue that may have passed from the vagina.

Administer oxygen if necessary, monitor vital signs frequently, and transport the patient immediately to the hospital. Never hold the woman's legs together or pack the vagina with gauze pads in an attempt to control bleeding.

Postpartum patients are also at increased risk of an embolism. One reason is the increased clotting ability that is a normal change of pregnancy. Also, a pregnant woman who has been on bed rest for any length of time is more prone to clots. The most common embolism seen in postpartum women is a pulmonary embolism, which is a clot that travels through the bloodstream and becomes lodged in the pulmonary circulation. This obstruction will block blood flow to the lungs and is potentially life threatening. If you deliver a newborn in the field and the woman begins to report sudden difficulty breathing or shortness of breath, consider the possibility that she has a pulmonary embolism.

You should also suspect a pulmonary embolism in patients of childbearing age with respiratory complaints who have recently delivered, especially with the sudden onset of difficulty breathing or altered mental status. Women have died of a postpartum pulmonary embolism from days to several weeks or months after childbirth. Provide supportive care of the ABCs with high-flow oxygen and rapid transport to the hospital.

YOU are the Provider — SUMMARY

1. What anatomic and physiologic changes occur during pregnancy? How will they affect your assessment of the patient?

Most pregnancy-related changes are observed in the respiratory and cardiovascular systems. As the uterus enlarges during pregnancy, it is displaced upward from the pelvic cavity, where it is normally protected, and is therefore exposed to potential injury. The enlarged uterus pushes upward on the diaphragm. This decreases the woman's ability to breathe deeply, so the respiratory rate increases slightly to maintain adequate minute volume. Pregnancy also increases maternal oxygen demand and consumption. Blood volume increases throughout pregnancy. To accommodate the increase in total blood volume, the woman's heart rate increases up to 20%, or about 20 beats/ min, by the third trimester of pregnancy.

Vital sign changes during pregnancy, such as an increase in heart rate and respiratory rate, should not be assumed to be pregnancy-related if the woman experiences an acute illness or injury. Instead, assume them to be signs of shock until proven otherwise.

2. How will you determine if delivery is imminent or if there is enough time to transport the pregnant patient?

Ask the patient how long she has been pregnant, when she is due to deliver, and if this is her first pregnancy. As a general rule, labor is longer in women who are pregnant for the first time (primigravida). If the patient is experiencing contractions, ask her how far apart they are and how long they last. Ask if her bag of water (amniotic sac) has ruptured. This typically occurs toward the end of the first stage of labor, but may not occur until the delivery itself. Ask her if she is experiencing any vaginal spotting or bleeding; during the first stage of labor a plug of mucus—sometimes mixed with blood (bloody show)—is expelled from the dilating cervix and discharged from the vagina. Ask the patient if she feels the urge to push or move her bowels. The presence of crowning is an obvious indicator that delivery is in progress. Perhaps one of the most reliable indicators of imminent delivery is when the patient states, "I'm having this baby now!" This is especially true in women who have given birth in the past.

3. What are gestational diabetes and preeclampsia? How can they affect this delivery?

Gestational diabetes, or diabetes of pregnancy, is a condition that develops during pregnancy and typically resolves on its own after delivery. Infants born to women with gestational diabetes are often large for their gestational age, which could lead to shoulder dystocia—a condition in which the fetus's shoulders are too broad to fit through the woman's pelvic opening—or other delivery complications caused by the fetus's size. In addition, many women experience nausea before labor and have not eaten recently—factors that could lead to hypoglycemia and weakness in the woman and fetus.

Preeclampsia, or pregnancy-induced hypertension, is characterized by hypertension; edema of the hands, feet, and face; and protein in the urine. Other symptoms may include visual disturbances (eg, seeing spots, blurred vision), headache, and anxiety.

Untreated preeclampsia may lead to eclampsia, which is characterized by life-threatening seizures. The

4. Is there time to transport this patient, or should you prepare for imminent delivery?

The patient is experiencing frequent (every 2 minutes) contractions that are lasting 45 seconds, and she has the urge to move her bowels, which indicates that the fetus is in the birth canal. On the basis of these factors, delivery will likely occur within the next few minutes; therefore, you and your partner should prepare for imminent delivery.

5. How should you manage the umbilical cord situation?

As soon as the head has delivered, you should assess for the umbilical cord. If present, an umbilical cord must be treated immediately because if the cord is wrapped tightly around the newborn's neck, the airway could be blocked. Usually, you can slip the cord gently over the head (or shoulders, if necessary). If not, clamp the cord about 2 inches (5 cm) apart and cut between the two clamps. In the rare event that the cord is wrapped more than once around the neck, clamp and cut only once and then unwrap it from around the neck. Handle the cord very carefully; it is fragile and easily torn. Do not let the clamps come off until the ends have been tied.

6. What would you do if the amniotic sac were still intact?

If you notice that the amniotic sac seems to be intact after the head delivers or as the head is crowning, immediately puncture the membrane and allow the fluid to drain. Avoid using sharp objects to puncture the membrane; first attempt to use your fingers. Once the membrane ruptures and the fluid drains, wipe the traces of the membrane away from the newborn's mouth and nose and continue with the delivery.

7. What is involved in the routine postdelivery care of a newborn?

Immediate postdelivery care of a newborn—regardless of his or her appearance—involves keeping the newborn dry and warm and facilitating effective breathing. The need for further treatment is based on assessment of the newborn's respiratory effort, heart rate, and skin color.

8. What immediate treatment is indicated for this newborn?

The newborn is breathing; however, her heart rate is low (80 beats/min) and her trunk and extremities are cyanotic. These clinical signs indicate that she is hypoxemic and will require additional resuscitative measures. Begin positive-pressure ventilations with a BVM. Newborn bradycardia is almost always the result of hypoxemia.

Ventilate the newborn at a rate of 40 to 60 breaths/ min for 30 seconds, and then reassess the heart rate. In most cases, only a brief period of positive-pressure ventilation is needed to increase the newborn's heart rate. If the heart rate is still less than 100 beats/min after 30 seconds of positive-pressure ventilation, continue ventilations, keep the newborn warm, and transport at once.

9. What further treatment is indicated for the mother?

After delivery and before transport, place a sterile pad or sanitary pad over the vagina and straighten the mother's legs. *Never place any pads or dressings into the vagina.* Gently massage the mother's abdomen with a firm, circular motion to cause the uterus to contract and help control bleeding.

If severe bleeding occurs after placental delivery, transport immediately, and treat the mother for shock. Place a sterile pad or sanitary pad over the mother's vagina, administer high-flow oxygen if necessary, and keep her warm with blankets. Closely monitor her vital signs en route.

10. What Apgar score should you assign to this newborn?

This newborn has a pink body but cyanotic hands and feet; therefore, you should assign a score of 1 for appearance. Her heart rate is 130 beats/min; therefore, assign a score of 2 for the pulse. She moves her foot away when you flick the soles; therefore, assign a score of 2 for grimace. She resists your attempts to straighten her knees, which indicates good muscle tone; therefore, assign a score of 2 for activity. Finally, her respirations are rapid (40 to 60 breaths/min is a normal newborn respiratory rate); therefore, assign a score of 2 for respirations. On the basis of your assessment findings, you should assign the newborn an Apgar score of 9.

EMS Patient Care Report (PCR)

Date: 12-9-16	**Incident No.:** 013115	**Nature of Call:** Woman in labor		**Location:** 2505 Landa Park Blvd	
Dispatched: 0625	**En Route:** 0627	**At Scene:** 0631	**Transport:** 0655	**At Hospital:** 0708	**In Service:** 0753

Patient Information

Age: 28 **Sex:** F **Weight (in kg [lb]):** 70 kg (155 lb)	**Allergies:** No known drug allergies **Medications:** Prenatal vitamins **Past Medical History:** Gestational diabetes, preeclampsia **Chief Complaint:** Active labor

Vital Signs

Time: 0638	**BP:** 122/82	**Pulse:** 110	**Respirations:** 24	**Spo_2:** 98%
Time: 0643	**BP:** 130/60	**Pulse:** 114	**Respirations:** 22	**Spo_2:** 98%
Time: 0651	**BP:** 126/60	**Pulse:** 98	**Respirations:** 20	**Spo_2:** 97%

EMS Treatment (circle all that apply)

Oxygen @ 6 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Assisted with delivery of baby; fundal massage

Narrative

Medic 44 is dispatched to a residence for a female in labor. Arrived on scene and found the patient, a 28-year-old female, lying supine in her bed. She was conscious and alert; her airway was patent, and her breathing, although increased in rate, was of adequate depth. Patient stated, "I am having my baby now!" She stated that this is her third baby. Her husband, who was present at the scene, advised that she has had gestational diabetes and preeclampsia with this pregnancy and has had regular prenatal care. The patient stated that her contractions were 2 minutes apart and lasting about 45 seconds each; she further stated that she had the urge to move her bowels and that her amniotic sac ruptured 5 hours ago. Initial visual inspection of the vaginal area did not reveal crowning. After initial set of vital signs were obtained, reassessment of vaginal area revealed crowning. Properly positioned patient, administered supplemental oxygen, and prepared for delivery. Husband remained present and provided emotional support and respiratory coaching to his wife. Delivery of head revealed nuchal cord, which was easily corrected by sliding the cord over the shoulders. Delivered the rest of the body without difficulty. After providing immediate postdelivery care to the newborn, a female, assessment revealed that she was breathing, had a heart rate of 80 beats/min, and had cyanosis of the trunk and extremities. Began assisted ventilation with a BVM at 40 breaths/min; reassessment after 30 seconds revealed marked improvement in newborn's heart rate and skin color; her hands and feet remained slightly cyanotic, but her body was pink. Allowed mother to hold the newborn while it was dried and wrapped. Clamped and cut the umbilical cord. Placental delivery occurred approximately 5 minutes after the birth of the baby. Reassessed mother's vital signs, and provided fundal massage for mild postpartum bleeding. Assigned 5-minute Apgar score of 9 (A, 1; P, 2; G, 2; A, 2; R, 2). Packaged mother and newborn and began transport to the hospital. En route, continued to assess mother and newborn; they both remained stable. Reassessment of vaginal bleeding revealed that it had stopped. Continued oxygen therapy for the mother, and delivered her and her baby to the hospital without incident. Provided verbal report to attending physician. Medic 44 returned to service at 0753.**End of report**

Prep Kit

Ready for Review

- Inside the uterus, the developing fetus is within the amniotic sac. The umbilical cord connects the woman and fetus through the placenta. Eventually, contractions of the uterus will propel the fetus through the birth canal.
- Throughout pregnancy, the body changes to accommodate the fetus. The primary systems involved with these changes are the respiratory, cardiovascular, and musculoskeletal systems.
- As a result of enlargement of the uterus, a pregnant patient's respiratory capacity changes with increased respiratory rates and decreasing minute volumes.
- A pregnant woman's blood volume increases by as much as 50%, and the heart rate increases by 20%.
- Increased hormone levels affect the musculoskeletal system by making the joints looser, or less stable.
- Complications of pregnancy include hypertensive disorders, bleeding, and diabetes.
- During a trauma call that involves a pregnant woman, you have two patients to consider—the woman and the unborn fetus. Trauma to the woman may have a direct effect on the condition of the fetus.
- The first stage of labor, dilation, begins with the onset of contractions and ends when the cervix is fully dilated. The second stage of labor, expulsion of the fetus, begins when the cervix is fully dilated and the fetus enters the birth canal; it ends with delivery of the newborn. The third stage of labor, delivery of the placenta, begins with the delivery of the newborn and ends with the delivery of the placenta.
- Once labor has begun, it cannot be slowed or stopped; however, there is usually time to transport the patient to the hospital during the first stage of labor. During the second stage of labor, you must decide whether to deliver at the scene or transport the patient. During the third stage of labor, after delivery of the newborn, you will probably not transport the patient until the placenta has delivered. Warm, dry, and stimulate the infant after birth.
- Abnormal or complicated deliveries include breech deliveries (buttocks first), limb presentations (arm or leg first), and prolapse of the umbilical cord (umbilical cord first). Quickly transport the patient with a limb presentation or prolapsed umbilical cord to the hospital.
- You should place a finger or hand into the vagina for only two reasons: to keep the walls of the vagina from compressing the fetus's airway during a breech presentation or to push the fetus's head away from the cord when the cord is prolapsed.
- Assess a newborn for term gestation, good muscle tone, and breathing/crying to determine whether he or she requires resuscitation. Also obtain an Apgar score one minute after birth as part of the initial evaluation.
- Excessive bleeding is a serious emergency. Cover the vagina with a sterile pad. Change the pad as often as necessary, and take all used pads to the hospital for examination.

Vital Vocabulary

abruptio placenta Premature separation of the placenta from the wall of the uterus.

amniotic sac The fluid-filled, baglike membrane in which the fetus develops.

anemic Describes a condition in which the patient has too few red blood cells, resulting in a decreased ability to transport oxygen throughout the body via the bloodstream.

Apgar score A scoring system for assessing the status of a newborn that assigns a number value to each of five areas.

birth canal The vagina and cervix.

bloody show A small amount of blood in the vagina that appears at the beginning of labor and may include a plug of pink-tinged mucus that is discharged when the cervix begins to dilate.

breech presentation A delivery in which the buttocks come out first.

cervix Narrowest portion of the uterus that opens into the vagina.

crowning The appearance of the fetus's head at the vaginal opening during labor.

eclampsia Severe hypertension in a pregnant woman, resulting in seizures (convulsions).

ectopic pregnancy A pregnancy that develops outside the uterus, typically in a fallopian tube.

embryo The early stage of development after the fertilization of the egg (first 10 weeks).

endometrium The lining of the inside of the uterus.

fetal alcohol syndrome A condition caused by the consumption of alcohol by a pregnant woman; characterized by growth and physical problems, mental retardation, and a variety of congenital abnormalities.

fetus The developing, unborn infant inside the uterus, from 10 weeks after fertilization until birth.

fundus The dome-shaped top of the uterus.

gestational diabetes Diabetes that develops during pregnancy in women who did not have diabetes before pregnancy.

lightening The movement of the fetus down into the pelvis late in pregnancy.

limb presentation A delivery in which the presenting part is a single arm or leg.

meconium Fetal stool. When appearing as a dark green material in the amniotic fluid, it can indicate distress or disease in the newborn; it can be aspirated into the fetus's lungs during delivery.

miscarriage The spontaneous passage of the fetus and placenta before 20 weeks; also called spontaneous abortion.

multigravida A woman who has had previous pregnancies.

nuchal cord An umbilical cord that is wrapped around the fetus's neck.

perineum In a woman, the area between the vagina and the anus.

placenta The tissue attached to the uterine wall that nourishes the fetus through the umbilical cord.

placenta previa A condition in which the placenta develops over and covers the cervix.

preeclampsia A pregnancy complication that is characterized by high blood pressure, headache, visual changes, and swelling of the hands and feet; also called pregnancy-induced hypertension or toxemia of pregnancy.

pregnancy-induced hypertension A condition of late pregnancy that is characterized by headache, visual changes, and swelling of the hands and feet; also called preeclampsia or toxemia of pregnancy.

presentation The position in which an infant is born; defined by the part of the body that appears first.

primigravida A woman who is experiencing her first pregnancy.

prolapse of the umbilical cord A situation in which the umbilical cord comes out of the vagina before the fetus.

spina bifida A developmental defect in which a portion of the spinal cord or meninges may protrude outside of the vertebrae and possibly even outside of the body, usually at the lower third of the spine in the lumbar area.

supine hypotensive syndrome Low blood pressure resulting from compression of the inferior vena cava by the weight of the pregnant uterus when the woman is supine.

term gestation A pregnancy that has reached full term, between 39 weeks and 40 weeks, 6 days.

umbilical cord The structure that connects the pregnant woman to the fetus via the placenta; contains two arteries and one vein.

vernix caseosa A white, cheesy substance that covers the body of the fetus.

vertex presentation A delivery in which the head of the newborn comes out first.

Assessment *in Action*

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You and your partner are called to a private residence for a woman in labor. On arrival, you find a 27-year-old woman lying on the living room couch, and she appears to be having a contraction.

1. The patient tells you that she is 38 weeks pregnant and her water broke when she was walking to the kitchen to get a drink. She says that she began experiencing contractions shortly afterward. The onset of her labor began when the:

   A. amniotic sac ruptured.
   B. fetus entered the birth canal.
   C. uterine contractions began.
   D. woman had the urge to push.

2. When your partner asks the patient about any complications related to this pregnancy, she tells her that she has been on bed rest for the past 7 weeks because she was diagnosed with preeclampsia. Preeclampsia is dangerous because:

   A. the headache can be a sign of a stroke.
   B. it causes swelling of the hands and feet.
   C. the high blood pressure can hide signs of shock.
   D. it can lead to eclampsia and seizures.

3. The answer to which of the following questions will help you determine whether delivery for this patient is imminent?

   A. Have you had a previous complicated pregnancy?
   B. Do you know if there is a chance of multiple deliveries?
   C. Is this your first baby?
   D. Do you use drugs or drink alcohol?

4. The patient informs you that her amniotic fluid was green and she is concerned. The green color is caused by:

   A. premature rupture of the membranes.
   B. the presence of meconium.
   C. prolonged gestation.

D. maternal infection.

5. As you deliver the head, you observe the umbilical cord is wrapped once around the neck. What should you do?

   A. Ask the patient not to push, and prepare for immediate transport.
   B. Clamp and cut the cord, and remove the cord from around the neck.
   C. Pull on the cord to speed the delivery.
   D. Try to slip the cord gently over the head.

6. Following delivery, what is the correct way to stimulate this newborn to breathe?

   A. Gently rub the newborn's back.
   B. Blow oxygen into the newborn's face.
   C. Smack the newborn on the buttocks.
   D. Begin chest compressions.

7. The best way to assess this newborn's circulation is:

   A. palpate the carotid pulse.
   B. assess for cyanosis in the extremities.
   C. palpate the brachial pulse.
   D. check for capillary refill on the sole of the foot.

8. Once an appropriate respiratory effort is present in the newborn after delivery, what is the next most important measure in determining the newborn's need for resuscitation?

   A. Heart rate
   B. Blood pressure
   C. Pulse oximetry
   D. Apgar score

9. Discuss the proper management for a newborn who needs ventilatory assistance.

10. What is the significance of meconium in the amniotic fluid?

CHAPTER
34

Pediatric Emergencies

National EMS Education Standard Competencies

Special Patient Populations

Applies a fundamental knowledge of the growth, development, and aging and assessment findings to provide basic emergency care and transportation for a patient with special needs.

Patients With Special Challenges

› Recognizing and reporting abuse and neglect (pp 1268–1271 and Chapter 35, *Geriatric Emergencies*)

Health care implications of

› Abuse (pp 1268–1271 and Chapter 35, *Geriatric Emergencies*)
› Neglect (pp 1268, 1270 and Chapter 35, *Geriatric Emergencies*)
› Homelessness (Chapter 36, *Patients With Special Challenges*)
› Poverty (Chapter 36, *Patients With Special Challenges*)
› Bariatrics (Chapter 36, *Patients With Special Challenges*)
› Technology dependent (Chapter 36, *Patients With Special Challenges*)
› Hospice/terminally ill (Chapter 36, *Patients With Special Challenges*)
› Tracheostomy care/dysfunction (Chapter 36, *Patients With Special Challenges*)
› Home care (Chapter 36, *Patients With Special Challenges*)
› Sensory deficit/loss (Chapter 36, *Patients With Special Challenges*)
› Developmental disability (Chapter 36, Patients With Special Challenges)

Pediatrics

Age-related assessment findings, and age-related assessment and treatment modifications for pediatric-specific major diseases and/or emergencies

› Upper airway obstruction (pp 1228–1232, 1240–1243)
› Lower airway reactive disease (pp 1228–1232, 1240–1245)

› Respiratory distress/failure/arrest (pp 1232, 1240–1253)
› Shock (pp 1230, 1232, 1253–1255)
› Seizures (pp 1255–1256, 1260–1261)
› Sudden infant death syndrome (pp 1271–1274)

Age-related assessment findings, and developmental stage related assessment and treatment modifications for pediatric-specific major diseases and/or emergencies

› Upper airway obstruction (pp 1228–1232, 1240–1243)
› Lower airway reactive disease (pp 1228–1232, 1240–1245)
› Respiratory distress/failure/arrest (pp 1232, 1240–1253)
› Shock (pp 1230, 1232, 1253–1255)
› Seizures (pp 1255–1256, 1260–1261)
› Sudden infant death syndrome (pp 1271–1274)
› Gastrointestinal disease (pp 1257–1258)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Special Considerations in Trauma

Recognition and management of trauma in

› Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
› Pediatric patient (pp 1226–1240, 1261–1267)
› Geriatric patient (Chapter 35, *Geriatric Emergencies*)

Pathophysiology, assessment, and management of trauma in the

› Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
› Pediatric patient (pp 1226–1240, 1261–1267)
› Geriatric patient (Chapter 35, *Geriatric Emergencies*)
› Cognitively impaired patient (Chapter 36, *Patients With Special Challenges*)

Knowledge Objectives

1. Explain some of the challenges inherent in providing emergency care to pediatric patients and why effective communication with both the patient and his or her family members is critical to a successful outcome. (p 1218)
2. Discuss the physical and cognitive developmental stages of an infant, including health risks, signs that may indicate illness, and patient assessment. (pp 1219–1220)
3. Discuss the physical and cognitive developmental stages of a toddler, including health risks, signs that may indicate illness, and patient assessment. (pp 1220–1221)
4. Discuss the physical and cognitive developmental stages of a preschool-age child, including health risks, signs that may indicate illness, and patient assessment. (pp 1221–1222)
5. Discuss the physical and cognitive developmental stages of a school-age child, including health risks, signs that may indicate illness, and patient assessment. (p 1222)
6. Discuss the physical and cognitive developmental stages of an adolescent, including health risks, patient assessment, and privacy issues. (pp 1222–1223)
7. Describe differences in the anatomy and physiology of the pediatric patient compared to the adult patient and their implications for EMTs, with a focus on the following body systems: respiratory, circulatory, nervous, gastrointestinal, musculoskeletal, and integumentary. (pp 1223–1226)
8. Describe differences in the pathophysiology of the pediatric patient compared to the adult patient and their implications for EMTs, with a focus on the following body systems: respiratory, circulatory, nervous, gastrointestinal, musculoskeletal, and integumentary. (pp 1224–1226)
9. Explain the steps in the primary assessment of a pediatric patient, including the elements of the pediatric assessment triangle (PAT), hands-on ABCs, transport decision considerations, and privacy issues. (pp 1227–1236)
10. Explain the steps in the secondary assessment of a pediatric patient, including what EMTs should look for related to different body areas and the method of injury. (pp 1236–1240)

11. Describe the emergency care of a pediatric patient in respiratory distress, including the different causes of pediatric respiratory emergencies, the signs and symptoms of increased work of breathing, and the difference between respiratory distress and respiratory failure. (pp 1228–1229, 1240–1253)
12. List the possible causes of an upper and a lower airway obstruction in a pediatric patient and the steps in the management of foreign body airway obstruction. (pp 1241–1243)
13. Describe asthma, its possible causes, signs and symptoms, and steps in the management of a pediatric patient who is experiencing an asthma attack. (pp 1243–1244)
14. Explain how to determine the correct size of an airway adjunct intended for a pediatric patient during an emergency. (pp 1245–1249)
15. List the different oxygen delivery devices that are available for providing oxygen to a pediatric patient, including the indications for the use of each and precautions EMTs must take to ensure the patient's safety. (pp 1249–1253)
16. Describe the emergency care of a pediatric patient who is in shock (hypoperfusion), including common causes, signs, and symptoms. (pp 1253–1255)
17. Describe the emergency care of a pediatric patient with an altered mental status, including common causes, signs, and symptoms. (p 1255)
18. Describe the emergency care of a pediatric patient who has experienced a seizure, including the different types of seizures, common causes, signs, and symptoms. (pp 1255–1256)
19. Describe the emergency care of a pediatric patient with meningitis, including common causes, signs, symptoms, and special precautions. (pp 1256–1257)
20. Describe the emergency care of a pediatric patient who is experiencing a gastrointestinal emergency, including common causes, signs, and symptoms. (pp 1257–1258)
21. Describe the emergency care of a pediatric patient who has been poisoned, including common sources of poisoning, signs, and symptoms. (pp 1258–1259)
22. Describe the emergency care of a pediatric patient who is dehydrated, including how to gauge the severity of dehydration based on key signs and symptoms. (pp 1259–1260)
23. Describe the emergency care of a pediatric patient who is experiencing a fever emergency, including common causes. (pp 1260–1261)
24. Describe the emergency care of a pediatric patient who has experienced a drowning emergency, including common causes, signs, and symptoms. (p 1261)
25. Discuss the common causes of pediatric trauma emergencies; include how to differentiate between injury patterns in adults, infants, and children. (pp 1261–1267)
26. Discuss the significance of burns in pediatric patients, their most common causes, and general guidelines EMTs should follow when assessing patients who have sustained burns. (pp 1266–1267)
27. Explain the four triage categories used in the JumpSTART system for pediatric patients during disaster management. (pp 1267–1268)
28. Describe child abuse and neglect and its possible indicators, including the medical and legal responsibilities of EMTs when caring for a pediatric patient who is a possible victim of child abuse. (pp 1268–1271)
29. Discuss sudden infant death syndrome (SIDS), including its risk factors, patient assessment, and special management considerations related to the death of an infant patient. (pp 1271–1272)
30. Discuss the responsibilities of EMTs when communicating with a family or loved ones following the death of a child. (pp 1272–1273)
31. Discuss some positive ways EMTs may cope with the death of a pediatric patient and why managing posttraumatic stress is important for all health care professionals. (p 1273)

Skills Objectives

1. Demonstrate how to position the airway in a pediatric patient. (p 1231, Skill Drill 34-1)
2. Demonstrate how to palpate the pulse and estimate the capillary refill time in a pediatric patient. (pp 1232–1233)
3. Demonstrate how to use a length-based resuscitation tape to size equipment appropriately for a pediatric patient. (p 1246)
4. Demonstrate how to insert an oropharyngeal airway in a pediatric patient. (pp 1245–1247, Skill Drill 34-2)
5. Demonstrate how to insert a nasopharyngeal airway in a pediatric patient. (pp 1247–1249, Skill Drill 34-3)
6. Demonstrate how to administer blow-by oxygen to a pediatric patient. (p 1249)
7. Demonstrate how to apply a nasal cannula to a pediatric patient. (pp 1249–1250)
8. Demonstrate how to apply a nonrebreathing mask to a pediatric patient. (p 1250)

9. Demonstrate how to assist ventilation of an infant or child using a bag-valve mask (BVM). (pp 1250–1251)
10. Demonstrate how to perform one-person BVM ventilation on a pediatric patient. (pp 1251–1252, Skill Drill 34-4)
11. Demonstrate how to perform two-person BVM ventilation on a pediatric patient. (p 1253)
12. Demonstrate how to immobilize a pediatric patient who has been involved in a trauma emergency. (pp 1263–1264, Skill Drill 34-5)
13. Demonstrate how to immobilize a pediatric patient in a car seat who has been involved in a trauma emergency. (pp 1264–1265, Skill Drill 34-6)

Introduction

Children differ anatomically, physically, and emotionally from adults. The illnesses and injuries that children sustain, and their responses to them, vary based on age or developmental level. Children are not small adults; therefore, you must tailor your approach to accommodate the unique needs of pediatric patients. Depending on his or her age, the child may not be able to tell you what is wrong. Fear of EMS providers and pain can make the child difficult to assess. In addition, the child's parents or primary caregivers may be stressed, frightened, or behaving irrationally. For these reasons, **pediatrics**, the specialized medical practice devoted to the care of young patients, can be extremely challenging.

With the proper training and an understanding of this patient population, you will learn the tools necessary to form a baseline assessment and plan of care. Once you learn how to approach children of different ages and what to expect while caring for them, you will find that treating children also offers some very special rewards. Not only are their innocence and openness appealing, they often respond to treatment much more rapidly than adults do.

Communication With the Patient and the Family

In most situations, caring for an infant or child means that you must care for the parents or caregivers as well **Figure 34-1**. Family members often need emotional support when medical emergencies or problems develop. A calm parent or caregiver usually results in a calm child; he or she can often assist you with the child's care. An agitated parent or caregiver usually means that the child will act the same way, which often will make the child's care more difficult. Make sure that you are calm, efficient, professional, and sensitive as you deal with pediatric patients and their families.

Figure 34-1 Treating a sick or injured child can be extremely challenging. It is important to maintain a calm, professional demeanor as you care for both the child and the parents or caregivers.

Growth and Development

Recall from Chapter 7, *Life Span Development*, that many physical and emotional changes occur during childhood, which extends from birth until age 18 years. These changes will impact the care you provide to pediatric patients and can create difficulties during your assessment and treatment of the child if you do not expect them. For example, a child's head is proportionally larger than an adult's head, which predisposes the child to heat loss and head injuries from falls and other forms of trauma.

Whereas each child is unique, the thoughts and behaviors of children as a whole are often grouped into five stages: infancy, the toddler years, preschool years, school-age years, and adolescence. Children in each stage grapple with different developmental issues. Even though there are specific issues that are important to different age groups, there are also some general rules that apply when you care for children of any age.

YOU are the Provider — PART 1

At 2323 hours, you are dispatched to 545 West San Antonio Street for a 4-year-old girl with respiratory distress. You and your partner proceed to the scene; your response time is 6 minutes. It is a clear autumn day. The temperature is 58°F (14.4°C), and the traffic is light.

1. How does a child's airway and respiratory system differ from an adult's?
2. What are some airway and breathing problems that are unique to pediatric patients?

The Infant

Infancy is usually defined as the first year of life; the first month after birth is called the neonatal or newborn period.

0 to 2 Months

Infants younger than 2 months spend most of their time sleeping or eating. They experience the world through their bodies and respond mainly to physical stimuli such as light, warmth, hunger, and sound. Infants sleep for up to 16 hours a day between feeding times and parent or caregiver interactions. An infant should be aroused easily from a sleeping state, and it should be considered an emergency if this is not the case.

Infants are unable to tell the difference between parents or caregivers and strangers. Other than crying, infants have a limited ability to communicate pain or discomfort. Infants may cry if certain basic physical needs must be met, such as food, warmth, and comfort. Soothing an infant should be relatively easy for the parent or caregiver, such as by holding, cuddling, or rocking the infant. Hearing is generally well developed at birth, so calm and reassuring talk is often helpful as well. Every reasonable attempt should be made to identify why the infant is crying. If all obvious needs have been addressed and the infant is still inconsolable, then this could be a sign of significant illness.

Infants at this stage have a sucking reflex for feeding. Head control is limited, but infants can turn their heads and focus on faces. Infants have poor thermoregulation (the body's ability to maintain normal temperature). Their heads also have a relatively large surface area. These factors predispose them to hypothermia, so parents or caregivers will often bundle infants in an attempt to keep them warm. With this in mind, it is often necessary to unbundle the infant during your assessment.

2 to 6 Months

Infants between ages 2 and 6 months are more active, which makes them easier to evaluate. They spend more time awake, they begin to smile and make eye contact, and they recognize parents or caregivers. Healthy infants in this age group will have a strong sucking reflex, active extremity movement, and a vigorous cry. They may follow a bright light or toy with their eyes or turn their heads toward a loud sound or a familiar voice.

During this stage the infant has an increased awareness of what is going on around him or her and will use both hands to examine objects and explore the world. About 70% of infants will sleep through the night by 6 months. At this point in development, infants will begin to roll over.

As with younger infants, persistent crying and irritability can be an indicator of serious illness. A lack of eye contact in a sick infant can also be a sign of significant illness, depressed mental status, or a delay in development.

6 to 12 months

During this stage, infants begin to babble and by their first year, infants can say their first word. These infants also sit without support, progress to crawling, and finally begin to walk. This form of locomotion predisposes this age group to increased exposure to physical dangers. At this age, infants are teething and prone to explore their world by picking things up and placing them in their mouths. This behavior increases the risk for choking and poisonings from toxic substances.

At 6 to 12 months, infants may begin to cry if separated from their parents or caregivers. This behavior is called separation anxiety, which is common among this age group **Figure 34-2**. One way you can limit the infant's agitation is to let the parent or caregiver hold the infant as you start your physical assessment. As with the younger infants, persistent crying or irritability can be a symptom of serious illness.

Assessment

Begin your assessment by observing the infant from a distance, preferably in a parent's or caregiver's arms—this will avoid separation anxiety and often make the assessment of the infant easier. Provide as much sensory comfort as you can: warm your hands and the end of the stethoscope and offer a pacifier if the parent or caregiver allows it. If possible, have a parent or caregiver hold the infant during all procedures or allow them to stay close to the infant. If possible, plan to do any painful or uncomfortable procedures at the end of the assessment process, so that the infant does not become agitated while you are trying to perform a physical examination. Complete each procedure efficiently and avoid interruptions. Explain each procedure to the parent or caregiver before you perform it, because the procedure and the infant's reaction to it may be upsetting.

Figure 34-2 Infants are usually not afraid of strangers, but as they reach 6 months to 1 year, they may become irritable or cry if separated from their parents or caregivers.

The Toddler

After infancy, until about age 3 years, a child is called a **toddler**. Toddlers experience rapid changes in growth and development.

12 to 18 Months

During this period, toddlers begin to walk and to explore their environment. They are able to open doors, drawers, boxes, and bottles. Because they are explorers by nature and are not afraid, injuries in this age group increase. At 12 to 18 months, toddlers begin to imitate the behaviors of older children and parents and may express a desire to dress like their mommies or daddies. The toddler knows major body parts when you point to them and may speak 4 to 6 words. Because of a lack of molars, toddlers may not be able to fully chew their food before swallowing, leading to an increased risk of choking.

18 to 24 Months

The mind of the toddler develops rapidly. At the beginning of this stage, the toddler may have a vocabulary of 10 to 15 words. By age 2 years, a toddler should be able to pronounce approximately 100 words. When you point to a common object, toddlers should be able to name it. At this stage, toddlers begin to understand cause and effect with such activities as playing with pop-up toys (jack-in-the-box) and turning on and off a light switch. The toddler's balance and gait also improve rapidly during this period. Running and climbing are two skills that develop. At this stage, toddlers tend to cling to their parents or caregivers and often have a special object such as a blanket or teddy bear that comforts them when they are separated. Be sure to use any comforting objects when available to help calm the toddler.

Assessment

Stranger anxiety may still develop early in this period. Toddlers may resist separation from parents or caregivers and be afraid to let others come near them. Allow the toddler to hold any special object that brings the toddler comfort ("Would you like to hold your blankie while I listen to your tummy?"). When possible, demonstrate the assessment on a doll or stuffed animal first, which may limit the toddler's anxiety and make it easier to perform the assessment. Because of their newfound independence, they may also be very unhappy about being restrained or held for procedures **Figure 34-3**. Two-year-olds in particular have a well-deserved reputation for having their own ideas about almost everything, which is why these years are often called the "terrible twos."

Toddlers have trouble describing or localizing pain because they do not have the verbal ability to be precise. Pain in the abdomen may be expressed as, "My tummy hurts," and the physical examination may reveal tenderness throughout the body. With this in mind, the use of visual clues and the Wong-Baker FACES pain scale, discussed later in this chapter, can be helpful with this age group.

Toddlers can be curious and adventuresome, so you may be able to distract them **Figure 34-4**. For example, you might allow the toddler to play with a tongue depressor while you assess his or her vital signs. Restrain the toddler for as short a time as possible, and allow him or her to be comforted by the parent or caregiver immediately after a painful procedure. Whenever possible, begin your assessment at the feet or far from the location of any pain to keep from upsetting the toddler.

Figure 34-3 Because of their newfound independence, toddlers may be unhappy about being restrained or held for procedures.

Figure 34-4 Allow a toddler to sit on the parent's or caregiver's lap during your assessment, and use a toy to distract him or her.

Like infants, persistent crying or irritability in a toddler can be a symptom of serious illness or injury. Painful procedures make a lasting impression at this stage. Older toddlers may remember negative experiences with physicians or nurses, such as vaccinations or stitches, and fear treatment. Remember to involve the parent or caregiver in any procedures. This not only provides you with an extra set of hands, but the presence of the parent or caregiver will comfort the toddler. If a parent or caregiver is unavailable, reassure the toddler using simple words and a calm, soothing voice.

The Preschool-Age Child

Preschool-age children (ages 3 to 6 years) are able to use simple language effectively. The most rapid increase in language occurs during this stage of development. These children can walk and run well and begin throwing, catching, and kicking during play. Toilet training is mastered at this stage.

Preschool-age children have a rich imagination, which can make them particularly fearful about pain and change involving their bodies **Figure 34-5**. At this age, they often believe that their thoughts or wishes can cause injury or harm to themselves or to others. They may believe that an injury is the result of a bad deed they did earlier in the day.

They are also learning which behaviors are appropriate and which behaviors will lead to a "time out." Tantrums may occur when preschool-age children feel they cannot control a situation or its outcomes.

The risk of foreign body airway obstruction continues to be high at this age.

Figure 34-5 Preschool-age children have a vivid imagination, so much of the history must still be obtained from the parent or caregiver.

Assessment

Preschool-age children can understand directions, be more specific in describing their sensations, and identify painful areas when questioned. Despite the increased ability to communicate, much of the child's history will still be obtained from parents or caregivers. Remember to communicate simply and directly. Tell the child what you are going to do immediately before you do it; this way, the child has no time to develop frightening fantasies. Also keep in mind that the preschool-age child can be very literal. Asking if you may "take" his or her blood pressure may lead the child to believe that you will not give it back. Use plain language and provide plenty of reassurance.

At this age, preschool-age children are easily distracted with counting games, small toys, or conversation **Figure 34-6**. Appealing to the preschool-age child's imaginative thinking may allow treatment to go a bit smoother. For example, have the child pretend to be a superhero inhaling special powers while breathing in oxygen. Be sure to adjust the level of the game to the developmental level of the child; do not assume that preschool-age children understand more than they actually do.

While caring for this age group and others within the pediatric population, never lie to the patient. Once you have lost your pediatric patient's trust, it will be a challenge to regain it.

Begin your assessment with the feet and move toward the head, similar to assessing a toddler. Use adhesive bandages to cover the site of an injection or other small wound, because the preschool-age child might be worried about keeping his or her body together in one piece. Keep in mind that modesty is developing at this age, so keep the child covered when possible.

Figure 34-6 A preschool-age child can be easily distracted by games or conversation.

School-Age Years

School-age children (ages 6 to 12 years) begin to act more like adults. They can think in concrete terms, respond sensibly to direct questions, and help take care of themselves. School is important at this stage and concerns about popularity and peer pressure occupy a great deal of time and energy. Children with chronic illness or disabilities can become self-conscious because of concerns about fitting in with their peers. At this stage, children begin to understand that death is final, but their understanding of what death is and why it occurs is still unrealistic. This may increase their anxieties about illness or injury.

Assessment

Your assessment begins to be more like an adult assessment; talk to the child, not just the parent or caregiver, while taking the medical history **Figure 34-7**. This will help you gain the patient's trust. At this stage, the child is usually familiar with the process of physical examination through check-ups and immunizations. This may make your job easier or more difficult, depending on whether the child's prior health care experiences have been positive or negative. Begin your assessment at the head and move toward the feet, similar to assessing an adult.

Whenever possible, give the school-age child simple, appropriate choices, such as "Would you like to sit up or lie down?" or "Would you like to take off your clothes yourself?" Only ask the type of questions that let you control the answer and do not bargain or debate with the patient. For example, ask the child if you may find out the blood pressure on the child's right or left arm. Presenting a choice allows you to obtain assessment information and gives the child some control in a frightening situation. Encourage cooperation by allowing the child to listen to his or her own heartbeat through the stethoscope. Ensure the patient's modesty during the examination.

Figure 34-7 School-age children are more like adults in that they can answer your questions and can help to take care of themselves.

Preschool-age children can understand the difference between emotional and physical pain and have concerns about what pain means. Give them simple explanations about what is causing their pain and what will be done about it. Games and conversation may distract them. Ask them to describe their favorite place, pets, school activities, or toys. Ask the parent's or caregiver's advice in choosing the right distraction. Rewarding the child after a procedure can be very helpful in his or her future cooperation and recovery. Often, kind words and a smile make a good reward when toys or books are unavailable.

Adolescents

Most **adolescents** (ages 12 to 18 years) are able to think abstractly and can participate in decision making. This is also the stage when personal morals begin to develop. Adolescents are able to discriminate between what is right and wrong. They are now able to incorporate their own values and beliefs into their daily decision-making process. Even though this age group is physically similar to adults, adolescents are still children on an emotional level. They gradually shift from relying on family to relying on friends for emotional psychologic support, social development, and acceptance from their peers (especially the opposite sex). Interest in romantic relationships begins.

Adolescence is when puberty begins. Primary and secondary sex characteristics develop (sex organs, facial/axillary hair). This period of change makes the adolescent very concerned about his or her appearance. Simple injuries or illnesses can be exaggerated or understated due to anxiety about body image or fear of disfigurement. The adolescent may dislike being observed during procedures and may have strong feelings about privacy.

Adolescence is a time of experimentation and risk-taking behaviors. Adolescents often feel that they are free from danger, and that they are "indestructible." Adolescents struggle with independence, loss of control, body image, sexuality, and peer pressure. They may have mood swings or depression and when ill or injured, may act younger than their age.

Assessment

Remember that adolescents can often understand complex concepts and treatment options; provide them with information when they request it **Figure 34-8**. When the adolescent's condition is stable, discuss the situation and allow the adolescent to be involved in his or her care. Provide the adolescent with choices regarding his or her health, while also lending guidance if needed. You will find adolescents to be more helpful and understanding of necessary procedures than younger patients.

If the adolescent's condition requires him or her to be exposed or partially exposed to be assessed, take every measure to respect the patient's modesty and privacy. If an EMT of the same gender is available to perform the physical examination, it may lessen the stress of the event. Adolescents undergo numerous body changes during puberty, and some adolescents may have a negative or altered body image (an unrealistic sense of what their bodies look like, how it should look, or how society expects them to look). An injury that could result in a scar from a laceration or burn will be challenging for you to address. The best practice is to be honest, tactful, and to reassure the adolescent that you are doing everything within your training to help in this situation. Allow the adolescent to speak openly about any thoughts and concerns.

Figure 34-8 Respect the adolescent's privacy at all times; give the patient whatever information he or she requests.

Because the adolescent is under the influence of hormonal changes, peer pressure, and emotional highs and lows, risk-taking behaviors are common. Some of the risks that the adolescent takes can ultimately facilitate development and judgment and help to shape his or her identity as an adult. However, some risks can result in unintentional trauma, drug and/or alcohol abuse, unprotected sex, and teen pregnancy.

Be aware that female adolescents may be pregnant, so ask, "Is there a chance you could be pregnant?" Communicate her answer to the receiving facility and note it on your patient care report. The adolescent might not want this information known to her parents or caregivers and may fear the consequences of her actions. If you suspect that the patient might want to tell you something, but is silent in front of a parent or caregiver, try to interview the adolescent without the parent or caregiver present.

Adolescents have a clear understanding of the purpose and meaning of pain. Whenever possible, explain any necessary procedures well in advance. Assess their level of pain by observing facial and body expression as well as by asking questions; adolescents can be very reserved and may not request pain relief even when they need it. To distract them, find out some of their interests, such as sports or movies, and get them talking.

Anatomy and Physiology

There is no other time in a person's life that his or her body is growing and changing as fast as during childhood. Newborns quickly adapt to the world outside the mother's body (uterus). Toddlers learn to walk and talk. Adolescents transition into sexual maturity. To effectively assess and treat a pediatric patient, you must understand the physical differences between children and adults and alter your patient care accordingly.

The Respiratory System

To manage the pediatric airway effectively, you must understand the anatomic differences between the adult and pediatric airway. To start with, the pediatric airway is smaller in diameter and shorter in length, the lungs are smaller, and the heart is higher in a child's chest. The glottic opening (vocal cords) is higher and positioned more anteriorly (toward the front), and the neck appears to be nonexistent. As the child develops, the neck gets proportionally longer as the vocal cords and epiglottis achieve their anatomically correct adult position.

The anatomy of a pediatric airway and other important structures differs from that of an adult's in the following ways **Figure 34-9**:

- A larger, rounder occiput, or back of the head, which requires more careful positioning of the airway.
- A proportionately larger tongue relative to the size of the mouth and a more anterior location in the mouth. The child's tongue is also larger relative to the small mandible and can easily block the airway.

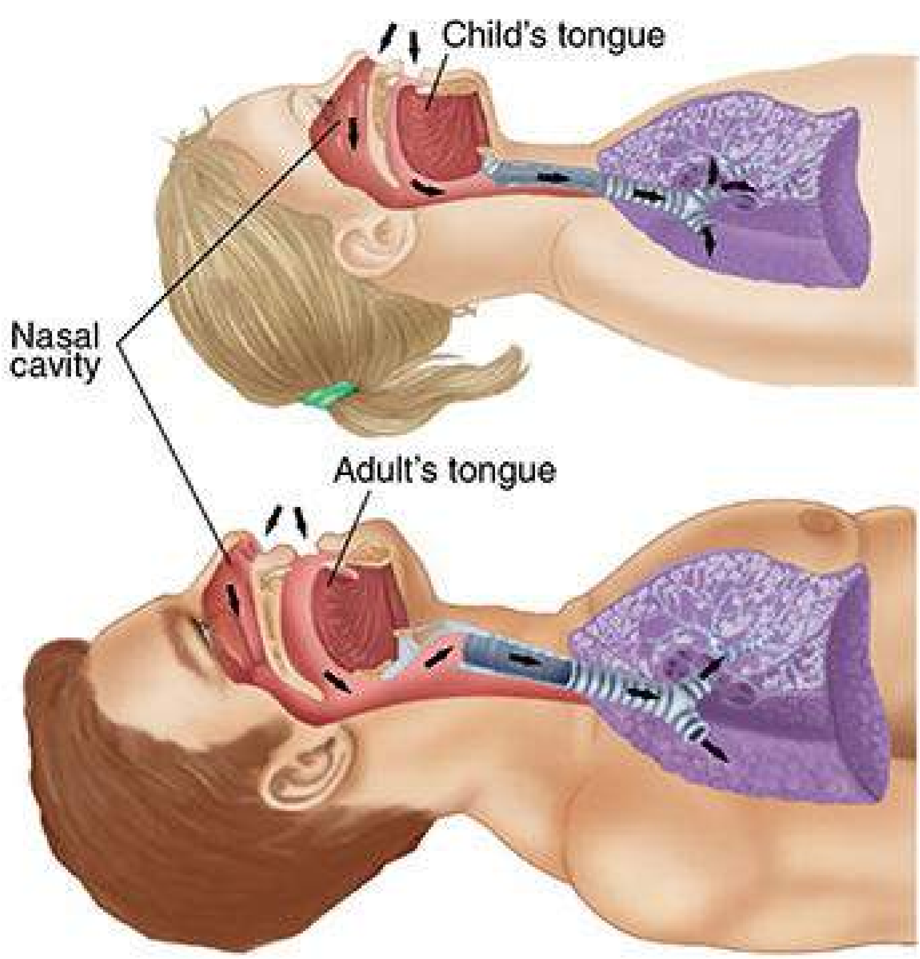


Figure 34-9 The anatomy of a child's airway differs from that of an adult's in several ways. The back of the head is larger in a child. The tongue is proportionately larger and is located more anterior in the mouth. The trachea is smaller in diameter and more flexible. The airway itself is lower and narrower (funnel-shaped).

- A long, floppy, U-shaped epiglottis in infants and toddlers is larger than an adult's, relative to the size of the airway that extends at a 45-degree angle into the airway.
- Less developed rings of cartilage in the trachea that may easily collapse if the neck is flexed or hyperextended.
- A narrowing funnel-shaped (wide to narrow) upper airway compared to that of a cylinder-shaped (same width) lower airway.

These differences will influence the treatment decisions that you make about pediatric patients, including whether or not intervention is needed and, if so, what procedure to use.

Words of Wisdom

To assist you with the assessment of a child, it is wise to utilize reference materials such as field guides or mobile device apps on these topics. Many EMS agencies also maintain copies of specialized pediatric protocols in their system. Refer to these resources during your care, and remember to make notes about your specific observations and treatment decisions. This “information-intensive” approach to pediatric care helps ensure good care and thorough documentation, and can reduce any anxiety you may feel about assessing children.

Because of the smaller diameter of the trachea in infants, which is about the same diameter as a drinking straw, their airway is easily obstructed by secretions, blood, or swelling. Infants are obligate nose breathers, which may require diligent suctioning or reassessment and management to maintain a clear airway.

An infant needs to breathe faster than an older child Table 34-1. Children’s lungs grow and develop increased abilities to handle the exchange of oxygen as they age. A respiratory rate of 30 to 60 breaths/min is normal for the newborn, whereas the adolescent is expected to have rates closer to the adult range (12 to 20 breaths/min). Children not only have a higher metabolic rate, but also a higher oxygen demand that is twice that of an adult. This in part is related to the actual size of the lung tissues and the volume that can be exchanged. Smaller lungs mean that the oxygen reserves are smaller. This higher oxygen demand combined with a smaller oxygen reserve increases the risk of hypoxia because of apnea or ineffective ventilation efforts.

Table 34-1 Pediatric Respiratory Rates

Age	Respirations (breaths/min)
Infant: 1 month to 1 year	30 to 60
Toddler: 1 to 3 years	24 to 40
Preschool-age: 4 to 5 years	22 to 34
School-age: 6 to 12 years	18 to 30
Adolescent: 13 to 18 years	12 to 16

Data From: Pediatric Advanced Life Support, 2012, the American Heart Association.

Safety Tips

In a pediatric patient, the lung tissues are prone to a simple or tension pneumothorax if excessive ventilatory pressures occur during assisted ventilations with a bag-valve mask (BVM). To prevent hypoxia and to avoid damaging the lung tissues, use the appropriate size mask and reservoir bag to avoid administering an excessively large tidal volume. Only use enough force to make the chest rise slightly. Focus your attention on the rise and fall of the chest wall, versus just simply squeezing the reservoir bag. Ventilate with the patient's underlying respiratory rate and be careful not to ventilate against the patient's efforts.

Breathing also requires the use of the chest muscles and diaphragm. Because intercostal muscles are not well developed in children, movement of the diaphragm, their major muscle of respiration, dictates the amount of air that they inspire. Young children also experience muscle fatigue much more quickly than older children. This can lead to respiratory failure if a child has to physically fight harder to breathe for long periods of time. Anything that places pressure on the abdomen of a young child can block the movement of the diaphragm and cause respiratory compromise. Gastric distention can also interfere with movement of the diaphragm and lead to hypoventilation. Use caution when applying straps to a spinal immobilization device because this may hinder full symmetrical chest wall expansion and thus limit tidal volume.

Breath sounds in children are easier to hear because of their thinner chest walls, but because less air is exchanged with each breath, detection of poor air movement or complete absence of breath sounds may be more difficult.

Table 34-2 Responsive Pediatric Pulse Rates

Age	Pulse Rate (beats/min)
Newborn to 3 months	85 to 205
3 months to 2 years	100 to 190
2 years to 10 years	60 to 140
>10 years	60 to 100

Data From: Pediatric Advanced Life Support, 2012, the American Heart Association.

The Circulatory System

It is important to know the normal pulse ranges when evaluating children Table 34-2. An infant's heart can beat as many as 160 times or more per minute if the body needs to compensate for injury or illness. This is the primary method the body uses to compensate for decreased perfusion.

Children are able to compensate for decreased perfusion by constricting the vessels in the skin. Constriction of the blood vessels can be so profound that blood flow to the extremities can be diminished. Signs of vasoconstriction include pallor (early sign), weak distal (eg, radial or pedal) pulses in the extremities, delayed capillary refill, and cool hands or feet.

The Nervous System

Compared with the adult nervous system, the pediatric nervous system is immature, underdeveloped, and not well protected. Recall that the head-to-body ratio of an infant and young child is disproportionately larger, making this population more prone to head injuries from falls or motor vehicle crashes. The occipital region of the head is larger, which increases the momentum of the head during a fall. The subarachnoid space is relatively smaller, leaving less cushioning for the brain. The brain tissue and the cerebral vasculature are fragile and prone to bleeding from shearing forces, such as during an incidence of shaken baby syndrome (discussed later in the chapter).

The pediatric brain requires a higher amount of cerebral blood flow, oxygen, and glucose than does adult brain tissue. Glucose stores are limited in the pediatric patient. These special needs mean that the pediatric brain is at risk for secondary brain damage from hypotension and hypoxic events.

Spinal cord injuries are less common in pediatric patients. According to studies conducted on the epidemiology of catastrophic spine injuries in high school, college, and professional sports, approximately 12,000 new spinal cord injuries are reported yearly in the United States. Roughly 10% of those spinal injuries occur in children under the age of 16. If a child's cervical spine is injured, it is most likely to be an injury to the ligaments as the result of a fall. If you suspect a neck injury, perform manual in-line stabilization or follow local protocols.

The Gastrointestinal System

The abdominal muscle structures are less developed in the pediatric patient, which results in less protection from blunt or penetrating trauma. The internal organs, such as the liver and the spleen, are proportionally larger and situated more anteriorly, so they are prone to bleeding and injury. Because the internal organs are positioned in a closer proximity to each other, there is a higher risk for multiple organ injury caused by minimal direct impact to this region, such as from a lap belt in a motor vehicle. The liver, spleen, and kidneys are more frequently injured in children than in adults.

The Musculoskeletal System

A child's bones are softer than an adult's. The skeletal system contains open growth plates at the ends of long bones, which enable these bones to grow during childhood. As a result of the active growth plates, children's bones are weaker and more flexible, making them prone to fracture with stress. The open growth plates are also weaker than ligaments and tendons, leading to length discrepancies if there is an injury to the growth plate. Because of these factors, immobilize extremities with suspected sprains or strains because they may actually be stress fractures.

The bones of the infant's head are flexible and soft, which allows the head to be delivered through the birth canal and for the growth of the brain during development. Located on the front (anterior) and back (posterior) portions of the head are soft spots known as **fontanelles**. Each will close at particular stages of development, 18 months for the anterior suture and 6 months for the posterior suture. It is important to note that some bulging is a normal assessment finding when the infant is either crying, coughing, or lying on the back or stomach. The fontanelles of an infant can be a useful assessment tool for such issues as increased cranial pressure (bulging with a noncrying infant) or dehydration (a sunken appearance).

The thoracic cage in children is highly elastic and flexible because it is primarily composed of cartilaginous connective tissue. The ribs and vital organs are less protected by muscle and fat. The highly flexible ribs mean that fractures in pediatric patients are rare, unless a high-energy impact to the chest wall is encountered, such as during a motor vehicle crash. However, underlying damage may still exist within the thoracic cavity without any exterior markings.

The Integumentary System

The integumentary system of the child differs from that of the adult in a few ways. The child's skin is thinner with less subcutaneous fat; it tends to burn more deeply and easily than an adult's, as in the case of a sunburn. Infants and children also have a larger body-surface-area-to-body-mass ratio, which can lead to significant fluid and heat losses.

Patient Assessment

Because a young child might not be able to speak, your assessment of his or her condition must be based in large part on what you can see and hear. Family members may be able to provide vital information about an incident or illness. Remember to include parents or caregivers as part of your team. Whenever possible, involve them in decisions and have them help comfort the infant or child during the assessment and any interventions.

Scene Size-up

The assessment begins at the time of initial dispatch. On the way to the scene, prepare mentally for approaching and treating an infant or child and interacting with the family. This means planning for a pediatric scene size-up, pediatric equipment, and the age-appropriate physical assessment. If possible, collect information from the dispatcher on the age and gender of the child, the location of the scene, the nature of illness (NOI), the mechanism of injury (MOI), and the chief complaint.

As with any EMS call, the scene size-up begins by ensuring that you and your partner have taken the appropriate safety precautions and standard precautions. As you enter the scene, note the position in which the child is found. Look for any possible safety threats to the child, parents or caregivers, bystanders, or EMS providers. Keep in mind that the child may be a safety threat if he or she has an infectious disease.

Next, do an environmental assessment. The environmental assessment will give important information on the chief complaint, number of patients, MOI or NOI, and ongoing health risks. Inspect the physical environment and observe the family–child and/ or caregiver–child interactions. Information from the parents or caregivers will be extremely important and may provide clues as to the patient's problem. As with the adult population, document dangerous scene conditions and obtain statements from parents, caregivers, or bystanders; this information will assist child protective services if the child is later determined to be a victim of an intentional injury. On the scene, be like a sponge; soak up as much useful information as possible to ensure scene safety and the delivery of timely care.

At a traumatic scene when the child is unresponsive or unable to communicate because of his or her developmental age, assume that the MOI was significant enough to cause head or neck injuries. Perform cervical spine immobilization if you suspect the MOI to be severe. Remember to pad under the child's head and/or shoulder to facilitate a neutral position for airway management. Always follow local protocols.

Primary Assessment

As with the adult population, the objective of the primary assessment is to identify and treat immediate or potential threats to life.

Pediatric Assessment Triangle

When you assess an infant or child, use the pediatric assessment triangle (PAT) to determine if the patient is sick or not sick. The **pediatric assessment triangle (PAT)** is a structured assessment tool that allows you to rapidly form a general impression of the child's condition without touching him or her. This "first glance" assessment, which can be performed in less than 30 seconds, will help you to identify the general category of the patient's physical problem and establish urgency for treatment and/or transport.

The PAT consists of three elements: appearance (muscle tone and mental status), **work of breathing**, and circulation to the skin Figure 34-10. The only equipment required for the PAT is your own eyes and ears.

As you evaluate the pediatric patient's appearance, note the level of consciousness or interactiveness and muscle tone—signs that will provide you with information about the adequacy of the pediatric patient's cerebral perfusion (mentation) and overall function of the central nervous system.

Much of the information regarding the pediatric patient's level of consciousness can be obtained by using the PAT. In addition, you can evaluate the pediatric patient's level of consciousness by using the AVPU scale, modified as necessary for his or her age Table 34-3.

An infant or child with a normal level of consciousness will act appropriately for his or her age, exhibiting good muscle tone and maintaining good eye contact Figure 34-11. An abnormal level of consciousness is characterized by age inappropriate behavior or interactiveness, poor muscle tone, or poor eye contact with the parent or caregiver or with you Figure 34-12.

YOU are the Provider — PART 2

You arrive at the scene, enter the residence, and find the child sitting on the couch next to her mother. She immediately makes eye contact with you, appears fearful of your presence, and starts clinging to her mother. You note that she is in obvious respiratory distress. As you approach the child, you make a visual assessment of her.

Recording Time: 0 Minutes	
Appearance	Obvious respiratory distress
Level of consciousness	Conscious; appears fearful
Airway	Open, no obvious obstructions
Breathing	Increased rate; moderate difficulty; nasal flaring; prominent supraclavicular retractions

Circulation	Skin pink and dry; no gross bleeding

3. Why did you not immediately perform a hands-on assessment of this child?
4. On the basis of your initial observations, is this child experiencing respiratory distress or respiratory failure?

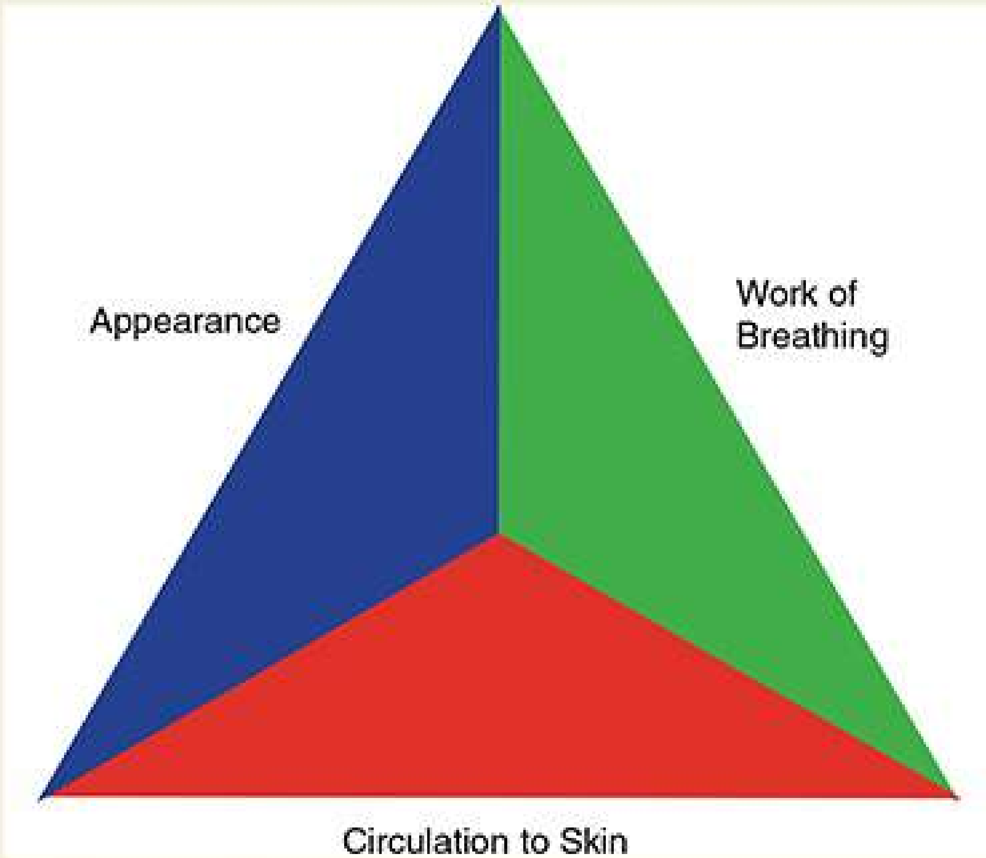


Figure 34-10 The three components of the pediatric assessment triangle (PAT) include appearance, work of breathing, and circulation to the skin.

Table 34-3 The AVPU Scale

Awake and Alert	Patient is awake; the eyes visually track people and objects
Responsive to Verbal Stimuli	Patient opens the eyes or moans, speaks, or moves in response to your voice
Responsive to Pain	Patient does not respond to verbal stimuli but moves or cries out in response to pain (eg, pinched ear lobe)
Unresponsive	No response to any stimulus

Figure 34-11 An infant or child making good eye contact is most likely not critically ill.

Figure 34-12 A limp child who is unable to maintain eye contact may be critically ill or injured.

Courtesy Health Resources and Services Administration, Maternal and Child Health Bureau, Emergency Medical Services for Children Program.

The mnemonic TICLS (or tickles) can also help to determine if the pediatric patient is sick or not sick. TICLS includes Tone, Interactiveness, Consolability, Look or gaze, and Speech or cry Table 34-4.

A pediatric patient's work of breathing increases as the body attempts to compensate for abnormalities in oxygenation and ventilation. Increased work of breathing often manifests as follows:

- **Abnormal airway noise:** (grunting or wheezing)
- **Accessory muscle use:** Contractions of the muscles above the clavicles (supraclavicular)
- **Retractions:** Drawing in of the muscles between the ribs (intercostal retractions) or of the sternum (substernal retractions) during inspiration Figure 34-13
- **Head bobbing:** The head lifts and tilts back during inspiration, then moves forward during expiration
- **Nasal flaring:** The nares (the external openings of the nose) widen; usually seen during inspiration

Table 34-4 Characteristics of Appearance: The TICLS Mnemonic

Characteristic	Features to Look For
Tone	Is the child moving or resisting examination vigorously? Does the child have good muscle tone? Or is the child limp, listless, or flaccid?
Interactiveness	How alert is the child? How readily does a person, object, or sound distract the child or draw the child's attention? Will the child reach for, grasp, and play with a toy or examination instrument, like a penlight or tongue blade? Or is the child uninterested in playing or interacting with the parent or caregiver or with the EMT?
Consolability	Can the child be consoled or comforted by the parent or caregiver or by the EMT? Or is the child's crying or agitation unrelieved by gentle reassurance?
Look or gaze	Does the child fix his or her gaze on a face, or is there a "nobody home," glassy-eyed stare?
Speech or cry	Is the child's cry strong and spontaneous or weak or high-pitched? Is the content of speech age-appropriate or confused or garbled?

Figure 34-13 Retractions of the intercostal muscles or sternum indicate increased work of breathing.

Courtesy of Health Resources and Services Administration, Maternal and Child Health Bureau, Emergency Medical Service for Children Program.

- **Tachypnea**: Increased respiratory rate
- **Tripod position**: In older children, this position will maximize the effectiveness of the airway **Figure 34-14**

As discussed previously, an important sign of perfusion is circulation to the skin. When cardiac output falls, the body, through vasoconstriction, shunts blood from areas of lesser need (such as the skin) to areas of greater need (such as the brain, heart, and kidneys). The PAT is a valuable tool in the field when you are confronted with various etiologies, such as respiratory distress or failure, cardiovascular shock leading to cardiopulmonary failure or arrest, isolated head injury, ingestion of a toxic substance, neurologic injuries—or even as an approach to a stable pediatric patient.

Figure 34-14 A patient in the tripod position will sit leaning forward on outstretched arms with the head and chin thrust slightly forward.

Pallor of the skin and mucous membranes may be seen in compensated shock; it may also be a sign of anemia or hypoxia. Mottling is caused by constriction of peripheral blood vessels and is another sign of poor perfusion **Figure 34-15**.

Cyanosis, a blue discoloration of the skin and mucous membranes, reflects a decreased level of oxygen in the blood.

Cyanosis is a late sign of respiratory failure or shock; absence of discoloration, however, does not rule out these conditions. Never wait for the development of cyanosis before administering oxygen!

On the basis of the findings of the PAT triangle, you will decide if the pediatric patient is in stable condition or requires urgent care. If the pediatric patient is in unstable condition, assess the ABCs, treat any life threats, and transport immediately to an appropriate facility. In pediatric patients with obvious life-threatening external hemorrhage, assess and address the CABs first, including applying tourniquets for arterial hemorrhage from extremities. See Chapter 25, *Bleeding,* for more information.

If the pediatric patient is in stable condition, then you have time to continue with the remainder of the patient assessment process, perform necessary interventions, and discuss transport options with the parents or caregivers.

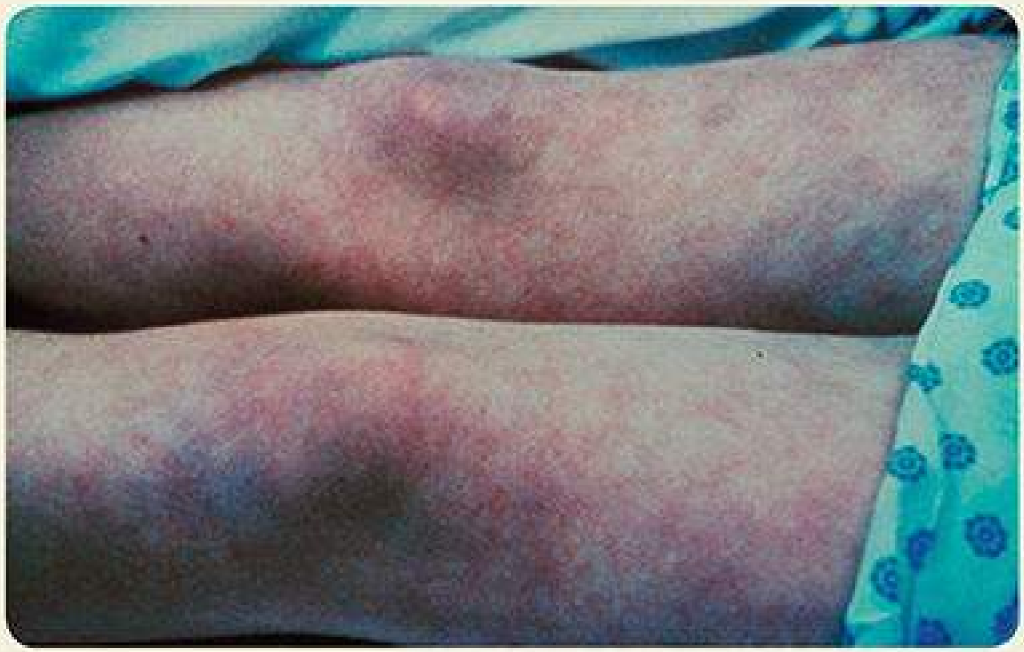


Figure 34-15 Mottling of the skin indicates poor perfusion and is the result of constriction of peripheral blood vessels.

Courtesy of Health Resources and Services Administration, Maternal and Child Health Bureau, Emergency Medical Service for Children Program.

Hands-on ABCs

For the pediatric patient, you will now perform a hands-on ABCs assessment. Assess and treat any life threats as you identify them by following the ABCDE format:

- **A**irway
- **B**reathing
- **C**irculation
- **D**isability
- **E**xposure

If the pediatric patient's airway is open and the patient can adequately keep it open (as is often the case in conscious pediatric patients), assess respiratory adequacy. However, if the pediatric patient is unresponsive or has difficulty keeping the airway clear, you must ensure that the airway is properly positioned and that it is clear of mucus, vomitus, blood, and foreign bodies.

If trauma has been ruled out, open the pediatric patient's airway with the head tilt–chin lift maneuver **Figure 34-16**. If spinal trauma is suspected, use the jaw-thrust maneuver to open the airway **Figure 34-17**.

Positioning the airway correctly is critical in pediatric emergency care. Always position the airway in a neutral **sniffing**

position. This accomplishes two goals at once, keeping the trachea from kinking and maintaining the proper alignment should you have to immobilize the spine.

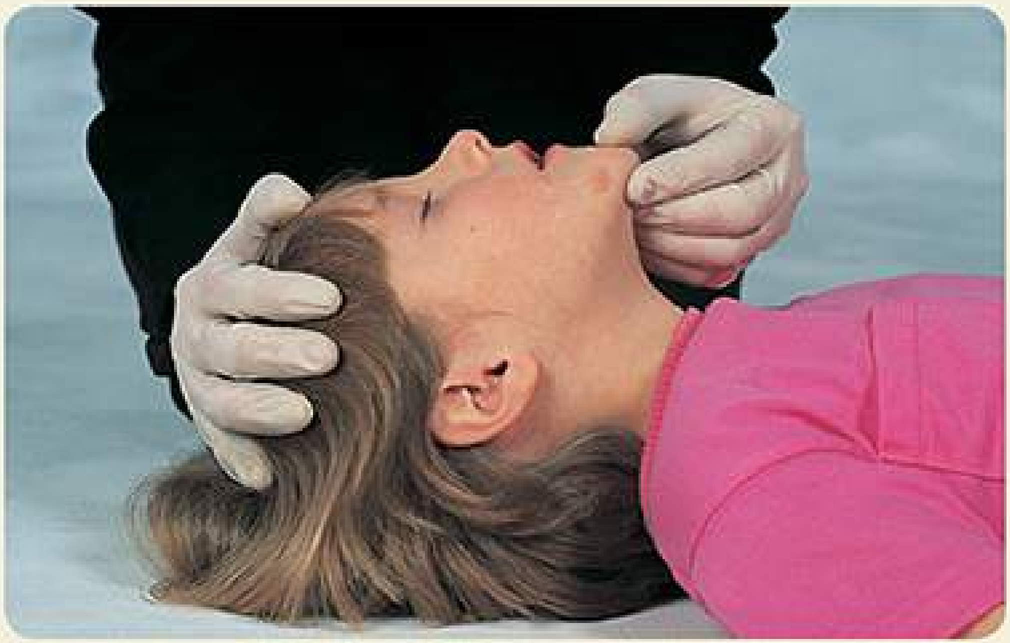


Figure 34-16 Use the head tilt–chin lift maneuver to open the airway of a pediatric patient without trauma.

Figure 34-17 Use the jaw-thrust maneuver to open the airway of a pediatric patient with possible spinal injury.

Follow these steps to position the airway in a pediatric patient without trauma **Skill Drill 34-1**:

1. Place the pediatric patient on a firm surface such as a short backboard or pediatric immobilization device **Step 1**.
2. Fold a small towel and place it under the pediatric patient's shoulders and back **Step 2**.
3. Stabilize the pediatric patient's forehead to limit rolling of the head during transport. Use the head tilt–chin lift maneuver to open the airway **Step 3**.

After the pediatric patient's airway has been opened, make sure that it is clear of potential obstructions such as mucus, blood, or foreign bodies. Next, establish whether the pediatric patient can maintain his or her own airway spontaneously (without the use of airway adjuncts) or whether adjuncts will be necessary to maintain airway patency. Techniques for airway management, and how to identify appropriately sized equipment for the pediatric patient, will be discussed later in this chapter.

Skill Drill 34-1 Positioning the Airway in a Pediatric Patient

Step 1

Position the pediatric patient on a firm surface.

Step 2

Place a folded towel about 1 inch (2.5 cm) thick under the shoulders and back.

Step 3

Stabilize the forehead to limit movement and use the head tilt–chin lift maneuver to open the airway.

Carefully assess the pediatric patient's breathing while at the same time feeling for a pulse. Note the degree of air movement at the nose and mouth and determine whether the chest is rising adequately and symmetrically. Assess the respiratory rate and effort with which the pediatric patient is breathing as well.

When you assess a pediatric patient, place both hands on the pediatric patient's chest to feel for the rise and fall of the chest wall. You will be able to count the actual respiratory rate and assess for symmetry. This assessment maneuver is especially helpful when your pediatric patient requires assisted ventilations with a BVM. In infants, belly breathing is considered adequate because of the soft pliable bones of the chest and the strong muscular diaphragm.

If the pediatric patient is conscious and not in need of immediate intervention (such as suctioning or assisted ventilation), it is usually easier to assess respirations with the pediatric patient sitting on the parent's or caregiver's lap. Listen for abnormal breath sounds **Table 34-5**, and note any signs of increased respiratory effort (work of breathing).

As the pediatric patient begins to tire, retractions often become weak and ineffective and the accessory muscles become less prominent during breathing. **Bradypnea**, a decrease in the respiratory rate, is an ominous sign and indicates impending respiratory arrest. Do not mistake bradypnea for a sign of improvement; it usually indicates that the pediatric patient's condition has deteriorated. Therefore, be prepared to begin ventilatory assistance.

When you assess circulation, you must determine if the pediatric patient has a pulse, is bleeding, or is in shock. Remember, infants and children can tolerate only small amounts of blood loss before circulatory compromise occurs. Assess and control any active bleeding early in your assessment.

A pulse may be difficult to palpate if it is weak, very fast, or very slow. In infants, palpate the brachial pulse or femoral pulse. In children older than 1 year, palpate the carotid pulse **Figure 34-18**. Note the rate and quality of the pulse: Is it weak or strong? Is it normal, slow, or fast? Strong **central pulses** usually indicate that the child is not hypotensive; however, this does not rule out the possibility of compensated shock. Weak or absent peripheral pulses indicate decreased perfusion. The absence of a central pulse (that is, brachial or femoral in infants, carotid in older children) indicates the need for cardiopulmonary resuscitation (CPR).

Tachycardia may be an early sign of hypoxia or shock, but it may also reflect less serious conditions such as fever, anxiety, pain, and excitement. Like the respiratory rate and effort, the pulse rate should be interpreted within the context of the overall history, PAT, and the entire primary assessment.

A trend of an increasing or decreasing pulse rate may be quite useful and may suggest worsening hypoxia or shock or improvement after treatment. When hypoxia or shock becomes critical, bradycardia occurs. Bradycardia is a condition in which the heart rate is less than 80 beats/min in children or less than 100 beats/min in newborns. As with slowing respirations, bradycardia in a pediatric patient is an ominous sign and often indicates impending cardiopulmonary arrest.

Table 34-5 Abnormal Breath Sounds

Crackles	A crackling or bubbling sound typically heard on inspiration; indicates inflammation or infection (such as in pneumonia)
Stridor	High-pitched inspiratory sound; indicates a partial upper airway obstruction (such as in croup or from a foreign body)
Wheezing	High- or low-pitched sound heard usually during expiration; indicates a partial lower airway obstruction (such as in asthma or bronchiolitis)
Grunting	An "uh" sound heard during exhalation; reflects the pediatric patient's attempt to keep the alveoli open by increasing pressure in the chest cavity; indicates inadequate oxygenation (such as in pneumonia)
Absent breath sounds (silent chest)	Combined with increased work of breathing, absent breath sounds indicate a complete upper or lower airway obstruction (such as from a foreign body, severe asthma, or pneumothorax); an ominous sign of impending respiratory failure that must be quickly addressed

Figure 34-18 **A.** Palpate the brachial pulse in infants. **B.** Palpate the femoral pulse as a second choice. **C.** In children older than 1 year, palpate the carotid pulse.

Feel the skin for temperature and moisture at the same time you assess the patient's pulse. Is the skin warm and dry, or cold and clammy? Estimate the capillary refill time by squeezing the end of a finger or toe for several seconds until the nail bed **blanches** and then observing the return of blood to the area **Figure 34-19**. Color should return within 2 seconds after you let go. The capillary refill time is used to assess end-organ perfusion. It is most reliable in children younger than 6 years; however, factors such as cold temperatures may affect the capillary refill time.

Figure 34-19 Estimate the capillary refill time by squeezing the end of a finger or toe for several seconds until the nail bed blanches. Normal color should return within 2 seconds after you let go.

Assess the pediatric patient's level of consciousness using the AVPU scale or the Pediatric Glasgow Coma Scale **Table 34-6**.

Check the responses of each pupil to a direct beam of light. A normal pupil constricts after a light stimulus. Pupillary response may be abnormal in the presence of drugs, ongoing seizures, hypoxia, or brain injury. Note if the pupils are dilated, constricted, reactive, or fixed.

Words of Wisdom

Helpful mnemonics to remember:

B	Blood pressure
L	Level of consciousness
S	Skin: color, temperature, moisture
C	Capillary refill time
P	Pulse: rate, rhythm, strength
R	Respiratory rate, effort, pattern

Next, look for symmetric movement of the extremities and note any neurologic motor deficit such as the inability to move the upper or lower extremities, an inability to communicate, weakness, or difficulty walking (gait).

Table 34-6 Pediatric Glasgow Coma Scale (GCS)

Activity	Score	Infant	Score	Child
Eye opening	4	Open spontaneously	4	Open spontaneously
	3	Open to speech or sound	3	Open to speech
	2	Open to painful stimuli	2	Open to painful stimuli
	1	No response	1	No response
Verbal	5	Coos, babbles	5	Oriented conversation
	4	Irritable cry	4	Confused conversation
	3	Cries to pain	3	Cries
	2	Moans to pain	2	Inappropriate words
	1	No response	1	Moans
				Incomprehensible words/sounds
				No response
Motor	6	Normal spontaneous movement	6	Obeys verbal commands
	5	Localizes pain	5	Localizes pain
	4	Withdraws to pain	4	Withdraws to pain
	3	Abnormal flexion (decorticate)	3	Abnormal flexion (decorticate)
	2	Abnormal extension (decerebrate)	2	Abnormal extension (decerebrate)
	1	No response (flaccid)	1	No response (flaccid)

Data Adapted From: Pediatric Advanced Life Support, 2012, the American Heart Association.

Pain is present with most types of injury and many illnesses. Inadequate treatment of pain has many adverse effects on the pediatric patient and the family. Pain causes significant morbidity and misery for pediatric patients and caregivers and interferes with assessment.

When you assess the severity of pain, consider the developmental age of the patient. The ability to recognize pain will improve as patients become older. For example, crying and agitation in an infant may be the result of hunger or a wet diaper. Meanwhile, a 3-year-old child can say, "My tummy really hurts." In children ages 3 and older, pain scales using pictures of facial expressions (Wong-Baker FACES Scale) may be helpful in assessing the level of pain **Figure 34-20**.

Proper exposure of the pediatric patient is necessary to complete the hands-on ABCs. The PAT requires that the parent or caregiver remove part of the pediatric patient's clothing to allow careful observation of the face, chest wall, and skin. Further exposure may be needed to fully evaluate physiologic functions, anatomic abnormalities, and unsuspected injuries or rashes. Be careful to avoid heat loss, especially in infants, by covering the patient as soon as possible.

The thermoregulatory system in the pediatric body is immature. Paired with thinner skin and a lack of subcutaneous fat, this makes the pediatric population more prone to hypothermia. Infants younger than 6 months lack the ability to shiver in response to a cold stimulus and therefore cannot generate body heat from this protective mechanism. Newborns and infants less than 1 month are the most susceptible to hypothermia.

Figure 34-20 The Wong-Baker FACES Scale.

Words of Wisdom

Remember that infants and children are prone to hypothermia because of poor thermoregulation and a larger surface-area-to-mass ratio than adults. You must ensure that a pediatric patient stays warm, especially when he or she is compromised due to illness or trauma.

Keep infants and young children warm (but not overly hot) during transport or when the patient is exposed to assess or reassess an injury. Cover the head in particular, because up to 50% of heat loss can occur with a head that is larger in proportion to the rest of the body. Without recognition and treatment of hypothermia, the pediatric patient may become unconscious and lapse into convulsive seizure activity.

Transport Decision

After you have completed the primary assessment using hands-on ABCs and initiated any treatment, you must decide when, how, and where to transport the patient. First, determine whether rapid transport to the hospital is indicated. If the pediatric patient is in stable condition, obtain a patient history, perform a secondary assessment at the scene, transport, and provide additional treatment as needed.

Rapid transport is indicated if the scene is unsafe for the pediatric patient or if any of the following conditions exist:

- A significant MOI—same MOIs as adults (Chapter 24, *Trauma Overview*), with the addition of:
  - Any fall from a height equal to or greater than a pediatric patient's height, especially with a headfirst landing
  - Bicycle crash (when not wearing a helmet)
- A history compatible with a serious illness
- A physical abnormality noted during the primary assessment
- A potentially serious anatomic abnormality
- Significant pain
- Abnormal level of consciousness, altered mental status, and/or any signs or symptoms of shock

In addition to the preceding factors, consider the following when making a transport decision:

- The type of clinical problem (injury versus illness)
- The expected benefits of advanced life support (ALS) treatment in the field

- Local EMS system treatment and transport protocols
- Your comfort level
- Transport time to the hospital

If the pediatric patient's condition is urgent, then initiate rapid transport to the closest appropriate facility. Specialty facilities such as trauma centers or children's hospitals have the training, staff, and equipment to provide complete care for all levels of pediatric patients. However, the most appropriate facility is not always the closest facility. To help you determine where to transport a pediatric patient, ask yourself this crucial question: *Can I deliver the pediatric patient to the most appropriate facility without risk or delay to the pediatric patient?* If you cannot, or if the illness or injury is so extensive that you cannot provide the care that the pediatric patient needs, then transport the pediatric patient to the closest facility. Additional assessment and treatment should occur en route to the hospital.

Pediatric patients weighing less than 40 pounds (18 kg) who do not require spinal immobilization should be transported in a car seat if the situation allows. Many types of car seats are available. A car seat should be chosen to fit the appropriate weight of the pediatric patient and should meet the current applicable standards set by your governing agency. There are only a few locations to place a car seat in an ambulance. Car seats are designed to be either forward-facing or rear-facing; they cannot be mounted sideways on a bench seat. Car seats should not be mounted in the front of an ambulance, especially if the ambulance is equipped with air bags. To mount a car seat to the stretcher, place the head of the stretcher in an upright position. Place the seat so it is against the back of the stretcher. Secure one of the stretcher straps from the upper portion of the stretcher through the seat belt positions on the seat and strap it tightly to the stretcher. Repeat on the lower portion of the stretcher. Push the car seat into the stretcher tightly and retighten the straps.

To secure a car seat to the captain's chair, follow the seat manufacturer's instructions. Remember that pediatric patients younger than 2 years must be transported in a rear-facing position because of the lack of mature neck muscles.

For pediatric patients who require spinal immobilization, it is no longer considered appropriate to secure a pediatric patient in a car seat. Immobilize the pediatric patient on a long backboard or other suitable spinal immobilization device. If the patient's condition is unstable and requires airway or ventilatory support, he or she should be positioned to maximize the ability to manage the airway and ventilatory requirements. Pediatric patients in cardiopulmonary arrest should likewise not be placed in a car seat but instead on a device that can be secured to the stretcher. Follow local protocols.

Do not use the pediatric patient's own car seat when the pediatric patient is in stable condition. Instead, transfer the pediatric patient to the ambulance's car seat or suitable restraining device. The goal is to secure and protect the pediatric patient for transport in the ambulance. The pediatric patient should be protected just as if he or she were in any other vehicle on the road.

Words of Wisdom

Depending on the age or developmental level of the pediatric patient, he or she may be unable to provide the necessary information for a thorough and complete patient history. Always include parents and primary caregivers in the history taking process. This is especially true when a child has a chronic, critical, or unique illness; the parents and caregivers will often have more experience and knowledge about the illness and the necessary care than you. Take advantage of their knowledge and their ability to assist you on scene, which will benefit the child's care.

History Taking

Your approach to the history will depend on the age of the pediatric patient. Historical information for an infant, toddler, or preschool-age child will need to be obtained from the parent or caregiver. When dealing with an adolescent, you will usually be able to obtain most of the immediate information from the patient; however, consult the parent or caregiver for a complete history.

Information about sexual activity, the possibility of pregnancy, or the use of illicit drugs or alcohol should be obtained from an adolescent patient in private. Adolescents will be reluctant to provide this information in the presence of their parents or caregivers. When asking sensitive questions, assure the adolescent that this information is important and is needed to provide the most appropriate care.

Question the parent or child about the immediate illness or injury based on the child's chief complaint. Together with an evaluation of the child's medical history, this may provide clues to the underlying illness or injury and other conditions that may exist.

When you interview the parent or caregiver or older child about the chief complaint, obtain the following pertinent information:

- The NOI or MOI
- How long the pediatric patient has been sick or injured
- The key events leading to the injury or illness: Were there any witnesses to the injury? From what height did the pediatric patient fall? What surface did the pediatric patient land on (soft or hard)?
- Presence of fever
- Effects of the illness or injury on the pediatric patient's behavior
- Pediatric patient's activity level
- Recent eating, drinking, and urine output
- Change in bowel or bladder habits
- Presence of vomiting, diarrhea, abdominal pain
- Presence of rashes

If the parent or caregiver is unable to accompany you to the hospital, obtain a name and phone number so a staff person can call if there are questions. This might be the case when you respond to a day care facility or babysitter's location. Most day care facilities require emergency contact information, past medical history, and/or a list of current prescribed medications taken by the child in case of an emergency. Care may be delayed if this information is not discovered early; however, you must never delay care of a critical patient.

Obtaining a SAMPLE history for a pediatric patient is the same as obtaining an adult's. However, the questions should be based on the pediatric patient's age and developmental stage of life Table 34-7.

Recall from Chapter 9, *Patient Assessment,* that the OPQRST format can help you gather additional information about a patient's history of present illness and current symptoms. The process for obtaining OPQRST is the same for children and adults. As with the SAMPLE history, the questions should be based on the pediatric patient's age and developmental stage Table 34-8.

Special Populations

A lower extremity injury should be suspected in any child who refuses to bear weight. Do not allow a patient with a suspected lower extremity injury to walk—question parents, bystanders, or even the child to determine the MOI and symptoms.

Secondary Assessment

In some instances, such as a critically ill or injured pediatric patient or a short transport time, you may not have time to conduct a secondary assessment. Perform a secondary assessment of the entire body when pediatric patients have the potential for hidden illnesses or injuries; for example, unresponsive medical patients or trauma patients with a significant MOI. This type of examination may help to identify problems such as a distended abdomen or possible fractures that were not as obvious during the primary assessment, but over time, the presenting signs and symptoms become more apparent.

Table 34-7 Pediatric SAMPLE Components

Component	Explanation
Signs and symptoms	Onset and nature of symptoms of pain or fever Age-appropriate signs of distress (see OPQRST listed below)
Allergies	Known drug reactions or other allergies
Medications	Exact names and doses of ongoing drugs (including over-the-counter, prescribed, herbal, and recreational drugs) Timing and amount of last dose Time and dose of analgesics or antipyretics
Pertinent past medical history	Previous illness or injuries Immunizations Complications surrounding pregnancy, labor, or delivery, including the route of delivery (infants and toddlers)
Last oral intake	Timing of the child's last food or drink, including bottle or breastfeeding
Events leading up to the illness or injury	Key events leading up to the current incident Fever history

Table 34-8 Pediatric OPQRST Components

Component	Explanation
Onset	How long has the patient been experiencing this event? What was the patient doing when the symptoms began?
Provocation/palliation	Does anything make the pain or discomfort better or worse? In what position is the patient most comfortable?
Quality	What does the pain feel like? "Dull," "sharp," or "cramping" are common descriptions. Does it come in waves?
Region/radiation	Where does the patient feel the symptoms?
Severity	Observe nonverbal cues (such as wincing or posture). Ask the pediatric patient to rate his or her symptoms using the Wong-Baker FACES pain scale (see) Figure 34-20.
Timing	When did symptoms begin? Have the symptoms been constant or do they come and go?

Use the DCAP-BTLS mnemonic (Deformities, Contusions, Abrasions, Punctures/Penetrations, Burns, Tenderness, Lacerations, and Swelling) to remind you what to assess for on a pediatric patient involved in a traumatic event.

After a physical examination of the whole body has been completed, perform a focused assessment on pediatric patients without life-threatening illnesses or injuries. Focus your physical examination on the area(s) of the body affected by the illness or injury as well as on the chief complaint, MOI or NOI, and on the findings of the primary assessment.

Words of Wisdom

Remember that DCAP-BTLS is *only* used for the trauma patient. For the medical patient, use SAMPLE and OPQRST and perform a full-body scan that focuses on the systems of the body.

Words of Wisdom

Young children are often afraid of authority figures in general, so you must earn their trust quickly in order to gain their cooperation. For example, demonstrate how you will perform the assessment using a stuffed animal or even an older sibling; this will show children that the assessment will not hurt them and establish a sense of trust. In addition, always remain calm and confident. Pediatric patients can sense fear and may not be willing to let you render care.

Infants, toddlers, and preschool-age children who do not have apparent life-threatening illness or injuries should be assessed starting at the feet and ending at the head; school-age children and adolescents can be assessed using the head-to-toe approach, as with adults. The extent of the physical examination will depend on the situation and may include the following:

- **Head.** The younger the infant or child, the larger the head is in proportion to the rest of the body, increasing the risk for head injury with deceleration (such as in falls or motor vehicle crashes). Look for bruising, swelling, and hematomas. Significant blood loss can occur between the skull and scalp of a small infant. A tense or bulging fontanelle in an upright, noncrying infant suggests elevated intracranial pressure caused by meningitis, encephalitis, or intracranial bleeding. A sunken fontanelle suggests dehydration.
- **Nose.** Young infants are obligate nose breathers, so nasal congestion with mucus can cause respiratory distress. Gentle bulb or catheter suction of the nostrils may bring relief.
- **Ears.** Look for any drainage from the ear canals. Leaking blood suggests a skull fracture. Check for bruises behind the ear or Battle sign, a late sign of skull fracture. The presence of pus may indicate an ear infection or perforation of the ear drum.
- **Mouth.** In the trauma patient, look for active bleeding and loose teeth. Note the smell of the breath. Some ingestions are associated with identifiable odors, such as hydrocarbons (eg, gasoline). Acidosis, as in diabetic ketoacidosis, may impart a fruity odor to the breath.
- **Neck.** Examine the area near the trachea for swelling or bruising. Note if the pediatric patient cannot move his or her neck and has a high fever. This may indicate that the pediatric patient has bacterial or viral meningitis.
- **Chest.** Examine the chest for penetrating injuries, lacerations, bruises, or rashes. If the pediatric patient is injured, feel the clavicles and every rib for tenderness and/or deformity.
- **Back.** Inspect the back for lacerations, penetrating injuries, bruises, or rashes.
- **Abdomen.** Inspect the abdomen for distention. Gently palpate the abdomen and watch closely for guarding or tensing of the abdominal muscles, which may suggest infection, obstruction, or intra-abdominal injury. Note any tenderness or masses. Look for any seat belt abrasions or bruising.
- **Extremities.** Assess for symmetry. Compare both sides for color, warmth, size of joints, swelling, and tenderness. Put each joint through full range of motion while watching the eyes of the pediatric patient for signs of pain, unless there is obvious deformity of the extremity suggesting a fracture.

Words of Wisdom

Because of the frequency of serious internal injuries in pediatric patients who show no external signs, it is especially important to investigate and thoroughly document the MOI. Do not let the rush at the scene distract you from determining the MOI, or at least direct another reliable responder to do so. Hospital care providers need this information.

Some of the guidelines used to assess adult circulatory status—heart rate and blood pressure—have important limitations in pediatric patients. First, normal heart rates vary with age in pediatric patients. Second, blood pressure is usually not assessed in pediatric patients younger than 3 years; it offers little information about the pediatric patient's circulatory status and is often difficult to obtain. In these pediatric patients, assessment of the skin is a better indication of their circulatory status.

It is important to use appropriately sized equipment when you assess a pediatric patient's vital signs. To obtain an accurate reading of a pediatric patient's blood pressure, use a cuff that covers two-thirds of the pediatric patient's upper arm. A blood pressure cuff that is too small may give you a falsely high reading, whereas a cuff that is too large may give you a falsely low reading. A useful tool to determine blood pressure in children ages 1 to 10 years (lower limits) is:

$$70 + (2 \times \text{child's age in years}) = \text{Systolic Blood Pressure}$$

Respiratory rates may be difficult to interpret. Rapid respiratory rates may simply reflect high fever, anxiety, pain, or excitement. Normal rates, on the other hand, may occur in a child who has been breathing rapidly with increased work of breathing for some time and is now becoming tired. Count the respirations for 30 seconds and then double that number. If the patient yawns, sighs, coughs, or talks during the 30-second period, wait a few seconds and begin again. In infants and children younger than 3 years, evaluate respirations by assessing the rise and fall of the abdomen. Assess the pulse rate by counting at least 1 minute, noting its quality and regularity.

Note that normal vital signs in pediatric patients vary with age **Table 34-9**. Remember that your approach to taking vital signs also varies with the age of the pediatric patient. Be gentle, talk to the pediatric patient, assess respirations and then pulse, and assess blood pressure last. Warm your stethoscope on your hands or a cloth before placing it on the skin. You may also want to let the pediatric patient hold the equipment first; this may help to reduce his or her anxiety.

Evaluate pupils in the child using a small pen-light. The response of pupils is a good indication of how well the brain is functioning, particularly when trauma has occurred. Be sure to compare the size of the pupils against each other.

A pulse oximeter is a valuable tool to measure the oxygen saturation in a pediatric patient with respiratory issues **Figure 34-21**.

YOU are the Provider — PART 3

Your partner hands the child's mother a pediatric nonrebreathing mask with the oxygen flow rate set at 12 L/min, and he asks her to hold the mask near the child's face. Although the child becomes somewhat agitated by the oxygen, she does not push the mask away. After your partner talks to the child and explains what he is going to do, he assesses her vital signs. You gather additional information from the child's parents.

Recording Time: 5 Minutes	
Respirations	34 breaths/min; labored
Pulse	124 beats/min; strong and regular
Skin	Pink, warm, and dry; capillary refill time, 1 second
Blood pressure	86/56 mm Hg
Oxygen saturation (Spo_2)	95% (on oxygen)

The child's mother tells you that her daughter has had a cold for the past 2 days, and has slowly developed a low-grade fever and high-pitched cough, which she describes as a "barking seal" sound. She was going to take her to the doctor tomorrow, but called 9-1-1 when the child began experiencing trouble breathing. Further assessment of the child reveals that her breath sounds are clear and equal bilaterally and she has prominent intercostal retractions.

5. What is the most likely cause of this child's respiratory distress?

6. Should you separate this child from her parents to provide further treatment? Why or why not?

Table 34-9 Pediatric Blood Pressure Ranges

Age	Systolic Blood Pressure (mm Hg)
Neonate: 1 day to 4 days	60 to 76
Neonate: 4 days to 1 month	67 to 84
Infant: 1 month to 3 months	73 to 94
Infant: 3 months to 6 months	78 to 103
Infant: 6 months to 1 year	82 to 105
Child: 1 year to 2 years	85 to 104
Child: 2 years to 7 years	88 to 106
Child: 7 years to 15 years	96 to 115
Adolescent: 15 years to 18 years	110 to 131

Data Adapted From: Pediatric Advanced Life Support, 2012, the American Heart Association.

Reassessment

Reassess the pediatric patient's condition as necessary—a general rule is to obtain vital signs and temperature every 15 minutes for a child in stable condition and at least every 5 minutes for a child in unstable condition. Infants and children can decompensate with alarming unpredictability; therefore, continually monitor respiratory effort, skin color and condition, and level of consciousness or interactiveness. Repeat the primary assessment and adjust your treatment accordingly.

When you provide interventions for a pediatric patient, remember that parents and caregivers may be able to assist you by calming and reassuring their child and are often well educated about their child's medical conditions. They are also able to assist with administering oxygen or medications via a nebulizer. Together you can build a trusting environment for the pediatric patient, who is already in a state of stress.

Communicate with the hospital on your findings and the interventions you used to improve the pediatric patient's condition. Be sure that all of this information is documented and given to emergency department (ED) personnel.

Figure 34-21 Pulse oximetry, which measures the pediatric patient's oxygen saturation, can be used to monitor the pediatric patient's status. **A.** Pulse oximeter probes can wrap around or clip onto fingers, toes, or ear lobes. **B.** A pulse oximeter being applied to an infant's foot.

Respiratory Emergencies and Management

Respiratory problems are the leading cause of cardiopulmonary arrest in the pediatric population. Failure to recognize and treat declining respiratory status will lead to death. A pediatric patient in respiratory distress still has the compensatory mechanisms and the ability to exchange oxygen and carbon dioxide. During respiratory distress, the pediatric patient is working harder to breathe and will eventually go into respiratory failure if left untreated. Respiratory failure occurs when the pediatric patient has exhausted all compensatory mechanisms and waste products begin to collect. If this is not treated, a total shutdown of the respiratory system will occur—respiratory arrest.

In the early stages of respiratory distress, you may note changes in the pediatric patient's behavior, such as combativeness, restlessness, and anxiety. As the body attempts to maximize the amount of air going into the lungs, the work of breathing increases. As discussed previously, the signs and symptoms of increased work of breathing include nasal flaring, abnormal breath sounds, accessory muscle use, and the tripod position.

As the pediatric patient progresses to possible respiratory failure, efforts to breathe decrease; the chest rises less with inspiration. The body has used up its available energy stores and cannot continue to support the extra work of breathing under these conditions. At this point, without care, cyanosis may develop (a late sign). Be aware not all pediatric patients develop cyanosis. You should be just as concerned about a pediatric patient with pale skin as one with blue skin.

Changes in behavior will also occur until the pediatric patient demonstrates an altered level of consciousness. The pediatric patient may experience periods of apnea (absence of breathing). As the lack of oxygen becomes more serious, the heart muscle itself becomes hypoxic and slows down. This leads to bradycardia—almost always an ominous sign in pediatric patients. If the heart rate is fast, you need to investigate the cause. However, if the heart rate is slow (less than 60 beats/min) or absent, especially in an unconscious infant or child, you must begin CPR immediately. Without aggressive airway management, bradycardia may quickly progress to cardiopulmonary arrest.

Of course, respiratory failure does not always indicate airway obstruction. It may indicate trauma, nervous system problems, dehydration (often caused by vomiting and diarrhea), or metabolic disturbances. For example, a pediatric patient with diabetes might have a blood glucose level that is too high or too low, or a pediatric patient might have a pH imbalance, as can happen with some rare pediatric diseases. Regardless of the cause, your first step is always to ensure adequate oxygenation and ventilation.

Never forget that a pediatric patient's condition can progress from respiratory distress to respiratory failure at any time. For this reason, you must reassess the pediatric patient frequently.

A child or infant in respiratory distress needs supplemental oxygen. Anxiety, agitation, or crying may increase the effort or work of breathing, so use whichever method seems least upsetting to the pediatric patient—mask, blow-by, or nasal cannula. You may need to get creative by distracting the pediatric patient with games, a toy, or conversation. Assist ventilation with a BVM and 100% oxygen for infants and children who are in possible respiratory failure.

Allow the pediatric patient to remain in a comfortable position. For a small child, this may mean sitting on the parent's or caregiver's lap. Give nothing by mouth, in case the patient's condition deteriorates suddenly. If the patient's condition progresses to respiratory failure, begin assisted ventilation immediately and continue to provide supplemental oxygen.

Airway Obstruction

Children, especially those younger than 5 years, can (and do) obstruct their airway with any object that they can fit into their mouth, such as hot dogs, balloons, grapes, or coins **Figure 34-22**. In cases of trauma, a child's teeth may have been dislodged into the airway. Blood, vomitus, or other secretions can also cause mild or severe airway obstruction.

As discussed in Chapter 15, *Respiratory Emergencies,* airway obstructions can also be caused by infections, including pneumonia, croup, epiglottitis, and bacterial **tracheitis** **Figure 34-23**. Consider infection as a possible cause of airway obstruction if a pediatric patient has congestion, fever, drooling, and cold symptoms.

Special Populations

Pediatric patients who have a tracheostomy tube to assist in breathing are at risk of tracheostomy dysfunction. This is an airway obstruction that results from an accumulation of thick mucus at the opening of the tracheostomy tube. These pediatric patients require urgent care and transport.

Obstruction by a foreign object may involve the upper or the lower airway, and may be partial or complete. Signs and symptoms that are frequently associated with a partial upper airway obstruction include decreased or absent breath sounds and stridor. Stridor is usually caused by swelling of the area surrounding the vocal cords or upper airway obstruction. Infants or children with a complete airway obstruction will have absent breath sounds and become rapidly cyanotic.

Figure 34-22 Any number of objects can obstruct a child's airway, including batteries, coins, toys, buttons, and candy.

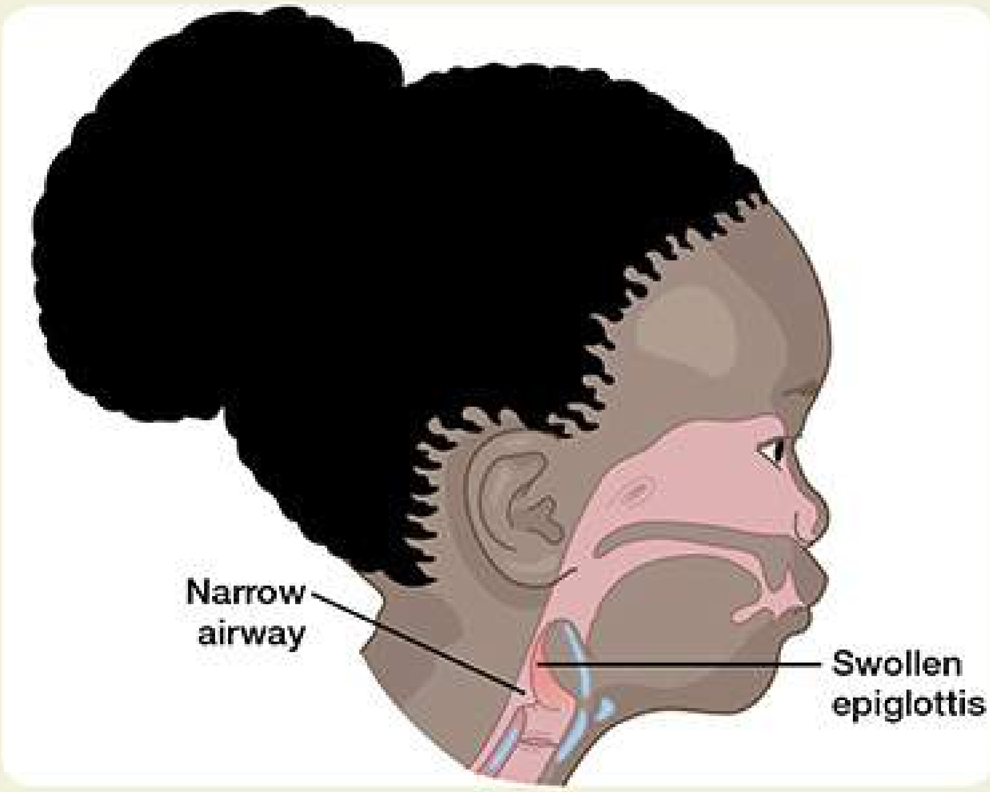


Figure 34-23 Epiglottitis is an infection that can cause airway obstruction in pediatric patients.

Signs and symptoms of a lower airway obstruction include wheezing and/or crackles. The best way to auscultate breath sounds in a pediatric patient is to listen on both sides of the chest at the level of the armpit **Figure 34-24**.

Immediately begin treatment of the pediatric patient with an airway obstruction. If the patient is conscious and coughing forcefully and you know for sure that there is a foreign body in the airway—that is, if someone actually saw the object go into the child's mouth—encourage the child to cough to clear the airway. If the material in the airway does not completely block the flow of air, the pediatric patient may be able to breathe adequately on his or her own without any intervention. In such cases, do not intervene except to provide supplemental oxygen **Figure 34-25**. Allow the pediatric patient to remain in whatever position is most comfortable, and monitor his or her condition during transport.

Figure 34-24 The best way to auscultate breath sounds in pediatric patients is to listen on both sides of the chest at the level of the armpit.

Figure 34-25 If a pediatric patient has a partial airway obstruction, do not intervene except to give supplemental oxygen. Allow the child to remain in whatever position is most comfortable during transport.

If you see signs of a severe airway obstruction, however, you must attempt to clear the airway immediately. The signs include the following:

- Ineffective cough (no sound)
- Inability to speak or cry
- Increasing respiratory difficulty, with stridor
- Cyanosis
- Loss of consciousness

If an infant is conscious with a complete airway obstruction, perform up to five back blows followed by five chest thrusts. First, position the infant facedown on your forearm. Support the infant's jaw and head with your hand. Next, use the heel of your other hand to slap the back forcefully five times (between the shoulder blades). If the airway does not clear, flip the infant onto his or her back, using your hand to support the head. Perform up to five chest thrusts in the same manner you would provide chest compressions for CPR. Repeat the process until the obstruction clears or until the infant becomes unconscious.

If a child (older than 1 year) is conscious with a complete airway obstruction, perform abdominal thrusts (Heimlich maneuver). Continue until the obstruction clears or until the child becomes unconscious.

If there is reason to believe that an unconscious child has a foreign body obstruction and there are no suspected spinal injuries, open the airway using the head tilt–chin lift maneuver and look inside the mouth to see whether the obstructing object is visible **Figure 34-26**. If the object is visible, try to remove it using a finger sweep motion. Never use finger sweeps if you cannot see the object because you may push it further into the airway.

Chest compressions are recommended to relieve a severe airway obstruction in an unconscious pediatric patient. Chest compressions increase the pressure in the chest, creating an artificial cough that may force a foreign body from the airway. Chapter 13, *BLS Resuscitation*, covers clearing a foreign body obstruction in an infant and child in detail.

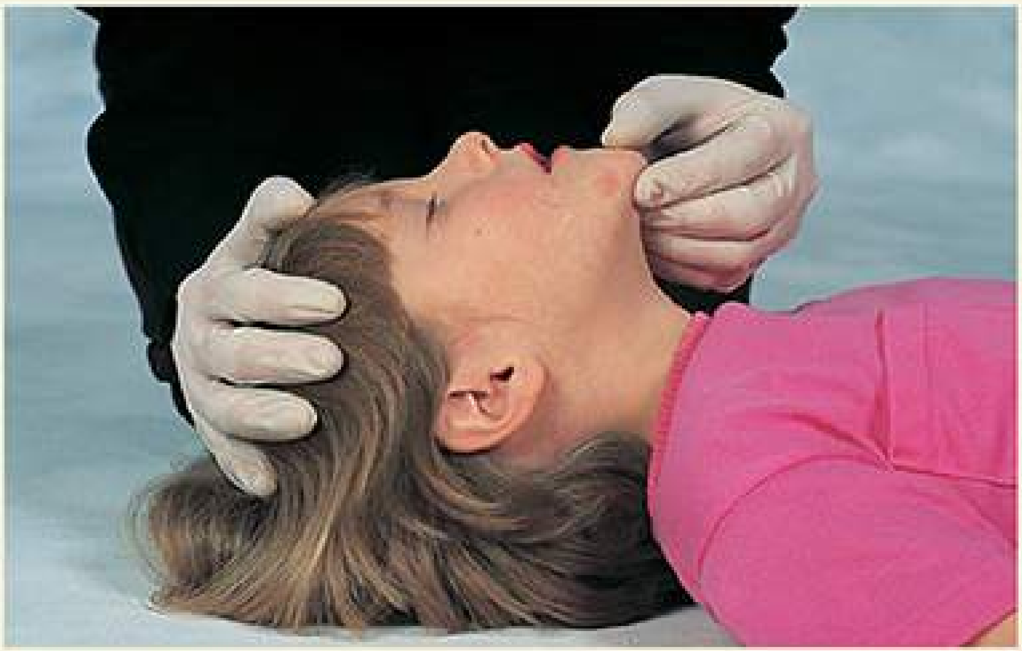


Figure 34-26 Open the airway and look inside the mouth of an unconscious pediatric patient with a possible airway obstruction.

Asthma

Asthma is a condition in which the smaller air passages (bronchioles) become inflamed, swell, and produce excessive mucus, which leads to difficulty breathing. Asthma is a true medical emergency if not promptly identified and treated. According to the Centers for Disease Control and Prevention (CDC), 10% of children in the United States have asthma and in 2007 alone, 185 children died of asthma. Common causes (triggers) for an asthma episode include upper respiratory infection, exercise, exposure to cold air or smoke, and emotional stress. Asthma is rare in children younger than 1 year.

Children with asthma will wheeze as they attempt to exhale through partially obstructed lower air passages; you may be able to hear loud wheezing without a stethoscope. In other cases, the airways are completely blocked and no air movement is heard. In severe cases, cyanosis and/or respiratory arrest may quickly develop. Asthma patients in respiratory distress will typically assume a position of comfort, such as the tripod position, to allow for maximum respiratory effort.

If possible, allow the pediatric patient to assume a position of comfort in the parent's or caregiver's lap. Avoid overexciting the pediatric patient because this may worsen the condition. Administer supplemental oxygen via a route that is tolerated by the child. Allow the parent or caregiver to assist the team by gathering any medications, calming the pediatric patient, or holding blow-by oxygen or a nonrebreathing mask.

A bronchodilator (albuterol, a beta-2 agonist) via a metered-dose inhaler (MDI) with a spacer-mask device may be administered based on local agency protocols. Often the parents or caregivers have attempted multiple dosages of albuterol via the MDI or nebulizer. In this case, ALS providers should be dispatched immediately to meet you en route for additional medication administration and advanced care.

If you must assist ventilations in a pediatric patient who is having an asthma attack, use slow, gentle breaths. Remember, the problem in asthma is getting the air out of the lungs, not into them. Resist the temptation to squeeze the reservoir bag hard and fast.

A prolonged asthma attack that is unrelieved may progress into a condition known as status asthmaticus. The pediatric patient is likely to be frightened, frantically trying to breathe, and using all the accessory muscles. Status asthmaticus is a true emergency. Administer oxygen and provide rapid transport to the ED.

The effort to breathe during an asthma attack is very tiring, and the pediatric patient may be exhausted by the time you arrive. An exhausted pediatric patient may have stopped feeling anxious or even struggling to breathe. It may look as if this patient is recovering; however, he or she is at a very critical stage and is likely to stop breathing. Aggressive airway management, oxygen administration, and prompt transport are essential in this situation. Consider calling for ALS backup. Follow local protocol.

Pneumonia

According to the World Health Organization, pneumonia is the leading cause of death for over 2 million children worldwide annually. Pneumonia is a general term that refers to an infection of the lungs. Pneumonia is often a secondary infection; it occurs during or after treatment for a pre-existing infection such as a cold. It can also be caused by direct lung injuries, such as from an accidental ingestion of a chemical or a submersion incident. Children with diseases causing immunodeficiency are at increased risk for pneumonia developing. You will notice that the incidence of this type of virus is greatest during the fall and winter months, affecting a large number of the pediatric population.

Often pediatric patients will present with unusually rapid breathing, or will breathe with grunting or wheezing sounds. Additional signs and symptoms include nasal flaring, tachypnea, and hypothermia or fever. The patient may also exhibit unilateral diminished breath sounds or crackles over the infected lung segments. Assess the work of breathing by observing for signs of accessory muscle usage. Pneumonia is particularly serious in infants because they have an increased oxygen demand and less respiratory reserve than older children or adults. For a pediatric patient with suspected pneumonia, your primary treatment will be supportive. Monitor the patient's airway and breathing status, and administer supplemental oxygen if required. If the child is wheezing, administer a bronchodilator if permitted in your EMS system. A diagnosis of pneumonia must be confirmed in the hospital setting with a chest x-ray, followed by the administration of antibiotics as the primary treatment.

Croup

Croup (laryngotracheobronchitis) is an infection of the airway below the level of the vocal cords, usually caused by a virus. This disease is typically seen in children between ages 6 months and 3 years. It is easily passed between children. The disease starts with a cold, cough, and a low-grade fever that develops over 2 days. The hallmark signs of croup are stridor and a seal-bark cough, which is a signal of significant narrowing of the air passage of the trachea that may progress to significant obstruction. Peak seasonal outbreaks of this disease occur in the late fall and during the winter. Croup often responds well to the administration of humidified oxygen. Bronchodilators are *not* indicated for croup and can make the child worse.

Epiglottitis

Epiglottitis (supraglottitis) is an infection of the soft tissue in the area above the vocal cords. Bacterial infection is the most common cause. Infants and children are the most common age groups diagnosed with epiglottitis, but it occurs in patients of all ages. Since the development of a vaccine against one organism that causes epiglottitis, the incidence of this disease has dramatically decreased. In preschool- and school-aged children especially, the epiglottis can swell to two to three times its normal size. This puts the airway at risk of complete obstruction. Patients with epiglottitis typically look very sick. The condition usually develops in otherwise healthy children, and symptoms are relatively sudden in onset. Children with this infection look ill, report a very sore throat, and have a high fever. They will often be found in the tripod position and drooling.

Bronchiolitis

Bronchiolitis is a specific viral illness of newborns and toddlers, often caused by respiratory syncytial virus (RSV) that causes inflammation of the bronchioles. RSV is highly contagious and spread through droplets when the pediatric patient coughs or sneezes. RSV is more common in premature infants and results in copious secretions that may require suctioning. The virus can also survive on surfaces, including hands and clothing. The infection tends to spread rapidly through schools and in child care centers.

Bronchiolitis occurs during the first 2 years of life and is more common in boys. These infections are most widespread in the winter and early spring. Bronchioles become inflamed, swell, and fill with mucus. The airways of infants and young children can become easily blocked.

When assessing a pediatric patient, look for signs of dehydration—infants with RSV often refuse liquids. If the RSV has progressed to bronchiolitis, shortness of breath and fever may be present.

Approach the pediatric patient with a calm demeanor and allow for a position of comfort. Treat airway and breathing problems as appropriate. Humidified oxygen is helpful if available. Consider calling for ALS backup and transport to the appropriate hospital.

Pertussis

Pertussis, also known as whooping cough, is a communicable disease caused by a bacterium that is spread through respiratory droplets. As the result of vaccinations, this potentially deadly disease is less common in the United States. The typical signs and symptoms are similar to a common cold: coughing, sneezing, and a runny nose. As the disease progresses, the coughing becomes more severe and is characterized by the distinctive whoop sound heard during inspiration. Infants infected with pertussis may develop pneumonia or respiratory failure. To treat pediatric patients, keep the airway patent (open) and transport. Because pertussis is contagious, follow standard precautions, including wearing a mask and eye protection.

Airway Adjuncts

In children with inadequate ventilation, use an airway adjunct to maintain an open airway. Airway adjuncts are devices that help to maintain the airway or assist in providing artificial ventilation, including oropharyngeal and nasopharyngeal airways, bite blocks, and BVMs. Placing the adjuncts correctly starts with choosing the appropriately sized equipment Table 34-10.

Oropharyngeal Airway

An oropharyngeal (oral) airway is designed to keep the tongue from blocking the airway, and it makes suctioning the airway, if necessary, easier. An oropharyngeal airway should be used for pediatric patients who are unconscious and in respiratory failure. This adjunct should not be used in either conscious pediatric patients or those who have a gag reflex. Pediatric patients with a gag reflex do not tolerate an oropharyngeal airway. In addition, this adjunct should not be used in children who may have ingested a caustic or petroleum-based product because it may induce vomiting.

Skill Drill 34-2 shows the steps for inserting an oropharyngeal airway in a child:

1. Determine the appropriately sized airway by placing the airway next to the face with the flange at the level of the central incisors and the bite block segment parallel to the hard palate. The tip of the airway should reach the angle of the jaw Step 1. Or, use length-based resuscitation tape to determine the appropriately sized airway.

YOU are the Provider — PART 4

The child's father carries her to the ambulance, where you appropriately secure her to the stretcher. You reassess her condition prior to transport and note that it has changed. On appearance, you note that her retractions have markedly weakened, she has a blank stare, and she is listless. Your partner quickly secures the child's mother in the front seat of the ambulance and begins rapid transport.

Recording Time: 10 Minutes	
Level of consciousness	Decreased activity; blank stare; listless
Respirations	18 breaths/min; weak retractions
Pulse	90 beats/min; weak and regular
Skin	Perioral cyanosis; cool and dry; capillary refill time, 3 seconds
Blood pressure	76/56 mm Hg
Spo_2	85% (on oxygen)

7. How has this child's condition changed? What should you do next?
8. How could an ALS intercept benefit this child?

Table 34-10 Pediatric Equipment: Getting the Size Right

The best way to identify the appropriately sized equipment for a pediatric patient is to use **length-based resuscitation tape** (Broselow tape). This color-coded tool can estimate weight as well as height in pediatric patients weighing up to 75 lb (34 kg) **Figure 34-27**. The proper sequence for using the tape is the following:

1. Place the pediatric patient supine on a flat surface.
2. Lay the tape next to the pediatric patient with the multicolored side facing up.
3. Place the red end of the tape at the top of the pediatric patient's head (red to head).
4. Place one hand with its side down at the top of the pediatric patient's head, covering the red box at the end of the tape.
5. Starting from the pediatric patient's head, run the side of your free hand down the tape.
6. Stretch the tape out the full length of the child, stopping at the heel. If the child is longer than the tape, stop here and use the appropriate adult equipment.
7. Place your free hand, side down, at the bottom of the child's heel.
8. Note the color or letter block and weight range on the edge of the tape where your hand is. Say the color or letter out loud.
9. Select the appropriately sized equipment by matching the color or letter on the tape to the color or letter on the equipment.

Figure 34-27 Length-based resuscitation tape is the best way to estimate the correct size for airway adjuncts in children.

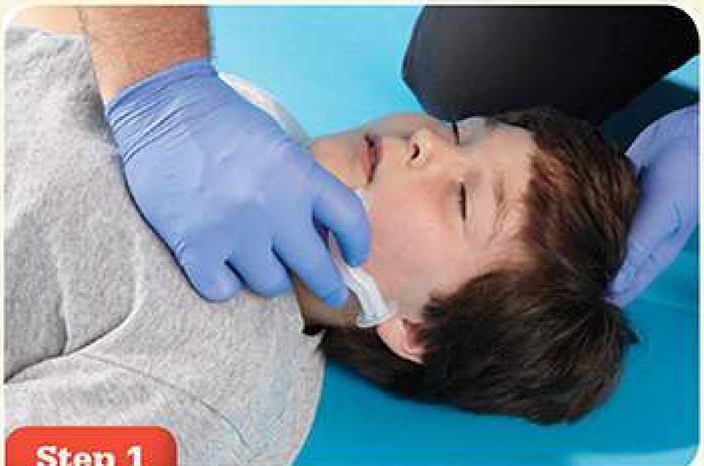
2. Position the pediatric patient's airway. If the emergency is medical, use the head tilt–chin lift maneuver. Avoid hyperextension; you may place a towel under the pediatric patient's shoulders. If the pediatric patient has a traumatic injury, use the jaw-thrust maneuver and provide manual in-line stabilization **Step 2**.
3. Open the mouth by applying pressure on the chin with your thumb.
4. Insert the airway by depressing the tongue with a tongue blade applied to the base of the tongue and inserting the airway directly over the tongue blade **Step 3**. If a tongue blade is unavailable, point the airway tip toward the roof of the mouth to depress the tongue. Gently rotate the airway into position as it passes through the mouth toward the curve of the tongue. Insert the airway until the flange rests against the lips.
5. Reassess the airway after insertion. Take care to avoid injuring the hard palate as you insert the airway. Rough insertion can cause bleeding, which can aggravate airway problems and may even cause vomiting. Note also that if the pediatric patient's airway is too small, the tongue may be pushed back into the pharynx, obstructing the airway. If the airway is too large, it may obstruct the larynx.

Nasopharyngeal Airway

A nasopharyngeal (nasal) airway is usually well tolerated and is not as likely as the oropharyngeal airway to cause vomiting. Unlike the oropharyngeal airway, the nasopharyngeal airway is used for pediatric patients who are responsive. In pediatric patients, the nasopharyngeal airway is typically used in association with possible respiratory failure. It is rarely used in infants younger than 1 year.

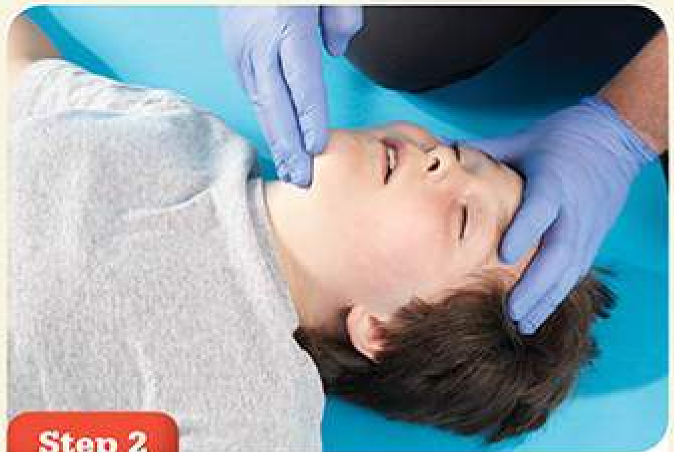
A nasopharyngeal airway should not be used in pediatric patients with nasal obstruction or head trauma (possible basilar skull fracture) or in pediatric patients with moderate to severe head trauma because this adjunct could increase intracranial pressure.

Skill Drill 34-2 Inserting an Oropharyngeal Airway in a Pediatric Patient



Step 1

Determine the appropriately sized airway. Confirm the correct size visually, by placing it next to the pediatric patient's face.



Step 2

Position the pediatric patient's airway with the appropriate method.

Step 3

Open the mouth. Insert the airway until the flange rests against the lips. Reassess the airway.

Follow the steps in **Skill Drill 34-3** to insert a nasopharyngeal airway in a pediatric patient:

1. Determine the appropriately sized airway. The external diameter of the airway should not be larger than the diameter of the nares, and there should be no blanching of the nares after insertion.
2. Place the airway next to the pediatric patient's face to make sure the length is correct. The airway should extend from the tip of the nose to the tragus of the ear. The tragus is the small cartilaginous projection in front of the opening of the ear.

3. Position the pediatric patient's airway, using the techniques described above for the oropharyngeal airway **Step 1**.
4. Lubricate the airway with a water-soluble lubricant.
5. Insert the tip into the right naris (nostril opening) with the bevel pointing toward the septum, or central divider in the nose **Step 2**. The right naris is commonly larger than the left naris in most patients.
6. Carefully move the tip forward, following the roof of the mouth, until the flange rests against the outside of the nostril **Step 3**. If you are inserting the airway on the left side, insert the tip into the left naris upside down, with the bevel pointing toward the septum. Move the airway forward slowly about 1 inch (2.5 cm) until you feel a slight resistance, and then rotate the airway 180 degrees.

Skill Drill 34-3 Inserting a Nasopharyngeal Airway in a Pediatric Patient

Step 1

Determine the correct airway size by comparing its diameter to the opening of the nostril (nare). Place the airway next to the pediatric patient's face to confirm correct length. Position the airway.

Step 2

Lubricate the airway. Insert the tip into the right naris with the bevel pointing toward the septum.

Step 3

Carefully move the tip forward until the flange rests against the outside of the nostril. Reassess the airway.

7. Reassess the airway after insertion.

As with the oropharyngeal airway, there can be problems with the nasopharyngeal airway. An airway with a small diameter may easily become obstructed by mucus, blood, vomitus, or the soft tissues of the pharynx. If the airway is too long, it may stimulate the vagus nerve and slow the heart rate or enter the esophagus, causing gastric distention. Inserting the airway in responsive patients may cause a spasm of the larynx and result in vomiting. Nasopharyngeal airways should not be used when pediatric patients have facial trauma because the airway may tear soft tissues and cause bleeding into the airway.

Oxygen Delivery Devices

When treating infants and children who require more than the usual 21% oxygen found in room air, you have several options:

- Blow-by technique at 6 L/min provides more than 21% oxygen concentration.
- Nasal cannula at 1 to 6 L/min provides 24% to 44% oxygen concentration.
- Nonrebreathing mask at 10 to 15 L/min provides up to 95% oxygen concentration (unassisted ventilations).
- BVM (with oxygen reservoir) at 15 L/min provides nearly 100% oxygen concentration (assisted ventilations).

Pediatric patients need enough air to be delivered for adequate gas exchange in the lungs. Therefore, use of a nonrebreathing mask, a nasal cannula, or a simple face mask is indicated only for pediatric patients who have adequate respirations and/or tidal volumes. The tidal volume is the amount of air that is delivered to the lungs and airways in one inhalation. Children with respirations of less than 12 breaths/ min or more than 60 breaths/min, an altered level of consciousness, and/or an inadequate tidal volume should receive assisted ventilation with a BVM.

Blow-by oxygen is not as effective as a face mask or nasal cannula for delivering oxygen. In the blow-by technique, an oxygen tube is held near the infant or child's nose and mouth. It is often used after childbirth to deliver a small amount of oxygen to the neonate. On rare occasions when other adjuncts cannot be used or the pediatric patient will not tolerate any other adjunct, this technique may be necessary. The blow-by technique does not provide a high concentration of oxygen but is better than no oxygen. To administer blow-by oxygen:

Figure 34-28 The blow-by technique may be less frightening to a child than an oxygen mask. Make a small hole in an 8-oz (237-mL) cup, or use a funnel inserted into the end of the oxygen tubing. Connect tubing to an oxygen source, and hold the cup about 1 to 2 inches (2 to 5 cm) from the child's face.

1. Place oxygen tubing through a small hole in the bottom of an 8-oz (237-mL) cup **Figure 34-28**. A cup is a familiar object that is less likely to frighten young children than is an oxygen mask.
2. Connect tubing to an oxygen source set at 6 L/min.
3. Hold the cup approximately 1 to 2 inches (2 to 5 cm) away from the child's nose and mouth.

Nasal Cannula

Some pediatric patients prefer the nasal cannula whereas others find it uncomfortable. To apply a nasal cannula:

1. Choose the appropriately sized pediatric nasal cannula. The prongs should not fill the nares entirely **Figure 34-29**. If the nares blanch, select a smaller cannula.
2. Connect the tubing to an oxygen source set at 1 to 6 L/min.

Figure 34-29 The prongs of a pediatric nasal cannula should not fill the nares entirely.

Nonrebreathing Mask

A nonrebreathing mask delivers up to 90% oxygen to the pediatric patient and allows the pediatric patient to exhale all carbon dioxide without rebreathing it **Figure 34-30**. To apply a nonrebreathing mask:

1. Select the appropriately sized pediatric nonrebreathing mask. The mask should extend from the bridge of the nose to the cleft of the chin.
2. Connect the tubing to an oxygen source set at 10 to 15 L/min.
3. Adjust oxygen flow as needed to match the pediatric patient's respiratory rate and depth. The reservoir bag should neither deflate completely nor fill to bulging during the respiratory cycle.

Bag-Valve Mask

Assisting ventilations with a BVM is indicated for pediatric patients who have respirations that are either too slow or too fast to provide an adequate volume of inhaled oxygen, who are unresponsive, or who do not respond in a purposeful way to painful stimuli.

Figure 34-30 A pediatric nonrebreathing mask delivers up to 95% oxygen and allows the patient to exhale carbon dioxide without rebreathing it.

Assist ventilation of an infant or child using a BVM in the following way:

1. Ensure that you have the appropriately sized equipment. The proper size mask will extend from the bridge of the nose to the cleft of the chin, avoiding compression of the eyes **Figure 34-31**. The mask is transparent, so you can watch for cyanosis and vomiting. In addition, mask volume should be small to decrease dead space and avoid rebreathing; however, the bag should contain at least 450 mL of air. Use an infant bag, not a neonatal bag, for infants younger than 1 year; use a pediatric bag for children older than 1 year. Older children and adolescents may need an adult bag. Make sure that there is no popoff valve on the bag; if the bag has a pop-off valve, make sure that you can hold it shut as necessary to achieve chest rise. Proper mask size for BVM ventilation is critical.
2. Maintain a good seal with the mask on the face.

Figure 34-31 Proper mask size for BVM ventilation is critical. The mask should extend from the bridge of the nose to the cleft of the chin, avoiding compression of the eyes.

3. Ventilate at the appropriate rate and volume using a slow, gentle squeeze, not a sharp, quick one. Stop squeezing and begin to release the bag as soon as the chest wall begins to rise, indicating that the lungs are filled to capacity. To keep from ventilating too rapidly, use the phrase "Squeeze, release, release." Say "Squeeze" as you squeeze the bag; when you see the chest start to rise, release pressure on the bag and slowly say "Release, release."

Words of Wisdom

Remember that one-person BVM ventilation is difficult; the ILCOR guidelines do not recommend this method. Errors in technique—such as providing too much volume with each breath, squeezing the bag too forcefully, or ventilating at a rate that is too fast—can result in gastric distention or overinflation of the lung, resulting in a pneumothorax. An inadequate mask seal or improper head position can lead to hypoventilation or hypoxia.

Special Populations

One of the problems associated with abdominal injuries in children is the presence of air in the stomach. Pediatric patients, especially those who have had a traumatic injury, tend to swallow air. Air in the stomach can cause distention and interfere with your assessment. Air can also accumulate in the stomach with artificial ventilation, making it less effective.

One-Person Bag-Valve-Mask Ventilation on a Pediatric Patient

Perform one-person BVM-ventilation according to these steps **Skill Drill 34-4**:

1. Open the airway, and insert the appropriate airway adjunct **Step 1**.
2. Hold the mask on the pediatric patient's face with a one-handed head tilt–chin lift maneuver (EC clamp technique). Form a *C* with the thumb and index finger along the mask while the other three fingers form an *E* along the mandible.

With infants and toddlers, support the jaw with only your third fingertip. Be careful not to compress the area under the chin because you may push the tongue into the back of the mouth and block the airway. Keep fingers on the mandible.

3. Make sure the mask forms an airtight seal on the face. Maintain the seal while checking that the airway is open **Step 2**.
4. Squeeze the bag using the correct ventilation rate of 1 breath every 3 to 5 seconds, or 12 to 20 breaths/min.
5. Each ventilation (squeeze of the bag) should last 1 second. Allow adequate time for exhalation **Step 3**.
6. Assess the effectiveness of ventilation by watching for adequate bilateral rise and fall of the chest **Step 4**.

Skill Drill 34-4 One-Person Bag-Valve Mask Ventilation on a Pediatric Patient

Step 1

Open the airway and insert the appropriate airway adjunct.

Step 2

Hold the mask on the pediatric patient's face with a one-handed head tilt–chin lift maneuver (EC clamp method). Ensure a good mask–face seal while maintaining the airway.

Step 3

Squeeze the bag using the correct ventilation rate of 1 breath every 3 to 5 seconds, or 12 to 20 breaths/min. Allow adequate time for exhalation.

Step 4

Assess the effectiveness of ventilation by watching bilateral rise and fall of the chest.

Two-Person Bag-Valve-Mask Ventilation on a Pediatric Patient

This procedure is similar to one-person ventilation except that it requires two EMTs—one to hold the mask to the pediatric patient's face and maintain the pediatric patient's head position, the other to ventilate the pediatric patient. This technique is usually more effective in maintaining a tight seal, as it provides an open airway due to proper body position.

Cardiopulmonary Arrest

As previously discussed, cardiac arrest in infants and children is most often associated with respiratory failure and respiratory arrest. Compared with adults, children are affected differently when it comes to decreasing oxygen concentrations. An adult becomes hypoxic and the heart develops a dysrhythmia that leads to sudden cardiac death. This is often in the form of ventricular fibrillation and is the reason that an automated external defibrillator (AED) is the treatment of choice. Children, on the other hand, become hypoxic and their hearts slow down, becoming more and more bradycardic. The heart will beat slower and more weakly until no pulse is felt. The overall survival rate from cardiac arrest in the prehospital setting in children is about approximately 8% according to the *2010 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care* published by the American Heart Association. The survival rate from respiratory arrest is only 70%. Any child who is breathing very poorly with a slowing heart rate must be ventilated with high concentrations of oxygen early to try to oxygenate the heart before cardiac arrest occurs. Chapter 13, *BLS Resuscitation*, covers providing CPR to pediatric patients in detail.

Circulation Emergencies and Management

The pediatric cardiovascular system is not all that different than an adult's. Although pediatric patients have a larger proportional amount of circulating blood volume than adults, they are more dependent on the actual cardiac output of the heart (amount of blood being pumped out of the heart in 1 minute). A pediatric patient actually may be in a state of shock while displaying a normal blood pressure. Infants and children have less blood circulating in their bodies than adults do, so the loss of even a small volume of fluid or blood may lead to shock.

Shock

As discussed in Chapter 12, *Shock*, shock is a condition that develops when the circulatory system is unable to deliver a sufficient amount of blood to the organs of the body. This results in organ failure and eventually cardiopulmonary arrest. The early stage of shock, while the body can still compensate for blood loss, is called compensated shock. The late stage, when blood pressure is falling, is called decompensated shock.

YOU are the Provider — PART 5

The closest ALS ambulance is 8 miles across town in heavy traffic and your estimated transport time is about 5 minutes, so you make the decision to continue transport. Your partner notifies the hospital and informs them of your impending arrival. Following additional treatment, you reassess the child's condition.

Recording Time: 18 Minutes	
Level of consciousness	Eyes are open; still appears listless
Respirations	20 breaths/min and shallow (baseline); assisted ventilations
Pulse	110 beats/min; stronger
Skin	Cyanosis is resolving; capillary refill time, 2 seconds
Blood pressure	84/54 mm Hg
Spo_2	96% (on oxygen)

9. Are you providing adequate ventilations? How can you tell?
10. Why is it especially important to avoid hyperventilating infants and children?

In pediatric patients, the most common causes include:

- Traumatic injury with blood loss (especially abdominal)
- Dehydration from diarrhea and vomiting
- Severe infection
- Neurologic injury, such as severe head trauma
- A severe allergic reaction to an allergen (anaphylaxis), such as an insect bite or food allergy
- Diseases of the heart

- A collapsed lung (tension pneumothorax)
- Blood or fluid around the heart (cardiac tamponade or pericarditis)

Pediatric patients respond differently than adults to fluid loss. They may respond by increasing their heart rate, increasing respirations, and showing signs of pale skin (pallor) or blue skin (cyanosis).

Signs of shock in infants and children are as follows:

- Tachycardia
- Poor capillary refill (>2 seconds)
- Mental status changes

Begin treating shock by assessing the ABCs, intervening immediately as required; do not wait until you have performed the complete assessment to take action. If there is an obvious life-threatening external hemorrhage, the order becomes CAB, because bleeding control is the most critical step. If cardiac arrest is suspected, the order also becomes CAB because chest compressions are essential. Pediatric patients in shock often have increased respirations but do not demonstrate a fall in blood pressure until shock is severe.

When you assess circulation, pay particular attention to the following:

- **Pulse.** Assess both the rate and the quality of the pulse. A weak, "thready" pulse is a sign that there is a problem. The appropriate rate depends on age; generally, except in the case of a newborn, anything over 160 beats/min suggests shock.
- **Skin signs.** Assess the temperature and moisture of the hands and feet. How does this compare with the temperature of the skin on the trunk of the body? Is the skin dry and warm, or cold and clammy?
- **Capillary refill time.** Squeeze a finger or toe for several seconds until the skin blanches, and then release it. Does the fingertip return to its normal color within 2 seconds, or is it delayed?
- **Color.** Assess the patient's skin color. Is it pink, pale, ashen, or blue?
- **Changes.** Changes in pulse rate, color, skin signs, and capillary refill time are all important clues suggesting shock.

Blood pressure is the most difficult vital sign to measure in pediatric patients. The cuff must be the proper size—two-thirds the length of the upper arm. The value for normal blood pressure is also age-specific. Remember that blood pressure may be normal with compensated shock. Low blood pressure is a sign of decompensated shock, requiring care from an ALS team and rapid transport.

Part of your assessment should also include talking with the parents or caregivers to determine when the signs and symptoms first appeared and whether any of the following has occurred:

- Decrease in urine output (with infants, are there fewer than 6 to 10 wet diapers?)
- Absence of tears, even when the child is crying
- A sunken or depressed fontanelle (infant patient)
- Changes in level of consciousness and behavior

Limit your management to these simple interventions. Do not waste time performing field procedures. Ensure that the airway is open; prepare for artificial ventilation; control bleeding; and give supplemental oxygen by mask or blow-by method as tolerated. Continue to monitor airway and breathing. Place the pediatric patient in a position of comfort. Keep the pediatric patient warm with blankets and by turning up the heat in the patient compartment. Provide rapid transport to the nearest appropriate facility and continue monitoring vital signs en route. Call for ALS backup as needed. Allow a parent or caregiver to accompany the pediatric patient whenever possible.

Anaphylaxis

Anaphylaxis, also called anaphylactic shock, is a life-threatening allergic reaction that involves a generalized, multisystem response to an antigen (foreign substance). Anaphylaxis is characterized by airway swelling and the dilation of blood vessels. Common causes include insect bites or stings, medications, and food.

A pediatric patient in anaphylactic shock will have hypoperfusion as well as additional signs such as stridor and/or wheezing, with increased work of breathing. The pediatric patient will also have an altered appearance with restlessness, agitation, and sometimes a sense of impending doom. Hives, an intensely itchy skin rash, are usually present.

Maintain the airway and administer oxygen via a route that is tolerated. If the pediatric patient is in stable condition, allow the parent or caregiver to assist in the positioning of the patient, oxygen delivery, and keeping the patient calm. Increased agitation and crying, combined with an increased work of breathing, may lead to increased bronchoconstriction. Based on local protocol, assist the parent or caregiver with administering a prescribed epinephrine auto-injector, if available. As discussed in Chapter 20, *Immunologic Emergencies*, the administration of epinephrine is the highest priority in infants and children with signs and symptoms of anaphylaxis. The pediatric epinephrine auto-injector (EpiPen Jr) is supplied in a dose of 0.15 mg and is given intramuscularly in the lateral thigh. Provide rapid transport to the hospital.

Bleeding Disorders

Hemophilia is a congenital condition in which the patient lacks one or more of the normal clotting factors of blood. There are several forms of hemophilia, most of which are hereditary and some of which are severe. Hemophilia is predominantly found in the male population. Sometimes bleeding may occur spontaneously. Because the pediatric patient's blood does not clot, all injuries, no matter how minor, are potentially serious. Transport a pediatric patient with hemophilia immediately and do not delay tourniquet application for life-threatening hemorrhage.

Neurologic Emergencies and Management

There are several causes of altered mental status in the pediatric population. Some of the most common causes are hypoglycemia, hypoxia, seizure, and drug or alcohol ingestion. The parent or caregiver is an important resource for you when you are gathering information regarding the baseline neurologic status of the pediatric patient. A pediatric patient with altered mental status may appear sleepy, lethargic, combative, or even unresponsive to tactile stimulus. Be diligent about assessing and managing the airway because pediatric patients may be prone to airway obstructions from their large tongues.

Altered Mental Status

An altered mental status is an abnormal neurologic state in which the pediatric patient is less alert and interactive than is age appropriate. Sometimes, the concern of the parent or caregiver is vague, stating that the child is "not acting right." Therefore, it is key that you understand normal developmental or age-related changes in behavior, and listen carefully to the parent's or caregiver's opinion about a pediatric patient's baseline behavior. For instance, a 4-month-old infant should be active, have the ability to track a toy or light with his or her eyes, smile, and make eye contact. As discussed at the beginning of this chapter, if the pediatric patient is not behaving in a developmentally appropriate manner, then this could indicate an altered mental status.

The mnemonic AEIOU-TIPS reflects the major causes of altered mental status **Table 34-11**.

The signs and symptoms of altered mental status vary widely from simple confusion to coma. Management of altered mental status focuses on the ABCs and transport. If the pediatric patient's level of consciousness is low, then the pediatric patient may not be able to protect his or her airway. Ensure a patent airway and adequate breathing through a nonrebreathing mask or a BVM. Pediatric patients with an altered level of consciousness may have inadequate breathing despite spontaneous respiratory effort, based on an inadequate respiratory rate or inadequate tidal volume. Transport to the hospital.

Seizures

A seizure is the result of disorganized electrical activity in the brain, causes of which are listed in **Table 34-12**. It can be very frightening to witness a seizure in a pediatric patient. Therefore, it is important to reassure the family and to approach assessment and management in a calm, step-by-step manner.

Table 34-11 Mnemonic to Assess Causes of Altered Mental Status

A	Alcohol
E	Epilepsy, endocrine, electrolytes
I	Insulin
O	Opiates and other drugs
U	Uremia (kidney failure)
T	Trauma, temperature
I	Infection
P	Poisoning, psychogenic causes
S	Shock, stroke, seizure, syncope, space-occupying lesion, subarachnoid hemorrhage

Table 34-12 Common Causes of Seizures

- Child abuse
- Electrolyte imbalance
- Fever
- Hypoglycemia (low blood glucose level)
- Infection
- Ingestion
- Lack of oxygen
- Medications
- Poisoning
- Seizure disorder
- Recreational drug use
- Head trauma
- No cause can be found

Seizures in children may manifest in a wide variety of ways, depending on the age of the child. Seizures in infants can be subtle, consisting only of an abnormal gaze, sucking motions, or “bicycling” motions. In older children, seizures are more obvious and typically consist of repetitive muscle contractions and unresponsiveness. Once a seizure has stopped, the patient’s muscles relax, becoming almost flaccid (floppy), and the breathing becomes labored (fast and deep). This is the postictal state. The longer and more intense a seizure is, the longer it will take for the imbalance to correct itself. Likewise, longer and more severe seizures will result in longer postictal unresponsiveness and confusion. Once the pediatric patient regains a normal level of consciousness, the postictal state is over.

Seizures that continue every few minutes without regaining consciousness or last longer than 30 minutes are referred to as status epilepticus. Recurring or prolonged seizures should be considered potentially life-threatening situations in which pediatric patients need emergency medical care. If the pediatric patient does not regain consciousness or continues to seize, protect the pediatric patient from harming himself or herself and call for ALS backup. These pediatric patients need advanced airway management and medication to stop the seizure.

Securing and protecting the airway are your priorities. Position the head to open the airway. Clear the mouth with suction. Consider placing the pediatric patient in the recovery position if the pediatric patient is actively vomiting and suction is inadequate to control the airway Figure 34-32. Provide 100% oxygen by nonrebreathing mask or blow-by method. If there are no signs of improvement, begin BVM-ventilation with appropriately sized equipment with supplemental oxygen. Some parents or caregivers will have given the child a rectal dose of diazepam (Diastat) to stop the seizure prior to your arrival. Monitor breathing and level of consciousness carefully in these patients. Transport the pediatric patient to the appropriate facility.

Figure 34-32 Position the head to open the airway and clear the airway with suction. If suction is inadequate or the patient is vomiting, consider placing the patient in the recovery position.

Pediatric seizures caused by fever (febrile seizures) are discussed later in the chapter.

Meningitis

Meningitis is an inflammation of the tissues called the meninges, that cover the spinal cord and brain. It is caused by an infection by bacteria, viruses, fungi, or parasites. If left untreated, meningitis can lead to permanent brain damage or death. You must be able to recognize a pediatric patient who may have meningitis.

Meningitis can occur in both children and adults, but some pediatric patients are at greater risk than others, as follows:

- Males
- Newborn infants
- Children with compromised immune systems (such as HIV/AIDS or cancer)
- Children who have any history of brain, spinal cord, or back surgery
- Children who have had head trauma
- Children with shunts, pins, or other foreign bodies within their brain or spinal cord

At especially high risk are children with a ventriculoperitoneal (VP) shunt. VP shunts drain excess fluids from around the brain into the abdomen. These children with special needs have tubing that can usually be seen and felt just under the scalp.

The signs and symptoms of meningitis vary, depending on the age of the patient. Fever and altered level of consciousness are common symptoms of meningitis in patients of all ages. Changes in the level of consciousness can range from a mild or severe headache to confusion, lethargy, and/or an inability to understand commands or interact appropriately. The child may also experience a seizure, which may be the first sign of meningitis. Infants younger than 2 to 3 months can have apnea, cyanosis, fever, a distinct high-pitched cry, or hypothermia.

In describing children with meningitis, physicians often use “meningeal irritation” or “meningeal signs” to describe pain that accompanies movement. Bending the neck forward or back increases the tension within the spinal canal and stretches the meninges, causing a great deal of pain. This results in the characteristic stiff neck of children with meningitis, who will often refuse to move their neck, lift their legs, or curl into a *C* position, even if coached to do so. One sign of meningitis in an infant is increasing irritability, especially when being handled. Another sign is a bulging fontanelle without crying.

One form of meningitis deserves special attention. Neisseria meningitidis is a bacterium that causes a rapid onset of meningitis symptoms, often leading to shock and death. Children with *N meningitidis* typically have small, pinpoint, cherry-red spots or a larger purple or black rash **Figure 34-33**. This rash may be on part of the face or body. These children are at serious risk of sepsis, shock, and death.

Figure 34-33 Children with *Neisseria meningitidis* typically have small, pinpoint, cherry-red spots or a larger purple or black rash.

All pediatric patients with possible meningitis should be considered contagious. Therefore, follow standard precautions whenever you suspect meningitis and follow up with the hospital to learn the patient's final diagnosis. If you have been exposed to saliva and respiratory secretions from a child with *N meningitidis*, you should receive antibiotics to protect yourself and others from the bacteria. This is particularly true if you managed the pediatric patient's airway. If you were not in close contact with the pediatric patient or his or her respiratory secretions, you do not need treatment.

Provide these pediatric patients with supplemental oxygen and assist with ventilations if needed. Reassess the pediatric patient's vital signs frequently as you transport the patient to the highest level of service available.

Gastrointestinal Emergencies and Management

As with any injury or complaint in the abdominal region, the signs and symptoms may be vague in nature. The abdominal wall muscles are not as developed, which leaves this region more prone to injury. Pediatric patients may not be able to pinpoint the exact site where the pain or discomfort originates, but will have complaints of diffuse tenderness. Never take a complaint of abdominal pain and discomfort lightly because a large amount of bleeding may occur within the abdominal cavity without any outward signs of shock. Remember that liver and splenic injuries are common among this age group and may result in life-threatening emergencies. The pediatric patient needs to be monitored for signs and symptoms of shock, which include an altered mental status; pale, cool skin; tachypnea; tachycardia; and bradycardia (late sign).

Complaints of gastrointestinal origin are common in the pediatric population. A common source of gastrointestinal upset is the ingestion of certain foods or unknown substances, such as milk or ice cream (lactose intolerance). In most cases, you will be faced with a pediatric patient who is experiencing abdominal discomfort with nausea, vomiting, and/or diarrhea. This can become a concern because both vomiting and diarrhea can cause dehydration in children.

Appendicitis is also common in pediatric patients and, if untreated, can lead to peritonitis (inflammation of the peritoneum, which lines the abdominal cavity) or shock. Appendicitis will typically present with a fever and pain on palpation of the right lower abdominal quadrant. Rebound tenderness is a common sign associated with appendicitis. Remember that constipation also can be a cause of abdominal pain in children. If you suspect appendicitis, promptly transport the pediatric patient to the hospital for further evaluation.

Because children are sensitive to fluid loss, obtain a thorough history from the parent or primary caregiver. In particular, ask questions such as:

- How many wet diapers has your child had today?
- Is your child tolerating liquids and is he or she able to keep them down?
- How many times has your child had diarrhea and for how long?
- Are tears present when your child cries?

These questions can help to determine how dehydrated the pediatric patient may be. If the pediatric patient is dehydrated, transport to the hospital for further care.

Poisoning Emergencies and Management

Poisoning is common among children, and the common sources of poisoning in children are listed in **Table 34-13**. It can occur by ingesting, inhaling, injecting, or absorbing a toxic substance.

The signs and symptoms of poisoning vary widely, depending on the substance and the age and weight of the pediatric patient. The pediatric patient may appear normal at first, even in serious cases, or he or she may be confused, sleepy, or unconscious. With some substances, one pill may be enough to cause death in a small child.

Infants may be poisoned as a result of being fed a harmful substance by a sibling, parent, or caregiver, or as a result of child abuse. Infants can be exposed to drugs and poisons left on floors and carpeting. They can also be exposed in a setting in which harmful drugs are being smoked. Toddlers are curious and often ingest poisons when they find them in the home or garage **Figure 34-34**. For example, some people store petroleum products in soda bottles. Toddlers may believe the substance to be soda. Adolescents are more likely to have ingested alcohol and street drugs while partying or during a suicide attempt.

Table 34-13 Common Sources of Poisoning in Children

- Alcohol
- Aspirin and acetaminophen
- Cosmetics
- Household cleaning products (such as bleach and furniture polish)
- Houseplants
- Iron
- Prescription medications
- Illicit (street) drugs (such as crack, cocaine, or PCP)
- Vitamins

After you have completed your primary assessment, ask the parent or caregiver the following questions:

- What is the substance(s) involved?
- Approximately how much of the substance was ingested or involved in the exposure (eg, number of pills, amount of liquid)?
- What time did the incident occur?
- Are there any changes in behavior or level of consciousness?
- Was there any choking or coughing after the exposure? (These can be signs of airway involvement.)

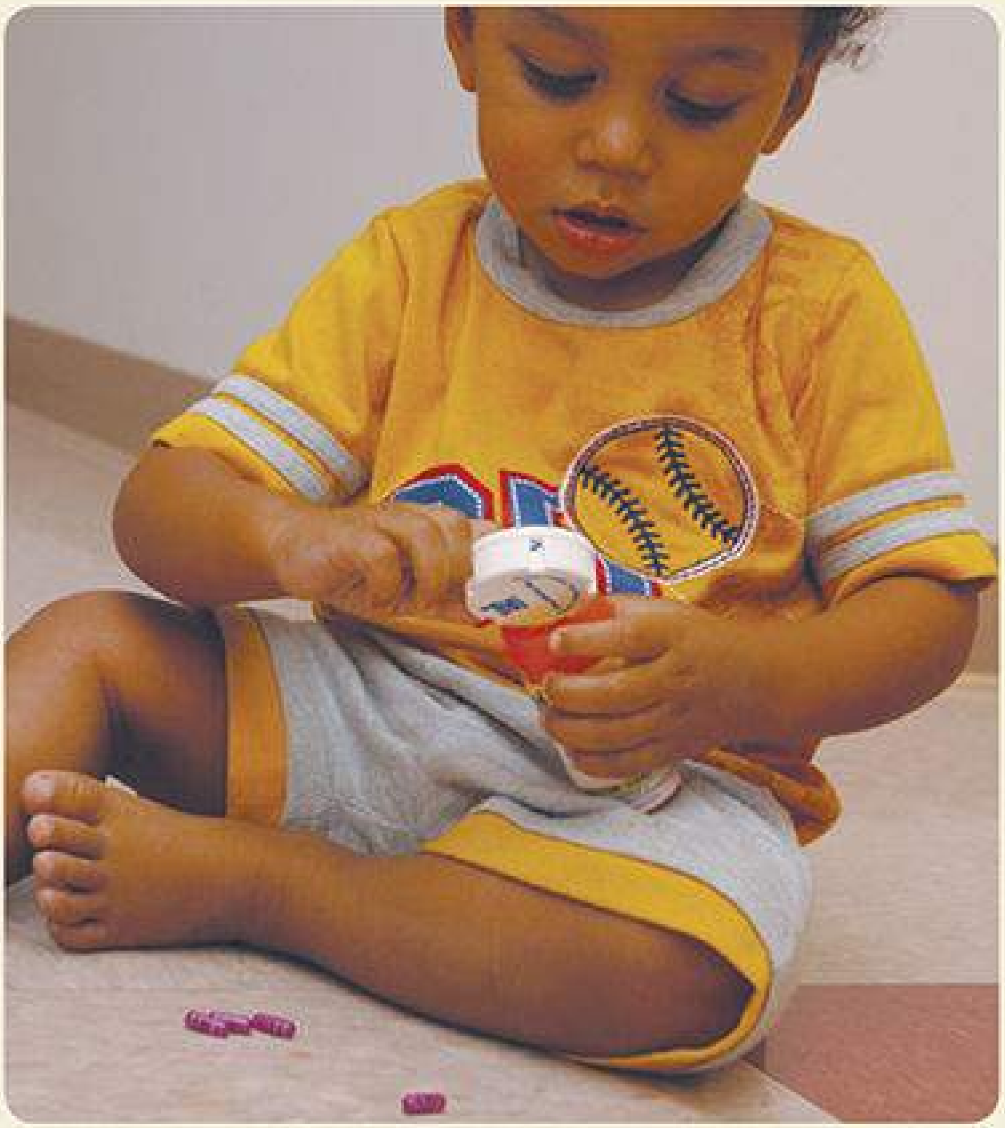


Figure 34-34 A curious child will try to taste or swallow almost any substance. A common victim of accidental ingestion of dangerous compounds is the unwatched toddler.

Contact the national Poison Control hotline for assistance in identifying poisons at 1-800-222-1222. This free service is available 24 hours a day, 7 days a week.

To treat a pediatric patient exposed to a poisonous substance, first perform an external decontamination. Remove tablets or fragments from the patient's mouth, and wash or brush poison from the skin. Treatment is supportive: assess and maintain the pediatric patient's ABCs and monitor breathing. Provide oxygen and perform ventilations if necessary. If the patient demonstrates signs and symptoms of shock, position the child supine, keep the child warm, and transport promptly to the nearest appropriate hospital.

In some cases, you will give activated charcoal to pediatric patients who have ingested poison, if approved by medical control or local protocol. Activated charcoal is not indicated for pediatric patients who have ingested an acid, an alkali, or a petroleum product; who have a decreased level of consciousness and cannot protect their airway; or who are unable to swallow. If local protocol permits, you will likely carry plastic bottles of premixed suspension, each containing up to 50 g of activated charcoal. Some common trade names for the suspension form are InstaChar, Actidose, and LiquiChar. The usual dose for a child is 1 g of activated charcoal per kilogram of body weight. The usual pediatric dose is 12.5 to 25 g. Chapter 21, *Toxicology*, discusses the administration of activated charcoal in detail.

Words of Wisdom

When you respond to a poisoning, remember to remain calm and control the scene. Poisonings can be emotional for the parents or caregivers involved because of the potential for self-blame.

Dehydration Emergencies and Management

Dehydration occurs when fluid losses are greater than fluid intake. The most common cause of dehydration in pediatric patients is vomiting and diarrhea. If left untreated, dehydration can lead to shock and eventually death. Infants and children are at greater risk than adults for dehydration because their fluid reserves are smaller than those in adults. Life-threatening dehydration can overcome an infant in a matter of hours.

Dehydration can be mild, moderate, or severe. The severity of the dehydration can be gauged by looking at several clues Table 34-14. For example, an infant with mild dehydration may have dry lips and gums, decreased saliva, and fewer wet diapers throughout the day. As the dehydration grows more severe, the lips and gums may become very dry, the eyes may look sunken, and the infant may be sleepy and/or irritable, refusing bottles. The skin may be loose and have no elasticity; this is called poor skin turgor Figure 34-35. Also, infants may have sunken fontanelles.

Table 34-14 Vital Signs and Symptoms of Dehydration

	Mild Dehydration	Moderate Dehydration	Severe Dehydration
Pulse	Normal	Increased	Increased; >160 beats/min is sign of impending shock in pediatric patients except newborns
Level of activity	Normal or slowed	Slowed	Variable, weak to unresponsive
Urine output	Decreased	Decreased	No output
Skin	Normal	Cool, mottled; poor turgor	Cool, clammy; poor turgor; delayed capillary refill time
Mouth	Decreased saliva	Dry mucous membranes	Dry mucous membranes
Eyes	Normal	No tears	Sunken eyes
Anterior fontanelle	Normal to sunken	Sunken	Very sunken
Level of consciousness	Normal	Altered	Altered; lethargic
Blood pressure	Normal	Normal	Normal to low

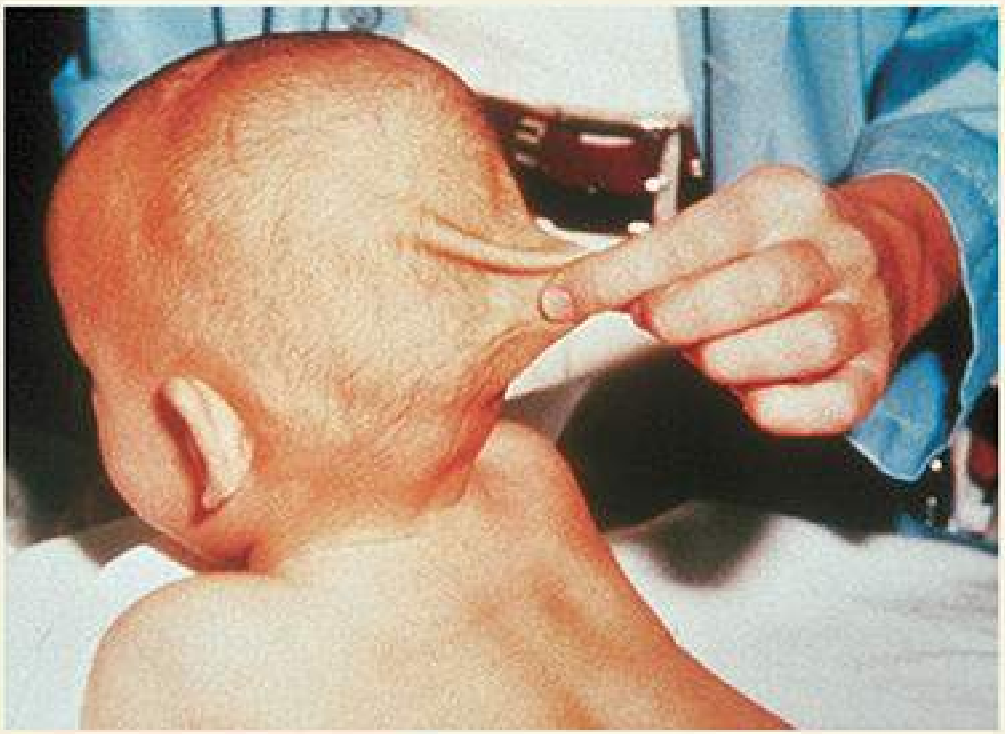


Figure 34-35 An infant with dehydration may exhibit "tenting" or poor skin turgor.

Courtesy of Ronald Dieckmann, MD.

Young children can compensate for fluid losses by decreasing blood flow to the extremities and directing blood flow to vital organs such as the brain and heart. Children who are moderately to severely dehydrated may have mottled, cool, clammy skin and delayed capillary response time. Respirations will usually be increased. Be aware blood pressure may remain within a normal range while the pediatric patient is in shock, because the compensatory mechanisms are still in place.

Emergency medical care should include assessing the ABCs and obtaining baseline vital signs. However, if the dehydration is severe, ALS backup may be necessary so that IV access can be obtained and rehydration can begin. All pediatric patients with signs and symptoms of moderate to severe dehydration should be transported to the ED for further evaluation and treatment.

Fever Emergencies and Management

Fever is a common reason why parents or caregivers call 9-1-1. Simply defined, a fever is an increase in body temperature, usually in response to an infection. Body temperatures of 100.4°F (38°C) or higher are considered to be abnormal. A fever may have many causes and is rarely life threatening. However, do not underestimate the potential seriousness of a fever that occurs in conjunction with a rash, which is a sign of serious illness, such as meningitis. Common causes of a fever in pediatric patients include the following:

- Infection, such as pneumonia, meningitis, or urinary tract infection
- Status epilepticus
- Cancer
- Drug ingestion (aspirin)
- Arthritis and systemic lupus erythematosus (rash across nose)
- High environmental temperature

Fever is the result of an internal body mechanism in which heat generation is increased and heat loss is decreased. Note that there are other conditions in which the core body temperature also increases. Hyperthermia differs from fever in that it is an increase in body temperature caused by an inability of the body to cool itself. Hyperthermia is typically seen in warm environments, such as a closed vehicle on a hot day.

An accurate body temperature is an important vital sign for pediatric patients. A rectal temperature is the most accurate for infants to toddlers. Older children will be able to follow directions if placing a thermometer under the tongue or under the arm.

A fever can have several causes, such as a viral or a bacterial infection. Depending on the source of infection, the pediatric patient may have additional signs of respiratory distress, shock, a stiff neck, a rash, skin that is hot to the touch, flushed cheeks, seizures, and bulging fontanelles in an infant. Assess the patient for other signs and symptoms such as nausea, vomiting, diarrhea, decreased feedings, and headache. A fever that is accompanied by a stiff neck, sensitivity to light, and a rash may be an indication that the patient has either bacterial or viral meningitis.

A pediatric patient with a fever may require only minimal interventions in the field. Provide rapid transport and manage the patient's ABCs. Follow standard precautions if you suspect that the patient may have a communicable disease such as meningitis.

Febrile Seizures

Febrile seizures are common in children between the ages of 6 months and 6 years. Most pediatric seizures are the result of fever alone, which is why they are called febrile seizures.

These seizures typically occur on the first day of a febrile illness, are characterized by **generalized tonic-clonic seizure** activity, and last less than 15 minutes with a short postictal phase or none at all. They may be a sign of a more serious problem, such as meningitis. Obtain a history from the parent or caregiver because these pediatric patients may have had a febrile seizure in the past.

If you are called to care for a pediatric patient who has had a febrile seizure, you often will find that the pediatric patient is awake, alert, and fully interactive when you arrive. Keep in mind that a persistent fever can lead to another seizure. Carefully assess the ABCs, begin cooling measures with tepid (not cold) water, and provide prompt transport. All pediatric patients with febrile seizures need to be seen in the hospital setting.

Drowning Emergencies and Management

In drowning emergencies, you must always ensure your own safety when rescuing the patient from the water. Do not become a victim yourself!

According to the CDC, drowning is the second most common cause of unintentional death among children aged 1 to 4 years in the United States. At this age, children often fall into swimming pools and lakes, but many drown in bathtubs and even puddles or buckets of water. Older adolescents drown when swimming or boating; alcohol is frequently a factor.

As discussed in *Chapter 32, Environmental Emergencies*, the principal condition that results from drowning is lack of oxygen. Even a few minutes (or less) without oxygen affects the heart, lungs, and brain, causing life-threatening problems such as cardiac arrest, respiratory failure, and coma. Submersion in icy water can lead to hypothermia. Although it is possible for victims of submersion hypothermia to survive long periods in cardiac arrest, most people in this situation die. Diving into the water, of course, increases the risk of neck and spinal cord injuries.

Signs and symptoms of a drowning patient will vary based on the type and length of submersion. A pediatric patient involved in a drowning emergency may have with coughing; choking; airway obstruction; difficulty breathing; altered mental status; seizure activity; unresponsiveness; fast, slow, or no pulse noted; pale, cyanotic skin; and abdominal distention from ingestion of fluids.

Once the pediatric patient is successfully removed from the water, assess and manage the ABCs, and call for ALS backup to intervene if needed. Administer oxygen at 100% via a nonrebreathing mask or BVM if assisted ventilations are required. Be prepared to suction as these patients often vomit. If trauma is suspected, apply a cervical collar and place the pediatric patient on a backboard. Pad all open spaces under the pediatric patient before securing the patient onto the backboard. If the pediatric patient is unresponsive and in cardiopulmonary arrest, perform CPR.

Words of Wisdom

Swimming pool and water hazards are major contributors to pediatric injury and death. Pool safety begins with educating children and parents or caregivers on the risks of playing around a pool. All swimming pools should be surrounded by a fence that is at least 6 feet (2 m) high, with slats no farther apart than 3 inches (8 cm). Additional precautions include pool covers and alarm systems. Children should also take water safety and swim lessons to help ensure their safety around pools and other bodies of water.

Words of Wisdom

Before using an AED on a pulseless drowning patient, ensure that the pediatric patient is dried off. Use caution when operating an AED in this situation.

Pediatric Trauma Emergencies and Management

According to the CDC, unintentional injuries are the number one killer of children in the United States. As an EMT, you will frequently treat injured children; therefore, you must have a thorough understanding of how trauma affects them. The quality of care in the first few minutes after a child has been injured can have an enormous impact on that child's chances for complete recovery.

The muscles and bones of children continue to grow well into adolescence. For this reason, coupled with their risk-taking approach to activities, adolescents are prone to fractures of the extremities. The younger the child, the more flexible the bone structures are to trauma. If a pediatric patient is unable to place weight on an extremity or favors an extremity, suspect injury until proven otherwise. Sprains are uncommon in this age group because the ligaments are more developed than the larger long bones.

A fracture of the femur is rare in pediatric patients, but when it does occur, it is a source of major blood loss. Older children and adolescents are prone to long bone fractures (femur and humerus) because they tend to take more risks during physical activities. The goal for care and treatment in this circumstance is to immobilize the injured extremity and to provide pain relief once ALS has arrived on the scene.

Physical Differences

As discussed, children are smaller than adults; therefore, when they are hurt in the same type of crash as an adult, the location of their injuries may differ from those in an adult. For example, the bumper of a motor vehicle will strike an adult pedestrian in the lower leg, whereas that same bumper will strike a child in the pelvis. In a crash involving sudden deceleration, an adult might injure a ligament in the knee; in that same crash, a child might injure the bones in the leg.

Children's bones and soft tissues are less well developed than those of adults; therefore, the force of an injury affects these structures somewhat differently than it does in an adult. Because a child's head is proportionately larger than an adult's, it exerts greater stress on the neck structures during a deceleration injury. Because of these anatomic differences, always carefully assess children for head and neck injuries.

Psychologic Differences

Children are also less mature psychologically than adults; therefore, they are often injured because of their undeveloped judgment and their lack of experience. For example, children are more likely than adults to cross the street without looking for oncoming traffic. As a result, children are more likely than adults to be struck by motor vehicles. Children and adolescents are also more likely to sustain injuries from diving into shallow water because they forget to check the depth of the water before they dive. In such situations, always assume that the child has serious head and neck injuries.

Injury Patterns

Although you are not responsible for diagnosing injuries in children, your ability to recognize and report serious injuries will provide critical information to hospital staff. For this reason, it is important for you to understand the special physical and psychologic characteristics of children and what makes them more likely to have certain kinds of injuries.

Vehicle Collisions

Children playing or riding a bicycle can dart out in front of motor vehicles without looking. In such a situation, the driver may have very little time to slow down or stop to prevent hitting the child. The area of greatest injury varies, depending on the size of the child and the height of the bumper at the time of impact. When vehicles slow down at the moment of impact, the bumper dips slightly, causing the point of impact with the child to be lowered. The exact area that is struck depends on the child's height and the final position of the bumper at the time of impact. Children who are injured in these situations often sustain high-energy injuries to the head, spine, abdomen, pelvis, or legs. In addition to differences in size and anatomy, children will often turn toward an oncoming vehicle when they see it approaching and, therefore, sustain different injuries than an adult who turns away.

Sports Activities

Children, especially those who are older or adolescents, are often injured in organized sports activities. Head and neck injuries can occur after high-speed collisions in contact sports such as football, wrestling, ice hockey, field hockey, soccer, or lacrosse. Remember to immobilize the cervical spine when caring for children with sports-related injuries when indicated. Familiarize yourself with local protocols related to helmet removal, and/or follow the guidelines presented in Chapter 28, *Head and Spine Injuries*.

Injuries to Specific Body Systems

Head Injuries

Head injuries are common in children. This is because the size of a child's head, in relation to the body, is larger than that of an adult. An infant also has a softer, thinner skull, which may result in injury to the underlying brain tissues. The scalp and facial vessels can bleed easily and may cause significant blood loss if the bleeding is not controlled. The signs and symptoms of head injury in a child are similar to those in an adult, but there are some important differences. Nausea and vomiting are common signs and symptoms of head injury in children; however, it is easy to mistake these for an abdominal injury or illness. You should suspect a serious head injury in any child who experiences nausea and vomiting after a traumatic event. Pediatric patients are managed in the same manner as adults. Chapter 28, *Head and Spine Injuries,* discusses head injuries in detail.

Immobilization. Spinal immobilization is necessary for all children who have possible head or spinal injuries after a traumatic event. Follow these steps **Skill Drill 34-5**:

1. Maintain the child's head in a neutral position by placing a towel under the shoulders and torso **Step 1**.
2. Place an appropriately sized cervical collar on the pediatric patient **Step 2**.
3. Carefully log roll the child onto the short backboard or pediatric immobilization device **Step 3**.
4. Secure the pediatric patient's torso to the short backboard or pediatric immobilization device first **Step 4**.
5. Secure the child's head to the short backboard or pediatric immobilization device **Step 5**.
6. Complete immobilization by ensuring that the child is strapped in properly **Step 6**.

Skill Drill 34-5 Immobilizing a Pediatric Patient

Step 1

Use a towel under the back, from the shoulders to the hips, to maintain the head in a neutral position.

Step 2

Apply an appropriately sized cervical collar.

Step 3

Log roll the child onto the short backboard or pediatric immobilization device.

Step 4

Secure the torso first.

Step 5

Secure the head.

Step 6

Ensure that the child is strapped in properly.

Immobilization can be difficult to perform because of the child's body proportions. Young children require padding under the torso to maintain a neutral position. Beginning at ages 8 to 10 years, children no longer require padding underneath the torso to create a neutral position. Instead, they can simply lie supine on the backboard. However, another complication may occur if a child is immobilized on an adult-sized backboard. A child's body is narrower than an adult's; therefore, padding will be required along the sides of the adult-sized backboard so that the child can be properly secured.

Many infants and children will be in a car seat when you approach them. The patient must be removed to a short backboard or pediatric immobilization device prior to transport. Follow these steps to immobilize a patient in a car seat **Skill Drill 34-6**:

1. Carefully stabilize the patient's head in a neutral position **Step 1**.
2. Lay the seat down into a reclined position on a hard surface. Position a short backboard or pediatric immobilization device between the patient and the surface on which the patient is resting **Step 2**.
3. Carefully slide the patient into position on the short backboard or pediatric immobilization device **Step 3**.
4. Make sure the patient's head is in a neutral position by placing a towel under the back, from the shoulders to the hips **Step 4**.
5. Secure the torso first and place padding to fill any voids **Step 5**.
6. Secure the patient's head to the short backboard or pediatric immobilization device. **Step 6**.

Chest Injuries

Chest injuries in children are usually the result of blunt trauma rather than penetrating objects. Remember that children have soft, flexible ribs that can be significantly compressed without breaking. This chest wall flexibility can produce a flail chest. Keep this in mind as you assess a child who has sustained high-energy blunt trauma to the chest. Even though there may be no external sign of injury, such as broken ribs, contusions, or bleeding, there may be significant injuries within the chest **Figure 34-36**. Pediatric patients are managed in the same manner as adults. Chapter 29, *Chest Injuries*, discusses the treatment of chest injuries in detail.

Abdominal Injuries

Abdominal injuries are common in children. Remember, though, that children can compensate for significant blood loss better than adults without signs or symptoms of shock developing **Figure 34-37**. They can also have a serious injury without early external evidence of a problem. All children with abdominal injuries should be monitored for signs and symptoms of shock, including a weak, rapid pulse; cold, clammy skin; decreased capillary refill (an early sign); confusion; and decreased systolic blood pressure (a late sign). Even in the absence of signs and symptoms of shock, or with only very few signs and symptoms, you should remain cautious about the possibility of internal injuries.

Skill Drill 34-6 Immobilizing a Patient in a Car Seat

Step 1

Stabilize the head in neutral position.

Step 2

Place a short backboard or pediatric immobilization device between the patient and the surface he or she is resting on.

Step 3

Slide the patient onto the short backboard or pediatric immobilization device.

Step 4

Place a towel under the back, from the shoulders to the hips, to ensure neutral head position.

Step 5

Secure the torso first; pad any voids.

Step 6

Secure the head to the short backboard or pediatric immobilization device.

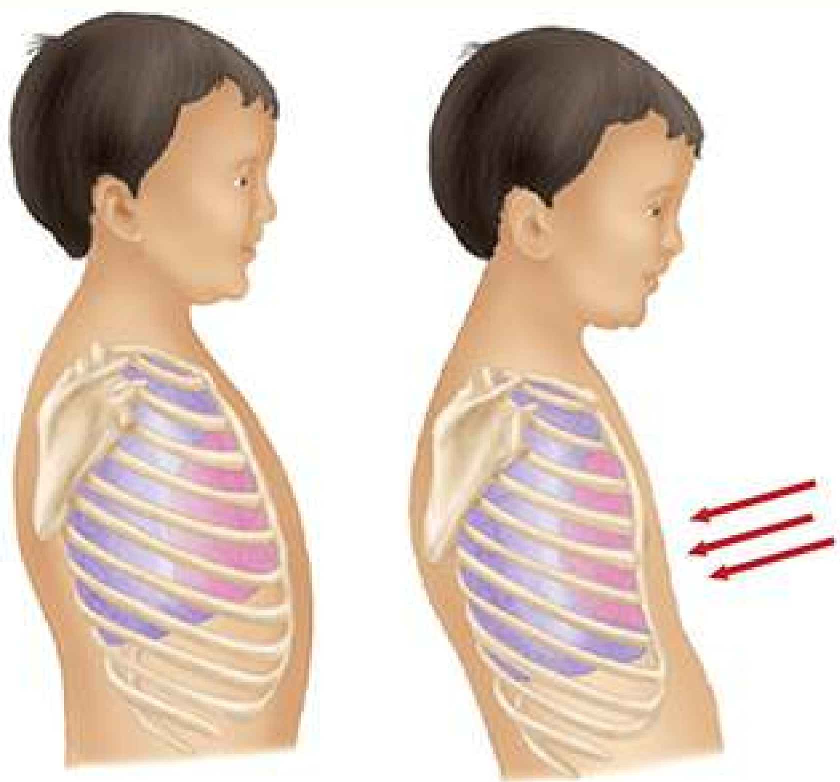


Figure 34-36 A child's ribs are softer and more flexible than an adult's. As a result, they may compress the lungs and heart if there is blunt trauma, causing serious injury with no obvious external damage.

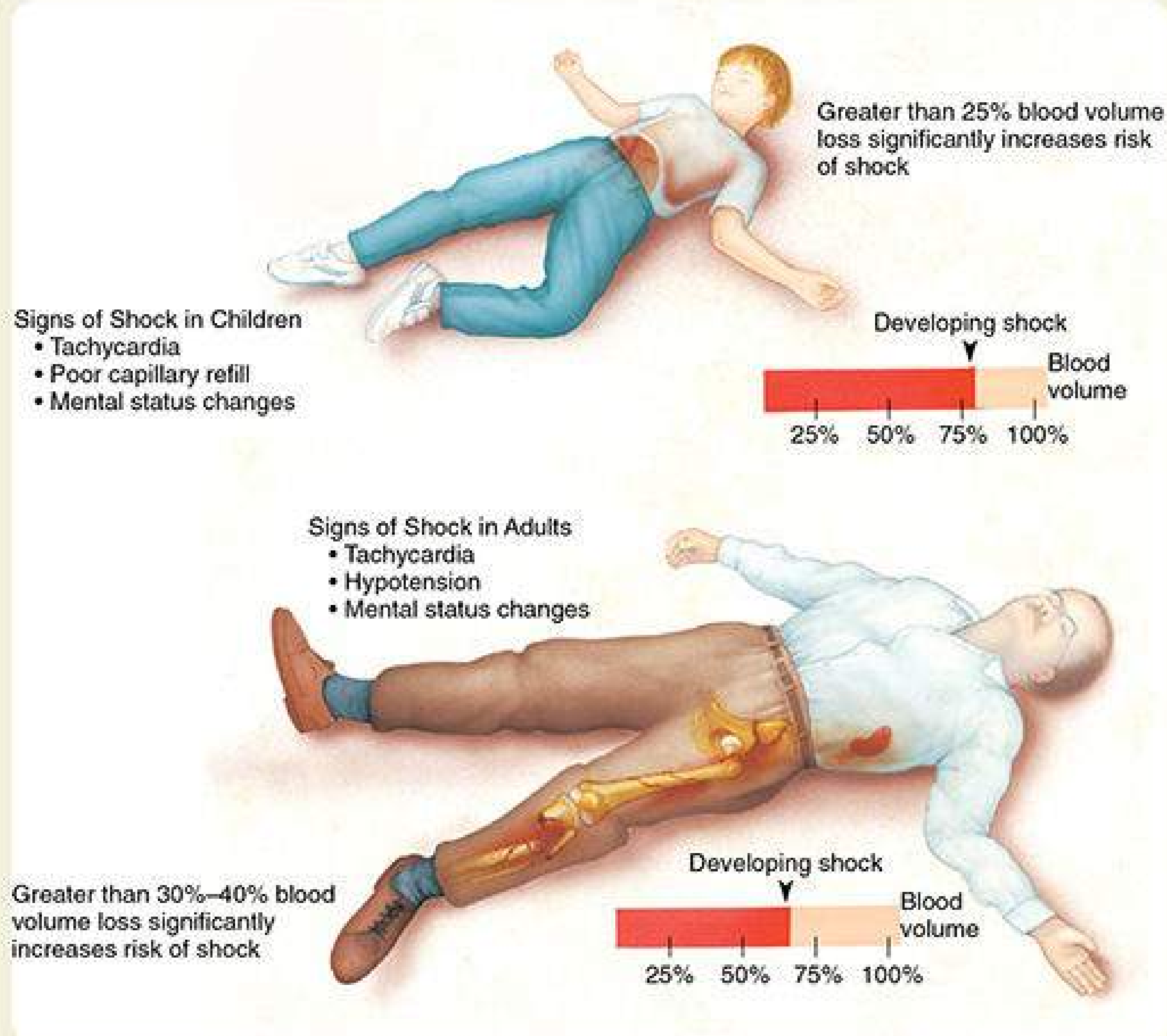


Figure 34-37 All children with abdominal injuries should be monitored closely for signs of shock. Although children may compensate for significant blood loss better than adults, shock develops in children after proportionally smaller blood losses.

Pediatric patients are managed in the same manner as adults. Chapter 30, *Abdominal and Genitourinary Injuries*, discusses abdominal injuries in detail. If the patient shows signs and symptoms of shock, prevent hypothermia by keeping the patient warm with blankets. If the patient has bradycardia, ventilate. Monitor the patient's condition during transport.

Burns

Burns to children are generally considered more serious than burns to adults. This is because infants and children have more surface area relative to total body mass, which means greater fluid and heat loss. In addition, children do not tolerate burns as well as adults do. Children are also more likely to go into shock, develop hypothermia, and experience airway problems because of the unique differences of their ages and anatomy.

Children can be burned in a variety of ways. The most common involve exposure to hot substances such as scalding water in a bathtub, hot items on a stove, or exposure to caustic substances such as cleaning solvents or paint thinners **Figure 34-38**.

According to the CDC, older children are more likely to be burned by flames from fire. You should suspect possible internal injuries from chemical ingestion when you see a child who has burns, particularly around the face and mouth.

One common problem following burn injuries in children is infection. Burned skin cannot resist infection as effectively as normal skin can. For this reason, sterile techniques should be used in handling the skin of children with burn wounds if possible.

Table 34-15 provides some general guidelines to follow in assessing a pediatric patient who has been burned. These guidelines may help you to determine which pediatric patients should be treated primarily at specialized burn centers. Also consider the possibility of child abuse in any burn situation. Make sure you report any information about your suspicions to the appropriate authorities.

Pediatric patients are managed in the same manner as adults. Chapter 26, *Soft-Tissue Injuries*, discusses burn care in detail. If the patient shows signs and symptoms of shock, prevent hypothermia by keeping the pediatric patient warm with blankets. If the pediatric patient has bradycardia, ventilate. Monitor the pediatric patient's condition during transport.

Figure 34-38 Some burns in children involve exposure to hot surfaces. This child's buttocks were placed against a hot heating grate.

Table 34-15 Severity of Burns in Pediatric Patients

Severity of Burn	Body Area Involved
Minor	Partial-thickness burns involving less than 10% of the body surface
Moderate	Partial-thickness burns involving 10% to 20% of the body surface
Severe	Any full-thickness burn Any partial-thickness burn involving more than 20% of the body surface Any burn involving the hands, feet, face, airway, or genitalia

Injuries of the Extremities

Children have immature bones with active growth centers. Growth of long bones occurs from the ends at specialized growth plates. These growth plates are potential weak spots in the bone and are often injured as a result of trauma. In general, children's bones bend more easily than adults' bones. As a result, greenstick (incomplete) fractures can occur.

Extremity injuries in pediatric patients are generally managed in the same manner as those in adults. Painful, deformed limbs with evidence of broken bones should be splinted. Specialized splinting equipment, such as a traction splint for fractures of the femur, should be used only if it fits the pediatric patient. Do not attempt to use adult immobilization devices on a pediatric patient unless the pediatric patient is large enough to properly fit in the device.

Pain Management

The first step in pain management is recognizing that the patient is in pain. Since some pediatric patients will be nonverbal or have a limited vocabulary, remember to look for visual clues and use the Wong-Baker FACES pain scale (see Figure 34-20).

When dealing with pediatric pain management issues, you are limited to the following interventions: positioning, ice packs, and extremity elevation. These interventions will decrease the pain and swelling to the site of an injury. However, additional interventions (medications) from an ALS provider may be necessary. Another important tool is simple kindness and providing emotional support to the patient and the parent or caregiver. This act alone can decrease pediatric patient anxiety and allow for a more soothing environment for all involved. Pediatric patients can sense fear and frustration from adults, so it is important to maintain a calm, professional, and trusting relationship with your patient and the family during the course of treatment.

Disaster Management

The JumpSTART triage system was developed for pediatric patients because the original START triage system did not take into account the developmental and physiologic differences in children **Figure 34-39**. This system is intended for pediatric patients younger than age 8 years or who appear to weigh less than 100 pounds (45 kg). Because infants and children may not be able to walk or follow commands (including children with special needs) during a disaster event, they must be considered for immediate delivery to the treatment area.

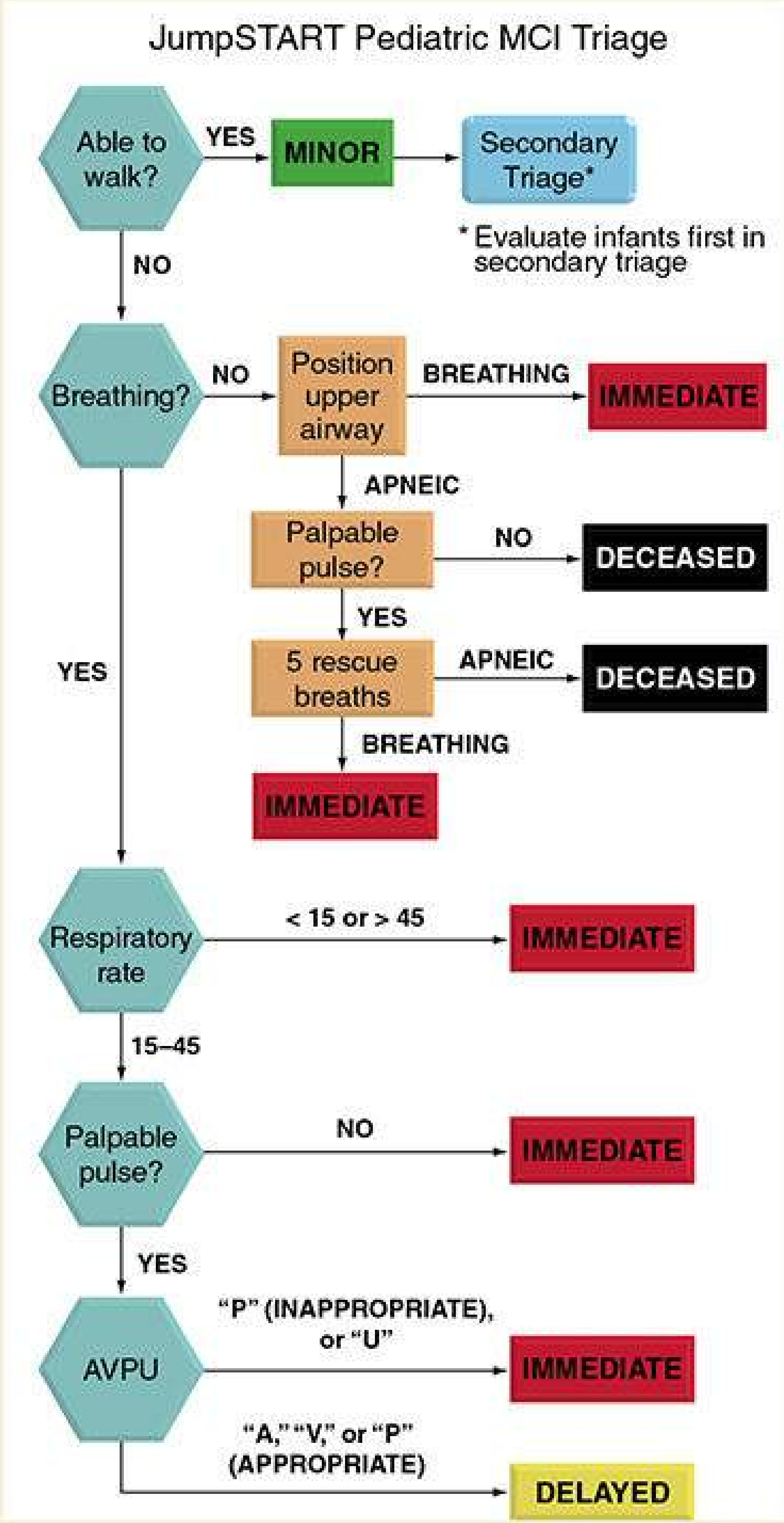


Figure 34-39 The JumpSTART triage system.

There are four triage categories in the JumpSTART system, designated by colors corresponding to different levels of urgency for treatment. Decision points include: ability to walk (except in infants); presence of spontaneous breathing; respirations of less than 15 or of greater than 45 breaths/min; palpable peripheral pulse; and appropriate response to painful stimuli on the AVPU scale.

Pediatric patients who are able to walk are designated as the third or minor priority (green tag), meaning they are not in immediate need of treatment. Patients who breathe spontaneously, have a peripheral pulse, and are appropriately responsive to painful stimuli are designated as the second priority (yellow tag). Their treatment and transport can be delayed. Pediatric patients who are breathing but pulseless, who are apneic and responsive to positioning or rescue breathing, or who are inappropriately responsive to painful stimuli are designated as the highest priority (red tag). These patients need immediate care and transport. Pediatric patients who are both apneic and pulseless, or who are apneic and unresponsive to rescue breathing, are considered deceased or expectant deceased (black tag). Triage is discussed in greater detail in Chapter 39, *Incident Management*.

Words of Wisdom

It is always difficult to deal with a situation of child abuse. When you assess a pediatric patient, you may find that the pattern of illness or injury, or the severity of the illness or injury, does not match the information that the child's parent or caregiver provides to you. Under no circumstances should you question the discrepancies. Remember that your sole focus is to ensure that the pediatric patient is transported to the hospital for an evaluation. If you offend or "tip off" the suspected abuser, he or she may deny transport of the pediatric patient and you may be forced to leave the pediatric patient on scene. Ensure that you are familiar with mandated reporting requirements per your local protocols. Privately inform the hospital staff of your findings.

Child Abuse and Neglect

The term **child abuse** means any improper or excessive action that injures or otherwise harms a child or infant; it includes physical abuse, sexual abuse, neglect, and emotional abuse. The intentional injury of a child, whether physical or emotional, unfortunately is not rare in our society. According to the report *Child Maltreatment 2012* from the US Department of Health & Human Services, over half a million children are victims of child abuse annually. Many of these children suffer life-threatening injuries, and some die. If suspected child abuse is not reported, the child is likely to be abused again and again, which can lead to permanent injury or death. Therefore, you must be aware of the signs of child abuse and neglect, and it is your responsibility to report suspected abuse to law enforcement or child protection agencies.

Signs of Abuse

As an EMT, you will be called to homes because of a reported injury to a child. Child abuse occurs in every socioeconomic status, so be aware of the patient's surroundings and document your findings objectively. EMTs are commonly called to testify in abuse cases, so it is essential to record all findings, including any statements made by parents or caregivers or others on the scene. If you suspect that physical or sexual abuse is involved, ask yourself the following questions:

- Is the injury typical for the developmental level of the child?
- Is the method of injury reported by the parent or caregiver consistent with the pediatric patient's injury?
- Is the parent or caregiver behaving appropriately (concerned about the child's well-being)?
- Is there evidence of drinking or drug use at the scene?
- Was there a delay in seeking care for the child?
- Is there a good relationship between the child and the parent or caregiver?
- Does the child have multiple injuries at different stages of healing?
- Does the child have any unusual marks or bruises that may have been caused by cigarettes, heating grates, or branding injuries?
- Does the child have several types of injuries, such as burns, fractures, and bruises?
- Does the child have any burns on the hands or feet that involve a glove distribution (marks that encircle a hand or foot in a pattern that looks like a glove)?
- Is there an unexplained decreased level of consciousness?
- Is the child clean and an appropriate weight for his or her age?
- Is there any rectal or vaginal bleeding?
- What does the home look like? Clean or dirty? Is it warm or cold? Is there adequate food?

Your assessment in the field will allow a better assessment by the medical staff later. An easy way to remember these points for the pediatric population is the mnemonic CHILD ABUSE, shown in Table 34-16.

As you assess the pediatric patient, look for and pay particular attention to the following signs Figure 34-40.

Bruises

Observe the color and location of any bruises. New bruises are pink or red. Over time, bruises turn blue, then green, then yellow-brown and faded. Note the location. Bruises to the back, buttocks, ears, or face are suspicious and are usually inflicted by a person.

Table 34-16 Mnemonic for Assessing Possible Child Abuse

C	Consistency of the injury with the child's developmental age
H	History inconsistent with injury
I	Inappropriate parental concerns
L	Lack of supervision
D	Delay in seeking care
A	Affect
B	Bruises of varying ages
U	Unusual injury patterns
S	Suspicious circumstances
E	Environmental clues

Words of Wisdom

In children, bumps and bruises are a common occurrence. You should be concerned when bruises are found in uncommon locations or in patterns. Elbow and knee bruising, or injuries that follow the patterns of falls or rough play, match the nature of a playing child, but bruises to the back, buttocks, or backs of the arms and legs are much less common. Also be mindful of bruises in various stages of healing, which can also be an indicator of abuse. If the bruises have a unique pattern, as if a child was struck with an object once or repeatedly, this may be a sign of abuse.

Burns

Burns to the penis, testicles, vagina, or buttocks are usually inflicted by someone else, as are burns that encircle a hand or foot to look like a glove. You should suspect abuse if the child has cigarette burns or grid pattern burns.

Fractures

Fractures of the humerus or femur do not normally occur without major trauma, such as a fall from a high place or a motor vehicle crash. Falls from a bed are not usually associated with fractures. Maintain some index of suspicion if an infant or young child sustains a femur fracture or a complete fracture of any bone. As discussed, children are more likely to experience greenstick (incomplete) fractures, as opposed to complete fractures, due to their soft and pliable bones.

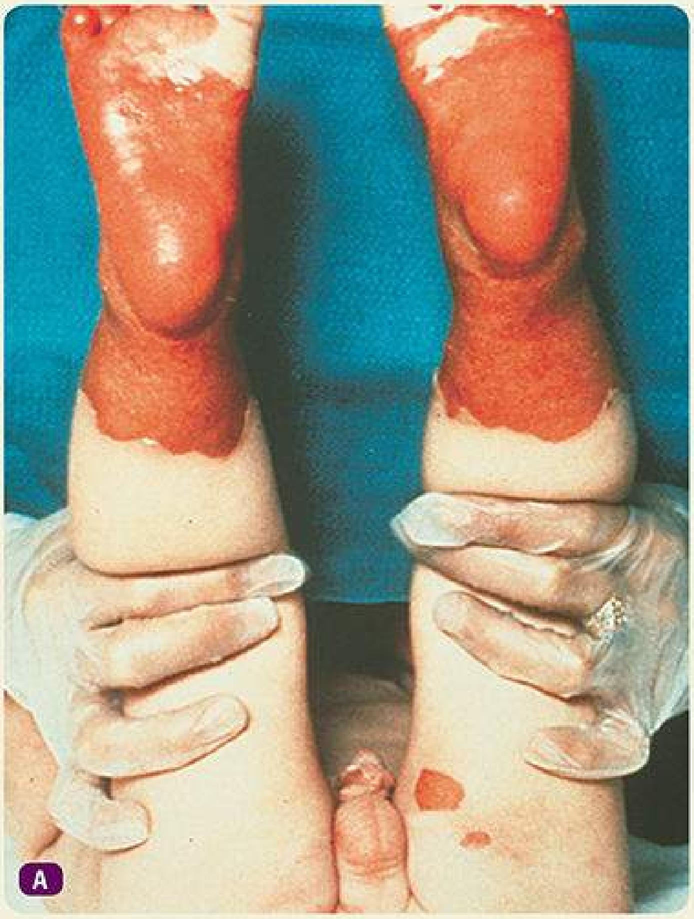


Figure 34-40 Signs of child abuse. **A.** A scald. **B.** Multiple injuries at different stages of healing.

Courtesy of Ronald Dieckmann, MD.

A complete fracture in a pediatric patient indicates that the child was exposed to significant traumatic force.

Shaken Baby Syndrome

Infants may sustain life-threatening head trauma by being shaken or struck on the head, a condition called **shaken baby syndrome**. With this condition, there is bleeding within the head and damage to the cervical spine as a result of intentional, forceful shaking. The infant will be found unconscious, often without evidence of external trauma. The call for help may be for an infant who has stopped breathing or is unresponsive. The infant may appear to be in cardiopulmonary arrest, but what has likely occurred is that the shaking tore blood vessels in the brain, resulting in bleeding around the brain. The pressure from the blood results in an increased cranial pressure, leading to coma and/or death.

Words of Wisdom

It is normal to have concerns about the care of children, but do not let your personal judgments cloud the true nature of a situation. You may feel upset by challenging socioeconomic factors that impact where a child lives, the condition of the home environment, and the child's sources of food. However, the parents or caregivers may have the best of intentions and may be doing everything possible for the child. In these situations, let the hospital staff or a supervisor know that the child and his or her family may need some assistance or community support.

Neglect

Neglect is refusal or failure on the part of the parent or caregiver to provide life necessities, such as food, water, clothing, shelter, personal hygiene, medicine, comfort, and personal safety.

Children who are neglected are often dirty or too thin or appear developmentally delayed because of a lack of stimulation. You may observe such children when you are making calls for unrelated problems. Report all cases of suspected neglect.

Symptoms and Other Indicators of Abuse

An abused child may appear withdrawn, fearful, or hostile. Be particularly concerned if the child refuses to discuss how an injury occurred. Occasionally, the parent or caregiver will reveal a history of several "accidents." Be alert for conflicting stories or a marked lack of concern from the parents or caregiver. Remember, the abuser may be a parent, caregiver, relative, or friend of the family. Sometimes the abuser is an acquaintance of a single parent.

EMTs in all states must report all cases of suspected abuse, even if the ED fails to do so. Most states have special forms for reporting. Supervisors are generally forbidden to interfere with the reporting of suspected abuse, even if they disagree with the assessment. You do not have to prove that there has been abuse. Law enforcement and child protection agencies are mandated to investigate all reported cases. Take all necessary precautions to protect yourself, your team, and the pediatric patient involved in this situation.

Sexual Abuse

Children of any age and either gender can be victims of sexual abuse. Maintain an index of suspicion regardless of the patient's social or economic situation. This type of sexual abuse is often the result of long-standing abuse by relatives.

Your assessment of a child who has been sexually abused should be limited to determining the type of dressing any injuries require. Sometimes, a sexually abused child is also beaten. Therefore, treat any bruises or fractures as well. Do not examine the genitalia of a young child unless there is evidence of bleeding or there is an injury that must be treated.

In addition, if you suspect that a child is a victim of sexual abuse, do not allow the child to wash, urinate, or defecate before a physician completes a physical examination. Although this step can be difficult for the victim, it is important to preserve evidence. If possible, ensure that an EMT or police officer of the same gender remains with the child, unless locating one will delay transport.

You must maintain professional composure the entire time you are assessing and caring for a sexually abused child. Assume a concerned, caring approach, and shield the child from onlookers and curious bystanders. Obtain as much information as possible from the child and any witnesses. The child may be hysterical or unwilling to say anything at all, especially if the abuser is a relative or family friend. You are in the best position to obtain the most accurate firsthand information about the incident. Therefore, record any information carefully and completely on the patient care report. Transport all children who are victims of sexual assault. Sexual abuse of a child is a crime. Cooperate fully with law enforcement officials in their investigations.

Sudden Infant Death Syndrome

The death of an infant or a young child is called **sudden infant death syndrome (SIDS)** when, after a complete autopsy, the cause of death remains unexplained. According to the CDC, about 3,500 infants die of SIDS annually. To reduce the risk of SIDS, the American Academy of Pediatrics recommends that an infant be placed on his or her back on a firm mattress, in a crib that is free of bumpers, blankets, and toys. The CDC recommends having the baby sleep in the same room, but not in the same bed, chair, or sofa, as an adult.

Although it is impossible to predict SIDS, there are several known risk factors:

- Mother younger than 20 years
- Mother smoked during pregnancy
- Low birth weight

Deaths as the result of SIDS can occur at any time of the day; however, these children are often discovered in the morning when the parents or caregivers go in to check on the infant. If you are the first provider at the scene of suspected SIDS, you will face three tasks: assessment of the scene, assessment and management of the patient, and communication and support of the family.

Patient Assessment and Management

SIDS is a diagnosis of exclusion. All other potential causes must first be ruled out, a process that can be time-consuming for physicians. An infant who has been a victim of SIDS will be pale or blue, not breathing, and unresponsive. Other causes for such a condition include the following:

- Overwhelming infection
- Child abuse
- Airway obstruction from a foreign object or as a result of infection
- Meningitis
- Accidental or intentional poisoning
- Hypoglycemia (low blood glucose level)
- Congenital metabolic defects

Regardless of the cause, assessment and management of the infant remain the same. Remember that what you find in assessing the infant and the scene may provide important diagnostic information.

Begin with an assessment of the ABCs, and provide interventions as necessary. Depending on how much time has passed since the child was discovered, he or she may show signs of postmortem changes. These include stiffening of the body, called rigor mortis, and dependent lividity, which is the pooling of blood in the lower parts of the body or those that are in contact with the floor or bed.

If the child shows such signs, call medical control. In some EMS systems, a victim of SIDS may be declared dead on the scene. Deciding whether to start CPR on a child who shows clear signs of rigor mortis or dependent lividity can be very difficult. Family members may consider anything less as withholding critical care. In this situation, the best course of action may be to initiate CPR and transport the patient and the family to the nearest ED, where the family can receive more extensive support (follow local protocols). If there is no evidence of postmortem changes, begin CPR immediately.

As you assess the infant, pay special attention to any marks or bruises on the child before performing any procedures, including CPR. Also note any intervention such as CPR that was done by the parents or caregivers before you arrived.

Scene Assessment

Carefully inspect the environment, following local protocols, noting the condition of the scene where the parents or caregivers found the infant. Your assessment of the scene should concentrate on the following:

- Signs of illness, including medications, humidifiers, or thermometers
- The general condition of the house
- Signs of poor hygiene
- Family interaction. Do not allow yourself to be judgmental about family interactions at this time. Note and report any behavior that is clearly not within the acceptable range, such as physical and verbal abuse.
- The site where the infant was discovered. Note all items in the infant's crib or bed, including pillows, stuffed animals,

toys, and small objects.

Communication and Support of the Family After the Death of a Child

The death of a child, whether sudden death of an infant or otherwise, is a devastating event for a family; it also tends to evoke strong emotional responses among health care providers, including EMS personnel. Part of your job at this point is to allow the family to express their grief in ways that may differ from your own cultural, religious, and personal practices. Provide emotional support in whatever ways you can.

In addition to any medical treatment the child may require, you must be prepared to offer the family a high level of empathy and understanding as they begin the grieving process. First, the family may want you to initiate resuscitation efforts, which may or may not conflict with your EMS protocols. If the child is clearly deceased and, under protocol, can be declared dead in the field, but family members are so distraught that they insist that resuscitation efforts be made, initiate CPR and transport the child.

The extent of your interaction with the family will depend, to some degree, on the number of providers available at the scene. Always introduce yourself to the child's parents or caregivers, and ask about the child's date of birth and medical history. If and when the decision is made to start or stop resuscitation efforts, inform the family immediately. Find a place for family members to watch resuscitation without being in the way. Do not, in any case, speculate on the cause of the child's death. The family will want to see the child and should be asked whether they want to hold the child and say good-bye. Parents and caregivers may be experiencing strong feelings of denial.

The following interventions are helpful in caring for the family at this time:

- Learn and use the child's name rather than the impersonal "your child."
- Speak to family members at eye level, and maintain good eye contact with them.
- Use the word "dead" or "died" when informing the family of the child's death; euphemisms such as "passed away" or "gone" are ineffective.
- Acknowledge the family's feelings ("I know this is devastating for you,"), but never say "I know how you feel," even if you have experienced a similar event; the statement will anger many people.
- Offer to call other family members or clergy if the family wishes.
- Keep any instructions short, simple, and basic. Emotional distress may limit their ability to process information.
- Ask each adult family member individually whether he or she wants to hold the child.
- Wrap the dead child in a blanket, as you would if he or she were alive, and stay with family members while they hold the child. Ask them not to remove tubes or other equipment that was used in an attempted resuscitation.

Table 34-17 lists additional guidelines for helping the family of a deceased child.

Remember that each individual and each culture expresses grief in a different way, some more visibly than others. Some will require intervention; others will not. Most parents or caregivers feel directly or indirectly responsible for the death of a child and may express this immediately; this does not mean that they are actually responsible. Although you should keep the possibility of abuse or neglect in mind, your role is not that of investigator. Any further inquiry is the responsibility of law enforcement.

Table 34-17 How You Can Help the Family of a Deceased Child

When Arriving on Site
- Introduce yourself quickly.
- Obtain a brief history.
- When possible, one EMT should stay with the family.
- Ask the child's name and refer to the child by that name.

If Resuscitation Is Attempted
- Give brief, frequent updates and explanations.
- Allow family members to stay within viewing distance if they wish.
- Allow family members to accompany the child to the hospital when possible.

If No Resuscitation Is Performed
- Sit down with the family.
- Inform the family immediately.
- Explain why no resuscitation will be attempted.
- Offer to arrange for religious support, including baptism or last rites.

Beginning the Grieving Process
- Learn and use the child's name.
- Allow the family to express emotions; be nonjudgmental.
- Give brief explanations and answers.
- Explain to the family that the cause of death is still unknown.
- Allow time for questions.

DO
- Tell the family how sorry you are.
- Tell the family whom they can call if they have questions later.
- Give written instructions and referrals.

DO NOT
- Say, "I know how you feel."
- Say, "You have other children," or "You can have other children."
- Attempt to answer the question "Why did this happen?"
- Try to tell the family that they will feel better in time.

Many times family members will ask specific questions about the event: Why did this happen? How did this happen? Let them know that their concerns will be addressed but that answers are not immediately available Table 34-18. Remember to always use the child's name when speaking to family members. If possible, allow the family to spend time with the child and to ride in the ambulance to the hospital.

Table 34-18 Common Questions Following the Death of a Child

Q: Was there pain?
A: This often can be answered by a simple "No." If you are uncertain, you may give an indirect answer such as, "We really don't know what patients feel in these circumstances."
Q: What did the child die of?
A: Do not answer this question; you would probably be guessing.
Q: Why did this happen?
A: Do not answer this question either, as the answer depends on one's own individual philosophy or religion. "I wish I had an answer for you," is usually the most appropriate response.
Q: What happens now?
A: This question usually concerns the next few minutes or the next hour. If you know, give the family a general idea of what will happen. For example, if there is no history of illness, you can say, "A medical examination will be done, and then [child's name] will be taken to the mortuary."

Some EMS systems arrange for home visits after the death of a child so that EMS providers and family members can come to some sort of closure together. This also gives the family an opportunity to ask any remaining questions about the event. However, you need special training for such visits.

Coping with the death of a child can be very stressful. You may find yourself with unexpected feelings of pain and loss. It is helpful to take some time before going back on the job to work through your feelings and to talk about the event with your EMS colleagues. Be alert for signs of posttraumatic stress in yourself and others, including nightmares, restlessness, difficulty sleeping, and changes in appetite. Consider the need for professional help if these signs or symptoms continue. Arrange for a proper debriefing after your involvement with the case comes to a close. This can be a session with a trained counselor or a group discussion with your colleagues or the entire health care team. As discussed in Chapter 2, *Workforce Safety and Wellness*, all EMS programs should have critical incident stress management protocols and debriefing teams available for traumatic incidents.

Although you may consider the death of a child to be a failure, your skill at coping with this kind of emotional event can be a great comfort to the family, helping them to accept their loss and begin the long process of grieving.

Words of Wisdom

Most parents or caregivers of children who die suddenly will experience extremely strong emotional responses for a long time after the death. Counseling and support services begin with your care, including immediate referral to longer-term services. You can usually make this referral through social services personnel in a hospital you work with; familiarize yourself with available resources. Many communities also have support groups for grieving families. Make sure the parents or caregivers are aware of available services, offer to put them in touch while you are there, and leave the contact information in written form for their later reference even if you have helped them make the contact.

Apparent Life-Threatening Event

Infants who have cyanosis and apnea and are unresponsive when found by their families sometimes resume breathing and color with stimulation. These children have had what is called an **apparent life-threatening event (ALTE)**, called near-miss SIDS in the past. In addition to cyanosis and apnea, a classic ALTE is characterized by a distinct change in muscle tone (limpness) and choking or gagging. Given the limited understanding of ALTEs and the inability to identify subtle causes in the field, parents and caregivers should be encouraged to have their infant promptly transported to an appropriate facility for a full evaluation. After the ALTE, you may find a child that appears healthy and shows no signs of illness or distress. Nevertheless, you must complete a careful assessment and provide rapid transport to the ED.

Pay strict attention to management of the airway. Assess the infant's history and, if possible, the environment. Be aware the ALTE might be the result of abuse. Allow parents or caregivers to ride in the ambulance if appropriate. If asked, explain that you cannot say what caused the event and that the physicians will have to determine the cause at the hospital.

YOU are the Provider — SUMMARY

1. How does a child's airway and respiratory system differ from an adult's?

Proportionately, infants and children have a larger, rounder occiput (back of the head). The child's tongue is proportionately larger than an adult's tongue and larger relative to the small mandible, which makes it easier to block the airway. In addition, the pediatric airway is narrower with a proportionately larger and floppier epiglottis when compared to an adult. Because of their relatively smaller lungs, infants and children need to breathe faster to adequately exchange oxygen and carbon dioxide. Children have both a higher metabolic rate and a higher demand for oxygen due in part to the actual size of the lung tissues and the volume of air that can be exchanged. Finally, breathing in children also requires use of both the diaphragm and intercostal muscles.

2. What are some airway and breathing problems that are unique to pediatric patients?

Foreign body airway obstruction is common in children; it commonly occurs when children put a small toy or other object in their mouths. A number of respiratory illnesses are unique to the pediatric population, including bacterial tracheitis, croup (laryngotracheobronchitis), epiglottitis, asthma, bronchiolitis, and pertussis (whooping cough).

3. Why did you not immediately perform a hands-on assessment of this child?

If an infant or child is clearly experiencing a life-threatening condition, such as unconsciousness or major trauma, then an immediate hands-on assessment is indicated. However, since the child is conscious, you can use the pediatric assessment triangle (PAT) to quickly form a general impression of the child without touching her. Based on the findings of the PAT, you should be able to determine whether the child is in stable condition, in which case you can continue with your assessment, or unstable condition, in which case you should begin immediate treatment and prepare for transport.

4. On the basis of your observations so far, is this child experiencing respiratory distress or respiratory failure?

Although the child appears fearful of your presence—a normal reaction for a young child—she is alert, exhibiting age-appropriate behavior, and maintaining eye contact with you. Her skin is pink and appears to be dry; however, she is experiencing increased work of breathing, as noted by an increased respiratory rate, obvious breathing difficulty, nasal flaring, and prominent retractions. This clinical presentation is consistent with respiratory distress.

5. What is the most likely cause of this child's respiratory distress?

On the basis of the child's clinical presentation and the progression of her symptoms, you should suspect that she has croup. This general impression is further reinforced by the presence of a high-pitched cough, a low-grade fever, and preceding cold symptoms. Her breath sounds are clear to auscultation bilaterally; this makes a lower airway problem highly unlikely. In addition, it is autumn; croup most commonly occurs during the autumn and early winter.

6. Should you separate this child from her parents to provide further treatment? Why or why not?

The decision to separate a sick or injured child from his or her parents is based on the child's condition and the parents' reaction to the situation. Although this child is experiencing respiratory distress, she is clinically stable and is clinging to her mother, who is showing no evidence of emotional distress. For these reasons, do not separate the child from her mother. If you do, you will likely find that the child will become more anxious. Anxiety can easily worsen the child's condition by making her breathe harder and making her heart beat faster.

7. How has this child's condition changed? What should you do next?

Compared with earlier assessments, the child's condition has obviously deteriorated; she is now in respiratory failure. When infants and children decompensate, they often do so with alarming speed. In this case, the child decompensated in the time it took to move her from the residence to the back of your ambulance! Clinical signs of this child's deterioration include a decreased level of activity; she was previously conscious and maintaining eye contact. She is breathing slower and her retractions have markedly weakened; this indicates chest wall muscle fatigue from prolonged increased work of breathing. She is developing cyanosis around her mouth (perioral cyanosis), indicating a decreased level of oxygen in her blood. This sign is further verified by the marked decrease in her oxygen saturation level. Perhaps the most ominous sign is the marked decrease in her heart rate. When the body is no longer able to compensate, the heart rate begins to fall; this is a sign of impending cardiopulmonary arrest.

You must act immediately to prevent this child from developing respiratory or cardiac arrest. Begin assisting her ventilations with a BVM and high-flow oxygen and transport immediately. If possible, coordinate an intercept with an ALS unit en route to the hospital. If her condition continues to deteriorate, she may require advanced airway management or medication therapy.

8. How could an ALS intercept benefit this child?

You are caring for a child who, at a minimum, requires assisted ventilation. If her condition continues to deteriorate, she may require CPR. ALS providers can perform advanced airway management, administer cardiac medications, and monitor the patient's cardiac rhythm. In some cases, children with respiratory failure require more than oxygen and assisted ventilations; certain medications may also be required. Because these interventions would clearly benefit the child—especially if she experiences cardiac arrest—consider an ALS intercept if it will lead to faster access to advanced care.

9. Are you providing adequate ventilations? How can you tell?

The child's level of consciousness (still listless) and slow, shallow respirations are clear indicators for the continued use of assisted ventilation. However, she is showing signs of improvement, indicating that your ventilations are adequate.

The child's heart rate has increased from 90 beats/min to 110 beats/min; as with any patient, an improvement in the heart rate is a sign of adequate artificial ventilation. The child's oxygen saturation has also improved significantly (from 85% to 96%); this indicates that you are adequately oxygenating her blood. The cyanosis around her mouth is resolving; this is also an indicator of adequate ventilation.

Despite the fact that you have noted clinical improvement with assisted ventilation, this does not mean that you can stop. The child is still breathing at a slow rate and the depth of her breathing is shallow. Also, she is not resisting your treatment, thus indicating that her level of consciousness is still depressed, and she is still fatigued. Continue to assist her ventilations.

10. Why is it especially important to avoid hyperventilating infants and children?

In the unprotected airway (ie, in the patient who is not intubated), hyperventilation forces excess air into the stomach, which causes gastric distention. Gastric distention increases the risk of aspiration if vomiting occurs. In infants and small children, there is the additional risk of pushing the diaphragm into the thoracic cavity, which may reduce the effectiveness of your ventilations. It takes much less air in the stomach of an infant or child to inhibit adequate positive pressure ventilations than it does in an adult.

EMS Patient Care Report (PCR)

Date: 1-15-16	**Incident No.:** 013210	**Nature of Call:** Respiratory distress		**Location:** 545 W. San Antonio St.	
Dispatched: 2323	**En Route:** 2324	**At Scene:** 2330	**Transport:** 2340	**At Hospital:** 2353	**In Service:** 2359

Patient Information

Age: 4 **Sex:** F **Weight (in kg [lb]):** 16 kg (35 lb)	**Allergies:** No known drug allergies **Medications:** None **Past Medical History:** Recent cold **Chief Complaint:** Respiratory distress

Vital Signs

Time: 2335	**BP:** 86/56	**Pulse:** 124	**Respirations:** 34	**Spo_2:** 95%
Time: 2340	**BP:** 76/56	**Pulse:** 90	**Respirations:** 18	**Spo_2:** 85%
Time: 2348	**BP:** 84/54	**Pulse:** 110	**Respirations:** 20	**Spo_2:** 96%

EMS Treatment (circle all that apply)

Oxygen @ 12 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other**

Narrative

Medic 3 dispatched to a residence for a 4-year-old child with respiratory distress. Arrived on scene and found the patient sitting on the couch next to her mother. She was conscious, maintained eye contact, and began clinging to her mother. Her airway was patent; however, her breathing was obviously labored. Visual assessment revealed that her skin was pink and appeared dry. She had prominent supraclavicular retractions and nasal flaring during inhalation. Administered blow-by oxygen via pediatric nonrebreathing mask and performed further assessment. Patient's mother states that she has had a cold for the past 2 days, and slowly developed a low-grade fever and high-pitched cough, which she described as a "barking seal." Mother denies that her child has any significant past medical history; she has been giving her ibuprofen as needed for her low-grade fever. Auscultation of breath sounds revealed that they were clear and equal bilaterally, but prominent intercostal retractions were noted on exposure of the chest. Capillary refill time, 1 second. Continued blow-by oxygen as patient's father carried her to the ambulance. Shortly after securing the child to the stretcher, reassessment revealed that her level of consciousness had markedly decreased. Her respiratory rate also decreased, her retractions were weak, and her oxygen saturation level markedly decreased. Began assisting the child's ventilations with a BVM and high-flow oxygen and began rapid transport. Attempted to coordinate ALS intercept; however, the closest ALS unit was too far away and would have resulted in unnecessary delay in transport. Notified receiving facility of the patient's condition and of our estimated arrival time and continued assisting ventilations. Reassessment revealed that the child was still listless and was not resistant to treatment; however, her heart rate, skin color, and oxygen saturation improved. Continued ventilatory assistance and delivered child to the emergency department. Verbal report was given to staff physician. Medic 3 cleared the hospital and returned to service at 2359.**End of report**

Prep Kit

Ready for Review

- Children are not only smaller than adults and more vulnerable, they are also anatomically, physiologically, and psychologically different from adults in important ways.
- Infancy is the first year of life. If possible, allow the parent or caregiver to hold the infant during the assessment.
- The toddler (age 1 to 3 years) may experience separation or stranger anxiety but may be able to be distracted by a special object (blanket) or toy.
- Preschool-age children (ages 3 to 6 years) can understand directions and can identify painful areas when questioned. Tell these children what you are going to do before you do it to prevent the development of frightening fantasies.
- School-age children (ages 6 to 12 years of age) are familiar with the physical examination process. Talk with them about their interests to distract them during a procedure.
- Adolescents (ages 12 to 18 years) are physically similar to adults, but are still children on an emotional level. Respect the adolescent's modesty at all times.
- General rules for dealing with pediatric patients of all ages include appearing confident, being calm, remaining honest, and keeping parents or caregivers together with the pediatric patient as much as possible.
- The growing bodies of the pediatric patient create some special considerations.
- The tongue is large relative to other structures, so it poses a higher risk of airway obstruction than in an adult.
- An infant breathes faster than an older child.
- Breathing requires the use of chest muscles and the diaphragm.
- The airway in a child has a smaller diameter than the airway in an adult and is therefore more easily obstructed.
- A rapid heartbeat and blood vessel constriction help pediatric patients to compensate for decreased perfusion.
- Children's internal organs are not as insulated by fat and may be injured more severely, and children have less circulating blood. Therefore, children exhibit the signs of shock more slowly, but they go into shock more quickly, with less blood loss.
- Children's bones are more flexible and bend more with injury, and the ends of the long bones, where growth occurs, are weaker and may be injured more easily.
- Because a young child might not be able to speak, your assessment of his or her condition must be based in large part on what you can see and hear. Families may be able to provide vital information about an incident or illness.
- Use the pediatric assessment triangle (PAT) to obtain a general impression of the infant or child.
- You will need to carry special sizes of airway equipment for pediatric patients.
- Use length-based resuscitation tape to determine the appropriately sized equipment for children.
- The three keys to successful use of the BVM in a child are: (1) have the appropriate equipment in the right size; (2) maintain a good face-to-mask seal; and (3) ventilate at the appropriate rate and volume.
- Signs of shock in children are tachycardia, poor capillary refill time (>2 seconds), and mental status changes. You must be alert for signs of shock in pediatric patients because they can decompensate rapidly.
- Begin treating shock by assessing the ABCs. In pediatric patients with obvious life-threatening external hemorrhage, address this first, as always.
- Febrile seizures may be a sign of a more serious problem such as meningitis.
- The most common cause of dehydration in children is vomiting and diarrhea. Life-threatening diarrhea can develop in an infant in a matter of hours.
- Fever is a common reason why parents or caregivers call 9-1-1. Body temperatures of 100.4°F (38°C) or higher are considered to be abnormal.
- Trauma is the number one killer of children in the United States.
- A victim of sudden infant death syndrome (SIDS) will be pale or blue, not breathing, and unresponsive. He or she may show signs of postmortem changes, including rigor mortis and dependent lividity; if so, call medical control to report the situation.
- Carefully inspect the environment where a SIDS victim was found, looking for signs of illness, abusive family interactions, and objects in the child's crib.
- Provide emotional support for the family in whatever way you can, but do not make judgmental statements.
- The death of a child is devastating for family members and for health care providers. In dealing with family members, acknowledge their feelings, keep any instructions short and simple, use the child's name, and maintain eye contact.
- Be prepared to respond to philosophic as well as medical questions. Indicate concern and understanding; do not be specific

about the cause of death.

- Be alert for signs of posttraumatic stress in yourself and others after dealing with the death of a child. It can help to talk about the event and your feelings with your EMS colleagues.

Vital Vocabulary

adolescents Children between ages 12 to 18 years.

apparent life-threatening event (ALTE) An event that causes unresponsiveness, cyanosis, and apnea in an infant, who then resumes breathing with stimulation.

blanch To turn white.

bradypnea Slow respiratory rate; ominous sign in a child that indicates impending respiratory arrest.

bronchiolitis Inflammation of the bronchioles that usually occurs in children younger than 2 years and is often caused by the respiratory syncytial virus.

central pulses Pulses that are closest to the core (central) part of the body where the vital organs are located; include the carotid, femoral, and apical pulses.

child abuse A general term applying to all forms of abuse and neglect of children.

croup An inflammatory disease of the upper respiratory system that may cause a partial airway obstruction and is characterized by a barking cough; usually seen in children.

epiglottitis A disease in which the epiglottis becomes inflamed and enlarged and may cause an upper airway obstruction.

fontanelles Areas where the neonate's or infant's skull has not fused together; usually disappear at approximately 18 months of age.

generalized tonic-clonic seizure A seizure that features rhythmic back-and-forth motion of an extremity and body stiffness. feelings, keep any instructions short and simple, use the child's name, and maintain eye contact.

grunting An "uh" sound heard during exhalation; reflects the child's attempt to keep the alveoli open; a sign of increased work of breathing.

infancy The first year of life.

length-based resuscitation tape A tape used to estimate an infant or child's weight on the basis of length; appropriate drug doses and equipment sizes are listed on the tape.

meningitis An inflammation of the meningeal coverings of the brain and spinal cord; it is usually caused by a virus or a bacterium.

nares The external openings of the nostrils. A single nostril opening is called a naris.

neglect Refusal or failure on the part of the parent or caregiver to provide life necessities.

Neisseria meningitides A form of bacterial meningitis characterized by rapid onset of symptoms, often leading to shock and death.

pediatric assessment triangle (PAT) A structured assessment tool used to rapidly form a general impression of the infant or child without touching him or her; consists of assessing appearance, work of breathing, and circulation to the skin.

pediatrics A specialized medical practice devoted to the care of the young.

pertussis An airborne bacterial infection that affects mostly children younger than 6 years, in which the patient is feverish and exhibits a "whoop" sound on inspiration after a coughing attack; highly contagious through droplet infection. Also called whooping cough.

preschool-age Children between ages 3 to 6 years.

school-age Children between ages 6 to 12 years.

shaken baby syndrome A syndrome seen in abused infants and children; the patient has been subjected to violent, whiplash-type shaking injuries inflicted by the abusing individual that may cause coma, seizures, and increased intracranial pressure due to tearing of the cerebral veins with consequent bleeding into the brain.

sniffing position An upright position in which the patient's head and chin are thrust slightly forward to keep the airway open; the optimum position for the uninjured child who requires airway management.

sudden infant death syndrome (SIDS) Death of an infant or young child that remains unexplained after a complete autopsy.

tachypnea Increased respiratory rate.

toddler A child age 1 to 3 years.

tracheitis Inflammation of the trachea.

tripod position An upright position in which the patient leans forward onto outstretched arms with the head and chin thrust slightly forward.

work of breathing An indicator of oxygenation and ventilation; reflects the child's attempt to compensate for hypoxia.

Assessment *in Action*

You and your partner are called to an elementary school for an 8-year-old boy with an altered mental status. On arrival, you find the child lying supine on the cafeteria floor. A teacher is waiting with the patient and the scene is safe. The teacher states that the child finished his lunch and began "shaking" in his chair, at which point the teacher moved him to the floor.

Your general impression provides the following information: there are no obvious life threats; he is alert; his work of breathing is unlabored; his skin color is pink. Your assessment reveals his airway is open and clear, his respiratory rate is 20 breaths/min, and his pulse rate is 90 beats/min. The child is responsive to verbal stimuli and is confused as to what happened and where he is. You do not see any injuries or skin rashes.

1. Which of the following would be the least likely cause of the patient's altered mental status?

A. Hypoglycemia
B. Drug ingestion
C. Hypoxia
D. Head injury

2. Which of the following assessment tools would you use to form a general impression of this patient without touching him?

A. Pediatric assessment triangle (PAT)
B. Glasgow Coma Scale
C. AVPU scale
D. TICLS mnemonic

3. The teacher tells you that the child has a history of seizures and recently had a medication change. Given the situation, which of the following would be the least likely cause of this seizure?

A. Fever or infection
B. Head injury
C. Hypoglycemia
D. Medication changes or errors

4. To evaluate this child's level of consciousness, you must note the mental status and assess his:

A. skin color.
B. pupil size.
C. chest rise.
D. age-appropriate responses to your questions.

5. The teacher reports that after the child was moved to the floor, he stopped "shaking" and his breathing became rapid. This period is referred to as the:

A. recovery state.
B. postictal state.
C. aural state.
D. reversal state.

6. If this patient were experiencing status epilepticus, the teacher would have described a seizure continuing every few minutes without regaining consciousness, or a single seizure lasting longer than:

A. 30 minutes.
B. 45 minutes.
C. 60 minutes.
D. 120 minutes.

7. If the patient begins seizing again during your care, which of the following would be your treatment priority?

A. Stop the seizure.
B. Secure and clear the airway.
C. Provide rapid transport.
D. Maintain the patient's body temperature.

8. During transport and your secondary assessment of the patient, which finding will help you determine when this patient is no longer in a postictal state?

A. Level of consciousness
B. Respiratory rate
C. Muscle tone
D. Blood pressure

9. Explain how seizure activity in an infant differs from that of an older child.

10. When you are using the pediatric assessment triangle, what information can you obtain by evaluating the appearance

of a pediatric patient?

CHAPTER
35

Geriatric Emergencies

National EMS Education Standard Competencies

Special Patient Populations

Applies a fundamental knowledge of growth, development, and aging and assessment findings to provide basic emergency care and transportation for a patient with special needs.

Geriatrics

› Impact of age-related changes on assessment and care (pp 1301–1310)
› Changes associated with aging, psychosocial aspects of aging and age-related assessment and treatment modifications for the major or common geriatric diseases and/or emergencies
  • Cardiovascular diseases (pp 1287–1289, 1301–1305)
  • Respiratory diseases (pp 1286–1287, 1301–1305)
  • Neurological diseases (pp 1290–1293, 1301–1305)
  • Endocrine diseases (pp 1295, 1301–1305)
  • Alzheimer disease (pp 1291, 1301–1305)
  • Dementia (pp 1291, 1301–1305)

Patients With Special Challenges

› Recognizing and reporting abuse and neglect (pp 1312–1313 and Chapter 34, *Pediatric Emergencies*)
› Health care implications of
  • Abuse (pp 1312–1313 and Chapter 34, *Pediatric Emergencies*)
  • Neglect (pp 1312–1313 and Chapter 34, *Pediatric Emergencies*)
  • Homelessness (Chapter 36, *Patients With Special Challenges*)
  • Poverty (Chapter 36, *Patients With Special Challenges*)
  • Bariatrics (Chapter 36, *Patients With Special Challenges*)
  • Technology dependent (Chapter 36, *Patients With Special Challenges*)

- Hospice/terminally ill (Chapter 36, *Patients With Special Challenges*)
- Tracheostomy care/dysfunction (Chapter 36, *Patients With Special Challenges*)
- Homecare (Chapter 36, *Patients With Special Challenges*)
- Sensory deficit/loss (Chapter 36, *Patients With Special Challenges*)
- Developmental disability (Chapter 36, *Patients With Special Challenges*)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Special Considerations in Trauma

› Recognition and management of trauma in the:
- Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
- Pediatric patient (Chapter 34, *Pediatric Emergencies*)
- Geriatric patient (pp 1306–1310)

› Pathophysiology, assessment, and management of trauma in the:
- Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
- Pediatric patient (Chapter 34, *Pediatric Emergencies*)
- Geriatric patient (pp 1306–1310)
- Cognitively impaired patient (Chapter 36, *Patients With Special Challenges*)

Knowledge Objectives

1. Define the term geriatrics. (p 1283)
2. Recognize some of the special aspects of the lives of older people. (pp 1283–1285)
3. Know generational considerations when communicating with a geriatric patient. (pp 1283–1284)
4. Describe the common complaints and the leading causes of death in older people. (p 1285)
5. Discuss the physiologic changes associated with the aging process and the age-related assessment and treatment modifications that result. (pp 1285–1299)
6. Define polypharmacy and the toxicity issues that can result. (pp 1297–1298)
7. Discuss the effect of aging on behavioral emergencies. (pp 1298–1299)
8. Explain the GEMS diamond and its role in the assessment and care of the geriatric patient. (pp 1299–1300)
9. Explain special considerations when performing the patient assessment process on a geriatric patient with a medical condition. (pp 1301–1305)
10. Discuss the effects of aging on environmental emergencies. (p 1306)
11. Explain special considerations when performing the patient assessment process on a geriatric patient with a traumatic injury. (pp 1306–1310)
12. Explain special considerations when responding to calls at nursing and skilled care facilities. (pp 1310–1311)
13. Define an advance directive and considerations with older patients. (pp 1311–1312)
14. Discuss the prevalence of elder abuse and neglect; include why the extent of elder abuse is not well known. (pp 1312–1313)
15. Recognize acts of commission or omission by a caregiver that result in harm, potential harm, or threat of harm to a geriatric patient. (p 1312)
16. Explain the assessment and care of a geriatric patient who has potentially been abused or neglected. (pp 1313–1314)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

Geriatrics is the assessment and treatment of disease in someone who is 65 years or older. In this chapter, 65 years is used as the threshold age to be consistent with the definition used by other medical groups and governmental agencies. How fast one ages, though, is a function of genetics, lifestyle, and, perhaps, attitude.

People born between 1946 and 1964, known as the baby boomer generation, are much more active today than people their age were in previous generations. The older population continues to increase. It is projected that between 2012 and 2050, the population aged 65 and older is expected to nearly double. This is a significant trend for EMS because older people are major users of both emergency medical services and health care systems in general.

Geriatric patients present a special challenge for health care providers because the classic presentations of injuries and illness are often altered by chronic conditions, multiple medications, and the physiology of aging. To provide effective treatment for this growing population, you must understand the issues related to aging and modify some of your assessment and treatment approaches accordingly.

Being a patient advocate for an older patient involves much more than management of medical and traumatic emergencies. As the older population increases, communities, companies, and hospitals are encouraging awareness of geriatric issues through the media and creating programs that promote prevention of injuries. EMTs who respond to the homes of geriatric patients are in an ideal position to provide key information to others in health care and social services systems. Interventions for geriatric patients may include reviewing the home environment to ensure that safe and tolerable living conditions exist, providing information on how to prevent falls, and making referrals to appropriate social service agencies when a patient needs assistance. Often, simple preventive measures can help older people avoid further injury, costly medical treatment, and death. You are in a position to not only recognize and manage a serious emergency, but also to help prevent problems before they occur.

Generational Considerations

It is important to understand and appreciate how the life of an older person might differ from yours. You will see older people who have recently lost a spouse and are struggling to fill the spouse's role, such as by managing the finances or doing the housework. Many older people also live on a fixed income, which can be very challenging. Some older people may not take all of their medications in an effort to save money. Many struggle to stay independent as long as possible and are living in the homes in which they raised their children—children who have now moved far away.

YOU are the Provider — PART 1

At 0625 hours, you are dispatched to a residence at 644 Yolanda Street for an 82-year-old woman whose daughter called 9-1-1 because her mother is experiencing shortness of breath. You and your partner respond to the scene, which is located only a short distance away.

1. As an EMT, why is it important for you to understand the anatomic and physiologic changes that occur with aging?
2. How does the process of aging affect a person's respiratory system?

Figure 35-1 Physical activity can help older people reduce their risk of illness and injury.

Courtesy of the National Cancer Institute.

It takes time and patience to interact with an older person. Always treat the patient with respect. Make every attempt to avoid *ageism*, which is a stereotyping of older people that often leads to discrimination. Common stereotypes include assuming that the patient has dementia, is hard of hearing, has a sedentary lifestyle, or is immobile. Older people can stay fit and be active, even though they are not able to perform at the same level as they did in their youth **Figure 35-1**.

Communication and Older Adults

Effective verbal communication skills are essential to the successful assessment and treatment of older patients. Communication with older people can be challenging. The aging process brings with it changes in vision, hearing, taste, smell, touch, and pain sensation. Also, there are changes in communication abilities that accompany aging, such as dementia and other diseases. These challenges are consequences of aging and should be expected, but not assumed.

Words of Wisdom

Older patients who learned English as a second language may revert back to their native language when stressed or in a crisis situation. Do not assume that the patient cannot understand you just because he or she is speaking another language.

Communication Techniques

Your first words to the patient and the attitude behind them can gain or lose a patient's trust. Speak respectfully when you introduce yourself. Address the patient by using "sir" or "ma'am." If you know the patient's last name, use "Mr.," "Mrs.," or "Miss." Using the patient's name shows respect and helps the patient focus on your questions. Older people may be insulted, however, if you use only their first name. Asking the patient how he or she prefers to be addressed can build trust. Never use familiar or casual terms such as "honey" or "dear" when referring to your patient unless he or she has invited you to do so.

When you interview an older patient, the following techniques should be used:

- **Identify yourself.** This helps to establish a relationship.
- **Be aware of how you present yourself.** Avoid showing frustration and impatience through body language, such as crossed arms.
- **Look directly at the patient at eye level and ensure good lighting.**
- **Speak slowly and distinctly.** Do not raise your voice. Try to talk in a lower tone; some older people can hear certain pitches better than others.
- **Have one person talk to the patient and ask only one question at a time.** Do not answer questions for patients out of frustration or impatience.
- **Do not assume that all older patients are hard of hearing.** Ask the patient if he or she can hear you, and verify by asking him or her to confirm understanding of what you just said. Be aware of the presence of hearing aids.
- **Give the patient time to respond unless the condition appears urgent.**
- **Listen to the answer the patient gives you.**
- **Explain what you are going to do before you do it.** Use simple terms to explain the use of medical equipment and procedures; avoid using medical jargon or slang.
- **Do not talk about the patient in front of him or her as though the patient was not there.** This gives the patient the feeling that he or she does not have a say in decisions about his or her care. This is easy to forget when the patient has impaired cognitive (thought) processes or has difficulty communicating.

Keep in mind the patient may be very nervous about going to the hospital. This may be due to fears of dying, a loss of independence, or being placed in a care center. By using effective communication skills, you can earn the patient's trust and help him or her feel more at ease.

Words of Wisdom

Remember, as with patients of any age, older patients may have more difficulty communicating clearly when they are stressed by an emergency or personal crisis.

Common Complaints and the Leading Causes of Death in Older People

The changing physiology of geriatric patients can predispose this population to a host of problems not seen in youth. A simple rib fracture in a 30- or 40-year-old patient can be inconsequential in the long-term. The same injury in a geriatric patient who is age 80 or 90 years can result in pneumonia and even death. A hip fracture from a low-mechanism fall is common in older people and may have dire consequences. Hip fractures are more likely to occur when bones are weakened by osteoporosis or infection. Sedentary behavior while healing can predispose the patient to pneumonia and blood clots that may interfere with healing and can cause death. Many older patients who experience hip fractures do not return to their preinjury levels of activity. Many older patients are well aware of this and may be frightened. All of these factors make assessment and treatment decisions more complex and patient complaints potentially more serious.

The most frequently occurring conditions in older people and the leading causes of death in the geriatric population are listed in Table 35-1.

Changes in the Body

The process of aging is gradual and starts much earlier than most people realize. Human growth and development peaks in the late 20s and early 30s, at which point the aging process begins. A 35-year-old is aging just as fast as an 85-year-old, but the older person exhibits the cumulative results of a longer process. Of course, the aging process can vary dramatically from one person to another. You have probably seen 60-year-olds who look frail, and 80-year-olds who could run marathons.

Table 35-1 Common Conditions and the Leading Causes of Death in Geriatric Patients

Common Conditions

- Hypertension
- Arthritis
- Heart disease
- Cancer
- Diabetes mellitus
- Asthma
- Chronic bronchitis or emphysema
- Stroke

Leading Causes of Death

- Heart disease
- Cancer
- Chronic lower respiratory disease
- Stroke
- Alzheimer disease
- Diabetes mellitus
- Influenza and pneumonia

Source: Federal Interagency Forum on Aging-Related Statistics. *Older Americans 2012: Key Indicators of Well-Being*. Federal Interagency Forum on Aging-Related Statistics. Washington, DC: U.S. Government Printing Office. June 2012. http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/Docs/EntireChartbook.pdf.Accessed Dec. 22, 2014.

The aging process is inevitably accompanied by changes in physiologic function, such as a decline in the function of the liver and kidneys. All tissues in the body undergo aging, albeit not at the same rate. The decrease in the functional capacity of various organ systems is normal, but it can affect the way a patient responds to illness.

As a health care professional, you need to be knowledgeable about decreased function in organ systems in older people because this knowledge will enable you to correctly respond to a patient's illness. For example, if you are unaware of the normal changes of aging, you may mistake the changes for signs of illness and give treatment when none is necessary. At the other end of the spectrum, there is a widespread—and unfortunate—tendency to attribute genuine disease symptoms to "just getting old" and to neglect their treatment.

Changes in the Respiratory System

Anatomy and Physiology

Age-related changes in the respiratory system can predispose an older adult to respiratory illness. Even a minor lung infection can become a life-threatening event. One of the conditions contributing to breathing problems is the weakening of the airway musculature that can cause decreased breathing capacity. This decreased muscle mass means that older patients have less help from muscles in the chest wall when they have trouble breathing. As one gets older, the alveoli in lung tissue can become enlarged and the elasticity decreases, making it harder to expel used air (air trapping). This change in lung tissue quality is comparable to a balloon that has been expanded and then deflated; the balloon loses some of its ability to contract to its original state after inflation. The lack of elasticity results in a decreased ability to exchange oxygen and carbon dioxide. The body's chemoreceptors, which monitor the changes in oxygen and carbon dioxide levels in the blood, slow with age. This, in turn, can make the body respond more slowly to hypoxia, a dangerous condition in which the body tissues and cells do not have enough oxygen.

In addition, loss of mechanisms that protect the upper airway include decreased cough and gag reflexes, resulting in a decreased ability to clear secretions. There is also a decrease in the number of cilia that line the bronchial tree; this lessens an older person's ability to cough and clear secretions, therefore increasing the chance of infection.

Pathophysiology

Pneumonia

Perhaps due to the prevalent use of tobacco during their generation, chronic lower respiratory disease, influenza, and pneumonia remain in the top five causes of geriatric deaths. In fact, one of the most common causes of death in older patients is infection with *Pneumococcus* bacteria.

Pneumonia is an inflammation of the lung from bacterial, viral, or fungal causes. Pneumonia is the leading cause of death from infection in Americans older than 65 years. It especially affects people who are chronically and terminally ill. The process of aging causes some degree of immune suppression and increases the risk of contracting infections like pneumonia. Increased mucus production, pulmonary secretions, and the inflammatory effects of infection all interfere with the ability of the alveoli to oxygenate the blood. Your management of pneumonia remains the same as described in Chapter 15, *Respiratory Emergencies*; however, it is important to maintain a high index of suspicion for any geriatric patient with signs and symptoms of possible pneumonia. Remember to wear respiratory protection when you are assessing a patient with a potentially infectious respiratory disease. You can also place a surgical mask on the patient.

Pulmonary Embolism

Another condition that can cause respiratory distress in older people is a **pulmonary embolism**. Pulmonary embolism is a condition that causes a sudden blockage of an artery by a venous clot. Clots develop in the veins of the legs or pelvis and then break off and embolize (move) through the pulmonary artery or one of its branches, where they lodge. A patient with a pulmonary embolism will present with shortness of breath and sometimes chest pain; thus, the pulmonary embolism can be confused with a cardiac, lung, or musculoskeletal problem. The top risk factors for a pulmonary embolism include living in a nursing home or recent hospitalization for medical illness or surgery (especially in a lower extremity). Other factors include trauma, cancer, history of blood clots or heart failure, presence of a pacemaker or central venous catheter, paralyzed extremities, obesity, recent long-distance travel, and sedentary behavior, especially after surgery.

The presentation can be subtle or dramatic depending on how large the clot is and how much lung tissue is damaged. Patients present with tachycardia; sudden onset of dyspnea (shortness of breath, which differentiates this from an infection like pneumonia); shoulder, back, or chest pain; cough; syncope in patients in whom the clot is larger; anxiety, which may be communicated as a sense of impending doom; apprehension; and possibly a low-grade fever or **hemoptysis** (the coughing up of blood). Also look for leg pain, redness, and swelling in just one ankle and foot for the source of the clot. The patient may present with profound fatigue and may go into cardiac arrest in a worst-case scenario.

Treatment should focus on airway, ventilatory, and circulatory support. Hemoptysis is usually not severe, but any blood that has been coughed up should be cleared from the airway. Because a considerable amount of lung tissue may not be functioning, supplemental oxygen is mandatory in a patient with a pulmonary embolism. Place the patient in a comfortable position, usually sitting, and apply high-flow oxygen via a nonrebreathing mask. Aggressive airway management may be necessary because a large pulmonary embolus may cause significant impairment of the patient's ability to breathe and could result in cardiac arrest if not managed properly. In this situation, ventilate with a bag-valve mask (BVM), using an oropharyngeal or nasopharyngeal airway. When a patient is in respiratory and/or cardiac arrest, manage according to current Emergency Cardiovascular Care guidelines and local protocol.

Changes in the Cardiovascular System

Anatomy and Physiology

A variety of changes occur in the cardiovascular system as a person grows older, with the net effect of a decrease in the efficiency of the system. Specifically, the heart hypertrophies (enlarges) with age, probably in response to the chronically increased afterload imposed by stiffened blood vessels. Bigger is not better, however. Over time, cardiac output (the amount of blood pumped out of the heart in one minute) declines, mostly as a result of a decreasing stroke volume (the amount of blood pumped out of the heart in one beat).

Arteriosclerosis—a disease that causes the arteries to thicken, harden, and calcify—contributes to systolic hypertension in many older patients, which places an extra burden on the heart. This phenomenon may be a consequence of disease states such as diabetes, atherosclerosis, and renal compromise, and it is associated with an increased risk of cardiovascular disease, dementia, and death. Compliance of the vascular walls depends on the production of collagen and elastin, proteins that are the primary components of muscle and connective tissue. An increase in pressure (normal hypertension seen with aging) leads to overproduction of abnormal collagen and decreased quantities of elastin; these actions contribute to vascular stiffening. The result is a widening pulse pressure, decreased coronary artery perfusion, and changes in cardiac ejection efficiency.

Some changes in cardiovascular performance are probably not a direct consequence of aging, but rather reflect the deconditioning effect of a sedentary lifestyle. Whether because of other disabilities (such as arthritis) or for behavioral reasons, many people tend to limit physical activity and exercise as they grow older. The phrase, "Use it or lose it," applies just as much to the cardiac muscle as to the biceps muscle.

Pathophysiology

Cardiac output is a measure of the workload of the heart. A younger person's body normally compensates for an increased demand on the cardiovascular system by increasing the heart rate, increasing the contraction of the heart, and constricting the blood vessels to nonvital organs. However, with aging, a person's ability to speed up contractions, increase contraction strength, and constrict or narrow blood vessels (vasoconstriction) is decreased because of stiffer vessels. As stroke volume is reduced, cardiac output decreases. The heart may lose its ability to raise cardiac output to meet the needs of the body.

Geriatric patients are at risk for **atherosclerosis**, an accumulation of fat and cholesterol in the arteries **Figure 35-2**. Major complications of atherosclerosis include myocardial infarction (heart attack) and stroke. Atherosclerotic disease originates in the teen years and affects more than 60% of people older than 65 years. The presence of atherosclerosis makes stroke, heart disease, hypertension, and bowel infarction more likely.

Older people are also at an increased risk for formation of an **aneurysm**, an abnormal, blood-filled dilation of the wall of a blood vessel. Severe blood loss can occur when an aneurysm ruptures.

The blood vessels themselves become stiff, which results in a higher systolic blood pressure. As a result, the left ventricle, which pushes blood out into the body, becomes thicker and eventually loses elasticity, resulting in decreased filling of the left ventricle, which in turn causes decreased cardiac output.

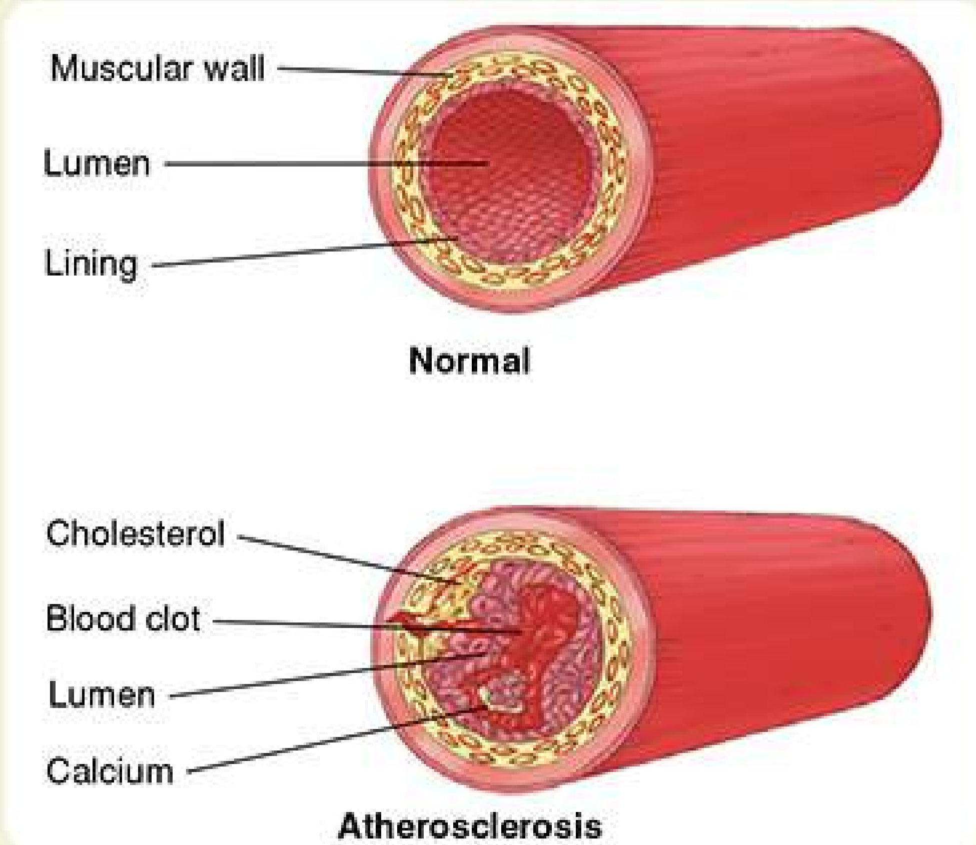


Figure 35-2 Atherosclerosis, the buildup of fat and cholesterol on arterial walls.

Other anatomic changes include stiffening and degeneration of the heart valves, which may impede normal blood flow in and out of the heart. Aging also alters the heart's electrical conduction system. The sinoatrial node is the normal pacemaker of the heart, but by the age of 75 years, the number of the cells in the sinoatrial node will decrease by 90%. This event, combined with fibrosis and fatty deposits attaching to the electrical pathway, makes it likely that the patient will have some kind of heart rhythm disturbance, or dysrhythmia. This can cause a heart rate that is too fast, too slow, or too erratic to provide effective blood flow to the body.

Another condition that affects older people is orthostatic hypotension (postural hypotension), which is a drop in blood pressure with a change in position. In younger people, the body senses changes in blood pressure and quickly compensates. In older people, you may see a drop in the systolic blood pressure of 20 mm Hg when an older patient moves from a sitting position to a standing position. This happens because the patient has become less sensitive to rapid changes in blood pressure. The body, therefore, is less able to adapt to rapid postural changes.

Another vessel-related problem is called venous stasis. Stasis means motionless state and in this context refers to loss of proper function of the veins in the legs that would normally carry blood back to the heart. This condition creates problems such as blood clots in the superficial veins (superficial phlebitis) and blood clots in the deep veins, known as **deep venous thrombosis**. Deep vein thrombosis is a serious concern because it can lead to pulmonary embolism.

People with venous stasis usually exhibit edema, or swelling, of the legs and ankles. Patients will report a feeling of fullness, aching, or tiredness in their legs, especially when standing. This condition eventually causes a red-brown discoloration on the skin and, in some cases, skin ulcers.

Myocardial Infarction (Heart Attack)

Chest pain is a common complaint of older people and can often mean heart-related issues like myocardial infarction. It is important to remember that the classic symptoms of a heart attack are often not present in geriatric patients. As many as one-third of older patients have "silent" heart attacks in which the usual chest pain is not present. This is particularly common in women and people with diabetes. Do not assume that your patient is not having a myocardial infarction because he or she is not reporting the classic, pressure-type, substernal chest pain. Any of the following symptoms may be a manifestation of acute cardiac disease in the older patient and should be evaluated by advanced life support (ALS) personnel for an underlying cardiac disorder: dyspnea; epigastric and abdominal pain; loss of bladder and bowel control; nausea and vomiting; weakness, dizziness, light-headedness, and syncope; fatigue; and confusion.

Other signs and symptoms in older people that can indicate a cardiovascular problem include issues with circulation; diaphoresis (profound sweating); pale, cyanotic (blue), or mottled skin; abnormal or decreased breath sounds; and increased peripheral edema (swelling).

It is essential to obtain baseline vital signs because this information will provide you with a primary picture of the severity of your patient's condition, and you can use these findings to measure against in your ongoing assessment of the patient. Pulse rates can be too slow, too fast, weak, or irregular. A blood pressure reading can show hypertension or hypotension, either of which is significant in the presence of cardiac chest pain. The respiratory rate may be higher as the body attempts to take in and use more oxygen to aid an ailing heart.

At the EMT level, treatment of an older patient's cardiac problem mostly consists of airway, ventilatory, and circulatory support. Give oxygen with adjuncts appropriate to the patient's condition. Some EMS system protocols allow EMTs to administer aspirin or assist patients with the administration of medications, such as nitroglycerin. Continue to evaluate your patient treatment through reassessment. Cardiac problems can be expected to worsen suddenly, so be prepared.

Heart Failure

The signs and symptoms of heart failure will differ depending on the extent to which the right and/or left side of the heart is not functioning correctly.

Right-sided heart failure occurs when the fluid backs up into the body. You will see **jugular vein distention** (visual bulging of the jugular veins in the neck), **ascites** (fluid in the abdomen), and peripheral edema in the body tissues. An enlarged liver may also be present from blood backing up through the portal vein. This may be determined by palpation. Right-sided heart failure is often caused by left-sided heart failure, so it is common to see signs of both when assessing the patient who has left-sided heart failure.

With left-sided heart failure, fluid backs up into the lungs. The excess fluid in the lungs causes pulmonary edema, and the patient will have severe shortness of breath and hypoxia with crackles in the lungs.

Paroxysmal nocturnal dyspnea is a condition that is characterized by a sudden attack of respiratory distress that wakes the person at night when the patient is in a reclining position. The respiratory distress is caused by fluid accumulation in the lungs. Patients report coughing, feeling suffocated, and cold sweats, and you will notice tachycardia. The term for not being able to breathe while lying down is orthopnea. If you suspect that your patient may have congestive heart failure, one question you can ask is, "Do you sleep sitting up?"

Treatment should consist of airway, ventilatory, and circulatory support. Provide oxygen with adjuncts appropriate to the patient's condition, and prepare for the next level of deterioration.

Stroke

Stroke (cerebrovascular accident, or CVA) is a leading cause of death in older people. The likelihood of having a stroke becomes greater as a person gets older. Causes of strokes are both preventable and nonpreventable. Preventable risk factors include smoking, hypertension, diabetes, atrial fibrillation, obesity, and a sedentary lifestyle. Uncontrollable factors include age, race, and gender.

Signs and symptoms of stroke include acute altered level of consciousness (LOC); numbness, weakness, or paralysis on one side of the body; slurred speech; difficulty speaking (aphasia); visual disturbances; headache and dizziness; incontinence; and, in the worst cases, seizure. See Chapter 17, *Neurologic Emergencies*, for more information on stroke assessment.

Hemorrhagic strokes, in which a broken blood vessel causes bleeding into the brain, are less common and more likely to be fatal. Ischemic strokes occur when a blood clot blocks the flow of blood to a portion of the brain. Brain tissue distal to this clot is deprived of oxygen and will die if the clot is not broken down.

The treatment goal is to salvage as much of the surrounding brain tissue as possible. Many communities now have stroke centers that specialize in fast, effective treatment of stroke. Determining the onset of the symptoms of stroke is important. If the symptoms occurred within the past few hours, the patient will be a candidate for stroke center therapy and has a higher chance for recovery. Remember that transient ischemic attack (TIA) can have the same signs and symptoms as a stroke. Always manage the patient as if he or she is having a stroke unless medical control directs otherwise.

YOU are the Provider — PART 2

You arrive at the scene and are met at the door by the patient's daughter. She advises you that her mother has emphysema and that her respiratory distress has worsened during the past few days. You find the patient sitting in a chair in her living room; she has a blanket wrapped around her and is in mild respiratory distress. You introduce yourself to the patient and perform a primary assessment.

Recording Time: 0 Minutes	
Appearance	Obvious respiratory distress; chills
Level of consciousness	Conscious but confused
Airway	Open; clear of secretions and foreign bodies
Breathing	Increased rate; labored
Circulation	Radial pulse, irregular and weak; skin is pink, warm, and dry; no obvious bleeding

The patient is using home oxygen at 2 L/min via nasal cannula. She lives alone but her daughter visits daily. The patient's home appears to be well kept, and you can see numerous medication containers on a nearby table.

3. What is the GEMS diamond? How can it facilitate your overall care of an older patient?

Changes in the Nervous System

Anatomy and Physiology

Aging produces changes in the nervous system that are reflected in the neurologic examination. Changes in thinking speed, memory, and posture stability are the most common normal findings in older people. Studies have documented age-associated declines in mental function, especially slower central processing of sensory stimuli and language, and longer retrieval times for short- and long-term memory. Common findings during the physical examination include slow responses to questions and requests to repeat a question.

The brain decreases in terms of weight (10% to 20%) and volume as a person ages. This increases the amount of space in the cranium, thus increasing the chance for head injuries. Head injuries with a minimal mechanism are commonly missed in older people. In addition, there is a 5% to 50% loss of neurons in older people. Neurons are responsible for transmission of impulses, so the motor and sensory neural networks slow down with age. This affects the control of the rate and depth of breathing, heart rate, blood pressure, hunger, thirst, and body temperature. However, the functional significance of these changes is not clear. The human brain has an enormous reserve capacity, and having a smaller and lighter brain does not necessarily interfere with the mental capabilities of all older people, as evidenced by older people who remain active and productive.

Undeniably, though, the performance of most of the sense organs declines with increasing age. The senses of taste and smell diminish as a person ages. Visual changes may begin as early as age 40 years, such that as many as 50% of patients older than 65 years have vision problems. Causes of visual impairment in older people may include diabetic retinopathy and age-related macular degeneration.

Vision

Visual acuity, depth perception, and the ability of the eyes to accommodate to light change with age. The pupils require more time to adjust, which can make driving and even walking more hazardous **Figure 35-3**. **Cataracts**, clouding of the lenses or their surrounding membranes, interfere with vision and make it difficult to distinguish colors and see clearly, increasing the likelihood of falls, accidents, and mistakes in taking medications. Decreased tear production leads to drier eyes. An inability to differentiate colors and decreased night vision develop in older people, affecting their ability to drive. Vision changes, however, can occur earlier in life. Many people in their 40s lose the ability to see up close and may have to get eyeglasses for the first time. This condition is called presbyopia and is caused by a loss of elasticity of the crystalline lens.

Figure 35-3 Changes in vision, hearing, posture, and motor ability predispose older people to a greater risk of being struck by a vehicle or being involved in a motor vehicle crash.

A number of other disease processes plague the vision of older adults. These can include glaucoma, macular degeneration, and retinal detachment. Increased intraocular pressure is a risk factor for glaucoma, which can cause damage to the optic nerve. It sometimes causes headache with nausea and vomiting and visual disturbances. Macular degeneration is a deterioration of the macula, which is in the central portion of the retina; this condition generally affects adults older than 50 years. It causes a vision loss in the central part of the visual field. Retinal detachment is a medical emergency requiring prompt surgical treatment to preserve vision. In retinal detachment, the retina is pulled away from the choroid, a thin layer of blood vessels that supply nutrients and oxygen to the retina. This condition leaves the retinal cells deprived of oxygen; therefore, there is a potential for permanent vision loss. The patient may report floaters, debris in the visual field, sudden flashes of light or shadow, or visual blurring.

Hearing

Hearing is the sensory change that affects the most older people. Typical hearing problems cause changes in the inner ear and make hearing high-frequency sounds difficult. Changes in the ear can also cause problems with balance and make falls more likely. **Presbycusis** is age-related hearing loss. Over time, the wear and tear on the ears from noise damages the inner ear. Heredity and long-term exposure to loud noises are the main factors that contribute to hearing loss. When assessing your patient, check for the use of hearing aids. If the patient wears hearing aids, ensure that the aids are properly in place and turned on. Some patients may want you to talk into their “good ear.”

Taste

Even the sense of taste can be diminished for an older person because of a decrease in the number of taste buds. The negative result might be lessened interest in eating, which can lead to weight loss, malnutrition, and complaints of fatigue.

Touch

An older person may have a decreased sense of touch and pain perception from the loss of the end nerve fibers. This loss, in conjunction with the slowing of the peripheral nervous system, can create situations in which an older person may be injured and not know it. Specifically, there is a decreased sensation of hot and cold. An older person may be slow to react when touching something hot. This delayed response to pain could result in a burn. This is an especially acute problem in people with diabetes, who also lose sensation because of diabetic neuropathy or nerve damage.

Pathophysiology

Dementia

You may come across an older patient who is exhibiting delusions, hallucinations, or aggressive behavior. This patient may have dementia. **Dementia** is the slow onset of progressive disorientation, shortened attention span, and loss of cognitive function. It is a chronic, generally irreversible condition that causes a progressive loss of cognitive abilities, psychomotor skills, and social skills. Dementia develops slowly over a period of years rather than a few days. Dementia is the result of many neurologic diseases. Alzheimer disease, Parkinson disease, cerebrovascular accidents, and genetic factors may cause dementia.

To help you determine the patient's normal mental status, question family members or friends if present at the scene. You should evaluate the history, risk factors, and current medications.

On assessment, the patient might exhibit loss of cognitive function. It helps to determine if this was gradual or acute (began suddenly). Patients with dementia may have short- and long-term memory problems and a decreased attention span, or they may be unable to perform their daily routines. They also may show a decreased ability to communicate and appear confused. Again, determine why you were called, and establish a baseline of the person's cognitive abilities and functioning.

Other aspects of dementia can complicate your ability to assess and manage the patient. Sometimes patients are not only confused, but angry as well. They will generally be poor historians and have impaired judgment. Patients may be unable to vocalize areas of pain and current symptoms, or they may be unable to follow commands. Patients may exhibit disorganized thoughts: inattention, memory loss, disorientation, hallucinations, delusions, and a reduced level of consciousness.

Patients with dementia may express anxiety over movement out of their current residence. They may not understand why they need to go to the hospital and often express anxiety and fear of treatment. Their level of tolerance to changes in their routine may be very low. You have to exercise extreme tolerance and patience with patients who have altered mental status or are experiencing dementia.

Special Populations

Alzheimer disease is a common cause of dementia. Although its cause is unknown, the disease results in loss of brain tissue. Symptoms include memory loss, lack of spontaneity, subtle personality changes, disorientation, impaired thinking, restlessness, agitation, wandering, impaired judgment, and inappropriate social behavior. In late stages of the disease, the patient shows indifference to food, an inability to communicate, incontinence, and seizures. Patients with Alzheimer disease may live at home with a spouse or child who is also the caregiver or they may live in a specialized nursing facility. As with all patients, you must treat patients with Alzheimer disease with patience and respect.

Delirium

Delirium is a sudden change in mental status, consciousness, or cognitive processes, and is marked by the inability to focus, think logically, and maintain attention. According to *The Merck Manual Home Edition* delirium affects 15% to 50% of hospitalized people aged 70 years or older.

Acute anxiety may be present in addition to the other symptoms. Usually memory remains intact. Delirium is commonly marked by acute or recent onset and is a red flag for some type of new health problem. This condition is generally the result of a reversible physical ailment, such as tumors or fever. However, delirium can also be present from metabolic causes. Any time a patient has an acute onset of delirious behavior, consider the evaluation of pathophysiology through history, possible risk factors, and current medications.

Other important things to look for in the history are intoxication or withdrawal from alcohol; withdrawal from sedatives; medical conditions such as a **urinary tract infection (UTI)** (caused by bacteria), bowel obstruction, dehydration, fever, cardiovascular disease, and hyperglycemia or hypoglycemia; psychiatric disorders like depression; malnutrition or vitamin deficiencies; and environmental emergencies.

Assess the patient for the following specific conditions that can be managed at the prehospital level:

- Hypoxia
- Hypovolemia
- Hypoglycemia
- Hypothermia

Any of these four conditions, if unrecognized or untreated, can be rapidly fatal. With these conditions, delirium has a rapid onset and is usually curable if identified early. The onset may be described in terms of minutes, hours, or days. Critical BLS and ALS interventions may include supplemental oxygen, treatment of shock, glucose, and rewarming measures.

During the physical examination, you may see changes in circulation, breath sounds, motor function, and pupillary response. Hypotension can be an indication of hypovolemia. Dilated pupils could suggest hypoxia; wheezing, crackles, and rhonchi are the result of disease processes that impair breathing and oxygenation.

Treatment will depend on the results of your assessment but should include airway, ventilatory, and circulatory support and oxygen with airway adjuncts appropriate to the patient's condition if tolerated by the patient. ALS personnel will attempt venous access to introduce fluids that will help correct hypovolemia.

Syncope

You should always assume that syncope, or fainting, in an older patient is a life-threatening problem until proven otherwise. **Syncope** is often caused by an interruption of blood flow to the brain. Syncope has many causes—some are serious and others are not. Regardless, an older person who has a period of unconsciousness should be examined to determine the cause of the syncope. **Table 35-2** shows some of the causes of syncope in geriatric patients.

Table 35-2 Possible Causes of Syncope in Geriatric Patients

Cause	Description
Dysrhythmias and heart attack	The heart is beating too fast or too slowly, the cardiac output drops, and blood flow to the brain is interrupted. A heart attack can also cause syncope.
Vascular and volume changes	Medication interactions can cause venous pooling and vasodilation, the widening of a blood vessel that results in a drop in blood pressure and inadequate blood flow to the brain. Another cause of syncope can be a drop in blood volume because of hidden bleeding (such as an aneurysm).
Neurologic cause	Syncope can be a sign of transient ischemic attack or stroke.

Neuropathy

Your patient could be experiencing a neuropathy, a disorder of the nerves of the peripheral nervous system in which function and structure of the peripheral motor, sensory, and autonomic neurons are impaired. Symptoms depend on whether the nerves affected are motor, sensory, or autonomic and where the nerves are located.

- **Motor nerves:** muscle weakness, cramps, spasms, loss of balance, and loss of coordination
- **Sensory nerves:** tingling, numbness, itching, and pain; burning, freezing, or extreme sensitivity to touch

- **Autonomic nerves:** affect involuntary functions that could include changes in blood pressure and heart rate, constipation, bladder and sexual dysfunction

Neuropathies are treated with medication and other therapies not available in a prehospital setting. You should make your patient as comfortable as possible and transport.

Changes in the Gastrointestinal System

Anatomy and Physiology

Changes in the mouth include a reduction in the volume of saliva, with a resulting dryness of the mouth. Dental loss is not a normal result of the aging process, but rather the result of disease of the teeth and gums; nevertheless, dental loss is widespread in the geriatric population and contributes to nutritional and digestive problems. Both of these oral changes increase the risk of choking.

Like oral secretions, gastric secretions are reduced as a person ages—although enough acid is still present to produce ulcers under certain conditions. Changes in gastric motility also occur, which may lead to slower gastric emptying—a factor of some importance when assessing the risk of aspiration.

Function of the small and large bowel changes little as a consequence of aging, although the incidence of certain diseases involving the bowel (such as diverticulosis) increases as a person grows older. In addition, nutrients from food are not as readily absorbed.

Blood flow to the liver declines. There are changes in hepatic enzyme systems, with some systems declining in activity and others increasing. Notably, the activity of the enzyme systems involved with the detoxification of drugs declines as a person ages.

Pathophysiology

Gastrointestinal issues in older people are attributable to changes related to age or to the diseases that come with advanced age. Age-related changes in the gastrointestinal system include issues with dental problems; decrease in saliva and sense of taste leading to poor nutrition; and poor muscle tone of the smooth muscle sphincter between the esophagus and stomach that can cause regurgitation and lead to heartburn and acid reflux. Other changes include a decrease in hydrochloric acid in the stomach and alterations in absorption of nutrients and slowing peristalsis (motion that moves feces through the colon), which can cause constipation. The rectal sphincter may also become weak, resulting in fecal incontinence, or lack of bowel control.

Changes in the liver predispose older people to a number of problems. The liver, which is responsible for removing toxins and breaking down drugs in the body, shrinks with age. Blood flow to the liver declines, and there is decreased metabolism. This has a direct effect on how medications may affect the patient.

Serious gastrointestinal issues that affect older people are gastrointestinal bleeding caused by disease processes, inflammation, infection, and obstruction of the upper and lower intestinal tract. Gastrointestinal bleeding is usually heralded by hematemesis (the vomiting of blood) or coffee ground–like vomitus. Bleeding that travels through the lower digestive tract usually manifests as **melena** (black, tarry stools), whereas red blood usually means a local source of bleeding, such as hemorrhoids. A patient with gastrointestinal bleeding may experience weakness, dizziness, or syncope. Bleeding into the gastrointestinal system can be life threatening because of the potential for blood loss and shock.

Specific gastrointestinal problems that are more common in older patients include diverticulitis, bleeding in the upper and lower gastrointestinal system, peptic ulcer disease, gallbladder disease, and bowel obstruction. Diverticulosis is a condition in which the walls of the gut weaken and small pouches protrude from the colon along those weakened segments. When inflammation develops in one of these pouches, the condition is called diverticulitis. A geriatric patient with diverticulitis generally presents with left lower quadrant pain and fever. Fever suggests a condition that requires immediate attention.

Upper gastrointestinal bleeding occurs in the esophagus, stomach, or duodenum. These bleeding episodes are sometimes seen in people who are long-term users of nonsteroidal anti-inflammatory drugs (NSAIDs) like celecoxib (Celebrex), ibuprofen, and naproxen or people who are long-term alcohol users. Irritation of the lining of the stomach or ulcers can cause forceful vomiting that tears the esophagus. Hepatitis and cancer can also contribute to bleeding problems.

Lower gastrointestinal bleeding occurs in the colon or rectum. Lower gastrointestinal bleeding can be serious, especially in cases where the patient presents with tachycardia and hypotension.

Peptic ulcer disease is more common in older adults, especially people who use NSAIDs. The patient will report a gnawing, burning pain in the upper abdomen that improves after eating but returns later. Complications of peptic ulcer disease include bleeding, anemia, and bowel perforation, which are medical emergencies.

Gallbladder disease is more common in older adults and they have a higher risk of complications from gallstones. The risk of death from surgery to remove the gallbladder increases with age. Patients with inflammation of the gallbladder, cholecystitis, will have fever and right upper quadrant pain that may radiate to the shoulder. Patients may also have jaundice, which is a yellow appearance of the eyes and skin. This condition is dangerous because infection can spread to the blood, causing sepsis and shock.

Bowel obstructions occur frequently in the geriatric population. The ability of the gastrointestinal tract to move feces through the system slows with aging, and patients can experience problems having bowel movements. When patients strain to have a bowel movement, they can stimulate the vagus nerve, which can cause a vasovagal response; this is a condition in which the heart rate drops dramatically and the patient becomes dizzy or passes out. The patient will usually be in stable condition on your arrival but requires transport to rule out other conditions.

In general, patients with gastrointestinal issues are agitated and are unable to find a comfortable position. When assessing patients with gastrointestinal problems, ask about NSAID and alcohol use. Presentation can include pale or yellow, thin skin; frail musculoskeletal system; peripheral, sacral, and periorbital edema; hypertension; fever; tachycardia; and dyspnea.

If permitted by local protocol, orthostatic vital signs can help determine if a patient is hypovolemic. Blood pressure and pulse rates are taken with the patient lying, sitting, and then standing. Note any drop in blood pressure and increase in heart rate that occurs as the patient moves to an upright position. Do not attempt to assess orthostatic vitals on a patient with obvious signs of shock, hypotension, altered level of consciousness, or possible spinal injury.

Treatment consists of airway, ventilatory, and circulatory support. Oxygen should be delivered with adjuncts appropriate to the patient’s condition.

The Acute Abdomen—Nongastrointestinal Complaints

Because of an aging nervous system, abdominal complaints in geriatric patients are extremely difficult to assess. A number of life-threatening problems are common in older patients. In the prehospital setting, the most serious threat from abdominal complaints is blood loss, which can lead to shock and death. **Abdominal aortic aneurysm (AAA)** is one of the most rapidly fatal conditions. An AAA (triple A) tends to develop in people who have a history of hypertension and atherosclerosis. The walls of the aorta weaken, and blood begins to leak into the layers of the vessel, causing the aorta to bulge like a bubble on a tire. If enough blood loss occurs into the vessel wall itself, shock occurs. If the vessel wall bursts, it rapidly leads to fatal blood loss. When the problem is found early, there is a chance to repair the vessel before rupture, and fatal blood loss is less likely to occur.

A patient with an AAA most commonly reports abdominal pain radiating through to the back with occasional flank pain. If the AAA becomes large enough, it can be felt as a pulsating mass just above and slightly to the left of the navel during your physical examination. If you see or palpate a pulsating mass, do not continue manipulation or allow other providers to palpate the mass. Occasionally, the AAA causes a decrease in blood flow to one of the legs, and the patient reports some discomfort in the affected extremity. Assessment may also reveal diminished or absent pulses in the extremity. Compensated shock (early shock) and decompensated shock (late shock) as a result of blood loss are common occurrences. Because of a decrease in blood volume and decreased blood flow to the brain, the patient may experience syncope. You should treat the patient for shock, including high-flow oxygen and thermal regulation, and ensure prompt transport to the hospital.

Changes in the Renal System

Anatomy and Physiology

The genitourinary system includes the reproductive organs and the urinary system. The largest component of the urinary system is the kidneys, or renal organs. Age-related changes in the genitourinary system specific to the kidney include a reduction in renal function, a reduction in renal blood flow, and tubule degeneration. For the genitourinary system in general, there is decreased bladder capacity, decline in sphincter muscle control, decline in voiding senses, increase in nocturnal voiding, and, in men, benign prostatic hypertrophy (enlarged prostate).

Age brings changes in the kidneys as well. The kidneys are responsible for maintaining the body’s fluid and electrolyte balance and have important roles in maintaining the body’s long-term acid-base balance and eliminating drugs from the body. In a young adult, the kidneys weigh 8 to 9 oz (250 to 270 g); in a healthy 70 year old, they weigh 6 to 7 oz (180 to 200 g). This decline in weight results from a loss of functioning nephron units, or tubule degeneration, translating into a smaller effective filtering surface. At the same time, renal blood flow decreases by as much as 50% as a person ages.

Pathophysiology

Although the kidneys of an older person may be capable of dealing with day-to-day demands, they may not be able to meet unusual challenges, such as those imposed by illness. For that reason, acute illness in older patients is often accompanied by derangements in fluid and electrolyte balance. Aging kidneys, for example, respond sluggishly to sodium deficiency. An older patient may have a great deal of sodium loss before the kidneys halt urinary sodium excretion, a problem that is exacerbated by the markedly decreased thirst mechanism in older people. The net result may be a rapid development of severe dehydration.

Bowel and bladder continence require anatomically correct gastrointestinal and genitourinary tracts, functioning and intact sphincters, and properly working cognitive and physical functions. Urinary incontinence (involuntary loss of urine) can have significant social and emotional impact, but relatively few people admit to the problem and even fewer seek treatment. Incontinence is not a normal part of aging and can lead to skin irritation, skin breakdown, and urinary tract infections. As people age, the capacity of the bladder decreases. As a consequence, an older person may find it difficult to postpone voiding or may have involuntary bladder contractions. An increase in nocturnal voiding is common. Two major types of incontinence are distinguished: stress and urge. Stress incontinence occurs during activities such as coughing, laughing, sneezing, lifting, and exercise. Urge incontinence is triggered by hot or cold fluids, running water, and even thinking about going to the bathroom. Treatment of incontinence consists of medications, physical therapy, and possibly surgery.

The opposite of incontinence is urinary retention or difficulty urinating. Patients may have difficulty voiding or absence of voiding as a result of many medical causes. In men, enlargement of the prostate can place pressure on the urethra, making voiding difficult. Bladder and urinary tract infections can also cause inflammation. In severe cases of urinary retention, patients may experience renal failure.

Changes in the Endocrine System

Anatomy and Physiology

The endocrine system functions as the control center of the body. It uses hormones to control physiologic processes. A significant change that occurs in an older person is decreased metabolism of thyroxine. This is a thyroid hormone that affects the body's metabolism, temperature, growth, and heart rate. A reduction in thyroid hormones can cause a condition called hypothyroidism. Most of the signs and symptoms people experience are attributed to the process of aging and include slower heart rate, fatigue, drier skin and hair, cold intolerance, and weight gain.

Other endocrine system changes include an increase in the secretion of antidiuretic hormone, causing fluid imbalance; hyperglycemia; and an increase in the levels of norepinephrine, possibly having a harmful effect on the cardiovascular system.

Pathophysiology

Hyperosmolar hyperglycemic nonketotic syndrome (HHNS) is a diabetic complication in older people, and occurs more often in people with type 2 diabetes than in those with type 1 diabetes. Unlike diabetic ketoacidosis (DKA), the resulting high blood glucose level does not cause ketosis; instead, it leads to osmotic diuresis and a shift of fluid to the intravascular space that results in dehydration. The signs and symptoms of HHNS and DKA often overlap. Associated signs and symptoms include hyperglycemia, polydipsia (thirst), polyuria (urination), and polyphagia (hunger), as well as dizziness, confusion, altered mental status, and possibly seizures.

On assessment, you may see changes in circulation such as warm, flushed skin; poor skin turgor; pale, dry, oral mucosa; and a furrowed tongue. The patient may present with signs and symptoms of hypotension and shock, including tachycardia. The blood glucose level will be variable in DKA, whereas in HHNS, the value is typically 600 mg/dL or higher. Another assessment difference is that patients with DKA will present with Kussmaul respirations (deep and labored), and patients with HHNS will not.

Assessment of the patient should include obtaining blood pressure, distal pulses, auscultation of breath sounds, temperature, and assessment of blood glucose level if permitted by local protocol.

Treatment should include airway, ventilatory, and circulatory support. Provide oxygen with adjuncts appropriate to the patient's condition.

Changes in the Immune System

Infections are commonly seen in older people because they generally have an increased risk of infection and are less able to fight infections once they occur. With age, systemic and cellular immune responses become less effective at fighting infection. Fevers are unable to develop in many older patients, but these patients may in fact be hypothermic as a manifestation of severe systemic infection. Anorexia, fatigue, weight loss, falls, or changes in mental status be the primary symptoms of infection in these patients. Pneumonia and urinary tract infection are common in patients who are bedridden. When infection occurs, signs and symptoms may be decreased or minimized by the patient because of the loss of sensation, lack of awareness, or fear of being hospitalized.

Changes in the Musculoskeletal System

Anatomy and Physiology

Aging brings a widespread decrease in bone mass in men and women, but especially among postmenopausal women. Bones become more brittle and tend to break more easily. The disks between the vertebrae of the spine begin to narrow, and a decrease in height between 2 and 3 inches may occur through the lifespan, along with changes in posture. Joints lose their flexibility and may be further immobilized by arthritic changes. In fact, more than half of all older people have some form of arthritis. A decrease in the amount of muscle mass often results in less strength.

Pathophysiology

Changes in physical abilities can affect older adults' confidence in their mobility. The muscle system atrophies and weakens with age. Muscle fibers become smaller and fewer, motor neurons decline in number, and strength declines. The ligaments and cartilage of the joints lose their elasticity. Cartilage also goes through degenerative changes with aging, contributing to arthritis.

The stooped posture of older people comes from atrophy of the supporting structures of the body. Two of every three older patients will show some degree of **kyphosis** (a forward curling of the spine, also called humpback or hunchback). A loss of height in older adults generally results from compression in the spinal column, first in the disks and then from the process of osteoporosis in the vertebral bodies.

Osteoporosis, a condition that affects men and women, is characterized by a decrease in bone mass leading to reduction in bone strength and greater susceptibility to fracture. The extent of bone loss that a person undergoes is influenced by numerous factors, including genetics, smoking, level of activity, diet, alcohol consumption, hormonal factors, and body weight. The most rapid loss of bone occurs in women during the years following menopause, and many postmenopausal women use hormone replacement therapy as a means to reduce the loss of bone. Calcium and vitamin D supplementation is another treatment of the condition, and many other medications are available to improve bone strength. Older people should remain active and engage in a low-impact exercise program to maintain bone and muscle strength.

YOU are the Provider — PART 3

Further assessment of the patient reveals that she has a fever and has not been eating lately. She has a weak cough, which is producing thick green sputum. Auscultation of her breath sounds reveals coarse rhonchi in all fields. Your partner takes her vital signs as you ask additional questions regarding her past medical history.

Recording Time: 5 Minutes	
Respirations	22 breaths/min; labored
Pulse	68 beats/min; weak and irregular
Skin	Hot to the touch; pink and dry
Blood pressure	158/88 mm Hg
Oxygen saturation (Spo_2)	92% on 2 L/min oxygen via nasal cannula

The patient's daughter advises you that in addition to emphysema, her mother has hypertension, atrial fibrillation, rheumatoid arthritis, and Alzheimer disease. You inquire about her confusion, and her daughter tells you that it has worsened in the last couple of days. She hands you a long list of medications and states that she personally gives her mother her medications every day.

4. Based on the patient's current condition, how appropriate is the current oxygen therapy?
5. What should concern you about patients who take numerous medications?
6. What other assessments, if any, should be performed for this patient?

Osteoarthritis is a progressive disease of the joints that destroys cartilage, promotes the formation of bone spurs in joints, and leads to joint stiffness. This type of arthritis is thought to result from "wear and tear" and, in some cases, from repetitive trauma to the joints. It affects 35% to 45% of the population older than 65 years. Typically, osteoarthritis affects several joints of the body, most commonly those in the hands, knees, hips, and spine. Patients report pain and stiffness that gets worse with exertion. The end result is often substantial disability and disfigurement. Patients are typically treated with anti-inflammatory medications and physical therapy to improve the range of motion.

Changes in Skin

The proteins that make the skin pliable decline with age. The layer of fat under the skin also becomes thinner because of the redistribution of fluids and proteins. As the elasticity of the skin declines, bruising becomes more common because the skin can tear more easily. Exocrine (sweat) glands do not respond as readily to heat because of atrophy and because of changes to the tissues of the dermal layer of the skin.

Another problem that affects the skin is pressure ulcers, sometimes referred to as bedsores or **decubitis ulcers**. Pressure ulcers form when a patient is lying or sitting in the same position for a long time. The pressure from the weight of the body cuts off the blood flow to the area of skin. With no blood flow to the skin, a sore develops. These sores can develop in as little as 45 minutes. To help prevent these ulcers, take special care to pad under any bony prominences and in the voids in a patient who may be immobilized for an extended period.

You may see these ulcers in the following various stages of development:

- **Stage I:** Nonblanching redness with damage under the skin
- **Stage II:** Blister or ulcer that can affect the dermis and epidermis
- **Stage III:** Invasion of the fat layer through to the fascia
- **Stage IV:** Invasion to muscle or bone

Decubitis ulcers can be painful and cause complications like bleeding, sepsis, and bone inflammation called osteomyelitis.

Toxicology

There are several pathophysiologic changes that cause older people to be susceptible to toxicity. These include decreased kidney function, altered gastrointestinal absorption, and decreased vascular flow in the liver that alters metabolism and excretion. The kidneys undergo many changes with age. The rate of filtration decreases an average of 50% between the ages of 50 and 90 years. Decreased liver function makes it harder for the liver to detoxify the blood and eliminate substances such as medications and alcohol. These metabolic issues can also make it difficult for physicians to find the appropriate dosage for new medications.

The use of medications by older people accounts for one-quarter of the prescribed medications and one-third of the over-the-counter (OTC) medications sold in the United States. Typical OTC medicines used by older people include aspirin, antacids, cough syrups, and decongestants **Figure 35-4**. Many people believe OTC medications cannot be dangerous, but these medications can have negative effects when mixed with each other and/or with herbal substances, alcohol, and prescription medications.

Polypharmacy refers to the use of multiple prescription medications by one patient. Many patients have more than one physician: a family physician for everyday care, a cardiologist for the heart, and an endocrinologist for the care of diabetes. All of them may prescribe medication. But what if patients do not tell each physician about all of the other medications that he or she takes? Patients may not remember what medications another doctor prescribed or may not want to tell one doctor about seeing another. This problem can be less of an issue if the patient receives all of his or her care within an integrated health system that maintains an electronic medical record that includes information from multiple physicians and health care providers, but this is not always the case. Also, many drugstore chains have a computerized database that can recognize multiple prescriptions, but this setup is helpful only if the patient deals exclusively with that one drugstore chain.

Negative effects can include overdosing and negative medication interaction. Adverse reactions occur when medications taken together change the absorption, distribution, or excretion of medications in the body or the effects of the medications on the body.

Figure 35-4 **A.** Over-the-counter medications such as aspirin, antacids, cough syrups, and decongestants can interact negatively with prescription medications. **B.** Grapefruit juice cannot be taken with several medications because it can interfere with the actions of those medications. **C.** Over-the-counter medicines such as diphenhydramine (Benadryl), nonsteroidal anti-inflammatory drugs, iron preparations, and mineral oil (used for constipation) were once thought to be harmless, but are now known to be potentially harmful in older adults.

Another complication associated with polypharmacy is the fact that a patient may have multiple prescriptions of different amounts that need to be taken at different times of the day. Patients can easily forget what they have taken and overdose or forget to take them altogether and underdose. Both scenarios can lead to serious problems.

Medication noncompliance in older patients is also an issue and may occur because of financial challenges; inability to open containers; or impaired cognitive, vision, and hearing ability. If you suspect medication noncompliance, you should check prescription dates and the number of pills available.

The geriatric population is more likely to have cases of polypharmacy because older people are affected most by the process of aging. Physiologic factors known to be true about the hepatic and renal functions of excretion and metabolism of medications can change in the face of multiple prescriptions being consumed at once. Always be mindful of this issue when obtaining the patient's medication history.

Behavioral Emergencies

For most older people, the later years are ones of fulfillment and satisfaction with a lifetime of accomplishments. For some older adults, however, later life is characterized by physical pain, emotional distress, doubts about the significance of life's accomplishments, financial concerns, loss of loved ones, dissatisfaction with living conditions, and seemingly unbearable disability. When these factors lead to hopelessness about the possibility for positive change in their lives, depression and, unfortunately, even suicide are possible outcomes. You are often the first health care professional to have contact with older adults who are depressed and, for some older patients, the only health care contact.

Depression

Depression is not part of normal aging, but rather a medical disease. This common, often debilitating psychiatric disorder affects millions of older Americans. Older adults residing in skilled nursing facilities are even more likely to be depressed. Depression is diagnosed three times more commonly in women than in men. In contrast with the normal emotional experiences of sadness, grief, loss, and temporary bad moods, depression is extreme and persistent and can interfere significantly with an older adult's ability to function.

The good news is that depression is treatable with medication and therapy. The bad news is that if depression goes unrecognized or untreated, it is associated with a higher suicide rate in the geriatric population than in any other age group. Depression in older patients can mimic the effects of many other medical problems (such as dementia). Risk factors for depression in older people include a history of depression, chronic disease, and loss (function, independence, or significant others).

It is impossible to predict which older adults will have depression, but studies indicate that substance abuse, isolation, prescription medication use, and chronic medical conditions all contribute to the onset of significant depression. Treatment of severe depression in older adults usually consists of behavioral counseling, medication, or a combination of both. For many older adults, simply reestablishing relationships with the community or with family is enough to lessen the severity of the illness.

Suicide

Depression may be difficult to recognize in older people because many do not want to complain about feeling sad, worthless, or unwanted. Disturbingly, most suicides involving older people occur in people who have recently been diagnosed with depression. In addition, most suicide victims have seen their primary care physician within the month before the event.

Older men have the highest suicide rate of any age group in the United States. Caucasian men over age 65 are eight times more likely to kill themselves than women of the same age. The suicide rate among older Caucasian men is almost twice the rate of all other male groups. At highest risk are white men 85 years and older, who use firearms as their suicide method of choice. Older people who attempt suicide choose much more lethal means than younger victims and generally have diminished recuperative capacity to survive an attempt. Unlike younger people, geriatric patients typically do not make suicidal gestures or attempt to get help. Instead, the rate of completed suicide is disproportionately high in the geriatric population. Many geriatric patients see no other way out when they have a terminal illness or debilitating cardiac or neurologic condition (such as severe heart disease or stroke).

Suicide can happen in any family, regardless of socioeconomic class, culture, race, or religious affiliation. Some common predisposing events and conditions include death of a loved one, physical illness, depression and hopelessness, alcohol abuse, alcohol dependence, and loss of meaningful life roles. Keep in mind that only a small percentage of older people pursue medical treatment for behavioral issues. Not only do many older adults fail to seek care, but they also frequently deny the problem when asked about it. When assessing the patient who is displaying signs of depression, it is appropriate to ask if he or she is considering suicide. If the answer is "yes," the next question should be, "Do you have a plan?" Include this information in your documentation and in your report as you transfer care at the hospital. It is vital that all members of the health care team be aware of these issues and take appropriate steps to ensure their own safety, as well as patient safety.

The GEMS Diamond

When you are called on to care for older patients, it is important to remember certain key concepts. The GEMS diamond Table 35-3 was created to help you remember what is different about older patients. The GEMS diamond is not intended to be a format for your approach to geriatric patients, nor is it intended to replace the ABCs of care. Instead, it serves as an acronym for the issues to be considered when assessing every older patient.

The "G" of the GEMS diamond stands for "geriatric patients." When responding to an emergency involving an older patient, you should consider that older patients are different from younger patients and may present atypically. Be familiar with the normal changes of aging and treat older patients with compassion and respect.

The "E" of the GEMS diamond stands for an environmental assessment. Assessment of the environment can help give clues to the patient's condition and the cause of the emergency. Is the home too hot or too cold? Is the home well kept and secure? Are there hazardous conditions? Preventive care is also very important for a geriatric patient, who may not carefully study the environment or may not realize where risks exist.

The "M" of the GEMS diamond stands for medical assessment. As stated, older patients tend to have a variety of medical problems and may be taking numerous prescription, OTC, and herbal medications. Obtaining a thorough medical history is very important in older patients.

The "S" stands for social assessment. Older people may have a smaller social network because of the death of a spouse, family members, and friends. Older people may also need assistance with activities of daily living (ADLs), such as dressing and eating. There are numerous social agencies that are readily available to help geriatric patients. Consider obtaining information pamphlets about some of the agencies for older people in your area. If you have these brochures with you and encounter a person in need, you can provide this valuable information. Social agencies that deal with the older population will be more than happy to share a listing of the services they provide.

Table 35-3 The GEMS Diamond

G Geriatric Patients

- Present atypically
- Deserve respect
- Experience normal changes with age

E Environmental Assessment

- What is the physical condition of the home? Is the interior or exterior of the home in need of repair? Is the home secure?
- Are hazardous conditions present (eg, poor wiring, rotten floors, unventilated gas heaters, broken window glass, clutter that prevents adequate egress)?
- Are smoke detectors present and functional?
- Is the home too hot or too cold?
- Is there a fecal or urine odor in the home?
- Are pets well cared for?
- Is food present in the home? Is it adequate and unspoiled?
- Are liquor bottles present (lying empty)?
- Is bedding soiled or urine-soaked?
- Are there burn patterns on the walls, cabinets, or floors?
- If the patient has a disability, are appropriate assistive devices (such as a wheelchair or walker) present and in adequate condition?
- Does the patient have access to a telephone?
- Are medications prescribed to someone else, expired, unmarked, or from many physicians?
- If the patient is living with others, is he or she confined to one part of the home?
- If the patient is residing in a nursing facility, does the care appear to be adequate to meet the patient's needs?

M Medical Assessment

- Older patients tend to have a variety of medical problems, making assessment more complex. Keep this in mind in all cases—that is, both trauma and medical. A trauma patient may have an underlying medical condition related to the traumatic event.
- Obtaining a medical history is very important in older patients—no matter what the primary complaint is.
- Primary assessment
- Reassessment

S Social Assessment

- Assess the activities of daily living (ADLs):
  - Eating
  - Dressing
  - Bathing
  - Toileting
- Are these activities being provided for the patient? If so, by whom?
- Are there delays in obtaining food, medication, or toileting? The patient may report this, or the environment may be suggestive of this.
- Does the patient have regular visits from family members, live with family members, or live with a spouse?
- If in an institutional setting, is the patient able to feed himself or herself? If not, is food still sitting on the food tray? Has the patient been lying in his or her own urine or feces for prolonged periods of time?
- Does the patient have a social network? Does the patient have ways to interact socially with others on a daily basis?

The GEMS diamond provides an organized way to remember the important issues for older patients. Using this concept will help you make appropriate referrals, and, as a result, you will help older patients maintain their quality of life.

Special Considerations in Assessing a Geriatric Medical Patient

Assessing an older person can be challenging because of communication issues, hearing and vision deficits, alteration in consciousness, complicated medical histories, and the effects of medications. Previous injury or illnesses that are not associated with the current problem may also alter the assessment findings. These may include medications that mask changes in vital signs that you might expect, such as tachycardia in shock. A previous stroke may have changed a patient's baseline level of consciousness and neurologic status.

Words of Wisdom

Medical and trauma conditions are often superimposed on each other. A simple fall may have been preceded by weakness and dizziness, suggesting a serious medical condition. What looks like an obvious trauma call could easily have been caused by a serious medical emergency.

Scene Size-up

Every emergency call begins with a thorough scene size-up. Is the scene safe? How many patients do you have? What is the nature of illness (NOI)? Have you taken proper standard precautions?

Geriatric patients are commonly found in their own homes, retirement homes, or skilled nursing facilities, but calls for assistance can come from any location. Many older people live alone. Access to them may be hampered if their condition prevents them from getting to the door to let you in. Police or fire department assistance may be required.

Many older people try to maintain their independence as long as they can. They may or may not have someone who checks on their welfare. You will find some people living in conditions that are not safe or appropriate. You need to take note of negative or unsafe environmental conditions. Is the home well maintained and sanitary? Are the utilities working? Look for clues that might explain the patient's medical history or current problem: Is it too hot or too cold? A geriatric patient can have hypothermia or heat stroke in temperatures that are not considered extreme. Is there food available? Is there evidence of abuse or alcohol or illegal drug use? Are there medications on the nightstand in the bedroom?

In a nursing home or residential care facility, you will need to locate the patient's room and find a staff member who can explain why you were called. In any case in which the patient's mental status is altered, you need to find someone who can tell you the patient's history and whether the patient's behavior or level of consciousness is normal or altered. The presence of a hospital bed, oxygen tanks, or therapeutic devices can give you a clue to the patient's medical history. The environment may give you the answer to questions when the patient cannot.

The NOI may be difficult to determine in older people who may have an altered mental status or dementia. Often it is someone other than the patient who called, so you must ask the family member, caregiver, or bystander why he or she called. Multiple and chronic disease processes may also complicate the determination of the NOI. Complaints from an older person may be vague, such as weakness, dizziness, or fatigue. These could be indicators of a more serious problem and require more assessment. You may need to ask specifically what is different *today* or specifically why the person called to determine acute versus chronic complaints. Chest pain, shortness of breath, and an altered level of consciousness should always be considered serious. You also may find that the patient's complaint is a symptom of something more serious. For example, sudden changes in the ability to talk could indicate a stroke, or the need to sleep on five pillows could suggest early congestive heart failure.

Primary Assessment

Once you have confirmed that the scene is safe, perform the primary assessment to address life threats such as problems with airway, breathing, and circulation. Determine the priority of your patient based on his or her condition. The priority of your patient may limit on-scene time and/or treatment. Maintain a high index of suspicion for serious injuries even with mechanisms of injury that might seem minor in younger patients.

The general impression is an important aspect of all patient assessment. As you approach the patient, you should be able to tell if the patient is generally in a stable or unstable condition. You will use this information to help you with your further assessment. Use the AVPU scale to determine the patient's level of consciousness.

Remember that anatomic changes that occur as a person ages predispose geriatric patients to airway problems. Aging and disease can compromise a patient's ability to protect his or her airway with loss of a gag reflex and normal swallowing mechanisms. Changes in level of consciousness, dementia, and poststroke weakness or paralysis can cause airway obstruction or aspiration. Ensure that the patient's airway is open and is not obstructed by dentures, vomitus, fluids, or blood. Suction may be necessary.

Anatomic changes with aging also affect a person's ability to breathe effectively. Increased chest wall stiffness, brittle bones, weakening of the airway musculature, and decreased muscle mass contribute to breathing problems. Loss of mechanisms that protect the upper airway, like cough and gag reflexes, cause a decreased ability to clear secretions. A decrease in the number of cilia that line the bronchial tree results in the inability of the patient to remove material from the lung, which can cause infection. In some patients, the alveoli are damaged, and a lack of elasticity results in a decreased ability to exchange oxygen and carbon dioxide. Superimposed on the physiologic changes are the chronic respiratory diseases common in older people that affect the ability of the patient to breathe effectively. Airway and breathing issues should be treated rapidly and monitored constantly.

Poor perfusion is a serious issue in an older adult. People who normally live with compromised circulation have little in the way of reserves during a circulatory crisis. Physiologic changes may negatively affect circulation. Less responsive nerve stimulation may lower the rate and strength of the heart's contractions, so lower heart rates and weaker and irregular pulses are common in older patients. Vascular changes and circulatory compromise might make it difficult to feel a radial pulse on an older patient. If choosing an alternative pulse point like the carotid, press gently. Another option is to listen to the apical pulse right over the heart. The pulse may be irregular because of common heart rhythm problems. It is important to determine if cardiac abnormalities in an older patient indicate an acute emergency or a chronic condition. Acute emergencies should be managed rapidly.

Patient assessment is more complicated in an older adult, and multiple problems can exist. Any complaints that compromise airway, breathing, or circulation should result in transportation of the patient as a priority patient. Priority patients include patients who have a poor general impression, airway or breathing problems, acute altered level of consciousness, shock, any severe pain, or uncontrolled bleeding. Your most important task is to determine conditions that are life threatening, treat them to the best of your ability, and provide transport. Older people do not have the reserves that younger people do, and they will easily decompensate. Even a general complaint of weakness and dizziness can be an indication of something more serious like a heart problem or pneumonia. Consider early on if ALS treatment and immediate transport is appropriate and available. If possible, try to take the patient to a facility where the patient has been treated before and his or her medical records reside.

Words of Wisdom

Dentures should not be removed unless they obstruct the airway or interfere with ventilation when rescue breathing is needed.

Words of Wisdom

Because of fear related to hospitalization, many older people will delay calling 9-1-1 until their problem is life threatening. Be prepared for a worst-case scenario.

History Taking

Begin by inquiring about the chief complaint or history of the present illness. Find and account for all medications. If a patient lives alone, look for a list of medications on the refrigerator or a notice by the front door. The Vial of Life Project is one program that recommends creating a medication history for caregivers or EMS personnel. There also may be similar local programs in your area.

Communication may be more complicated with an older adult, but it is critical that you obtain a thorough patient history. It is best to obtain what information you can directly from the patient, but family or caregivers may need to assist.

The determination should be made early on as to whether an altered level of consciousness is acute or chronic. Remember that chronic mental status impairment is not a normal process of aging but is caused by a pathologic or disease process. You should never accept confusion as normal. It is important for you to determine your patient's baseline mental status; question family members, if available.

Multiple disease processes and multiple and/or vague complaints can make assessment complicated, and older people may not show severe symptoms even if they are very ill. Ask questions to assess the nature of the problem, and determine whether it may or may not be life threatening. Take a full set of vital signs, and ask what is "normal" for that patient. You may be able to determine the exact nature of the problem and will need to use your general impression to guide you.

Getting an accurate SAMPLE history can also be complicated. The chances are good that the chief complaint is related to a chronic medical problem and the patient may have experienced it before. Symptoms should be determined to be acute or chronic. Also note the signs you observe and your general impression. Allergies to food and medications are important. Is the patient taking any new medications? Make sure you have a list of the patient's medications or take the medications with you to the hospital if possible. Patient medications can tell much about a patient's history. The hospital will also need to determine if the patient has been taking the medications as instructed. If time and opportunity allow, check the patient's pill sorter. Has the patient taken every dose this week? Has the patient taken the medications that are scheduled for tomorrow or the next day?

The last meal is particularly important in a patient with diabetes. A history of last oral intake can indicate that the patient may be dehydrated. Last, what is the event that prompted the call? Again, it is advantageous to provide transport to a facility that "knows" the patient's medical history if the patient's condition and other factors allow.

Secondary Assessment

The secondary assessment may be performed on scene, en route to the emergency department (ED), or in some cases, not at all. The priority of the patient will determine this for you.

Perform a physical examination when appropriate. You may find that your older patient is not comfortable with being exposed. Protect his or her modesty. Older people are often cold, and you may have to remove several layers of clothing. Consider the need to keep your patient warm during the exam.

Vital signs may be different in older people because of the physiologic changes that come with aging, chronic disease, and the effects of medications. The heart rate should be in the normal adult range but may be compromised by medications such as beta-blockers. These medications keep the heart rate low and prevent the tachycardia that might be typically seen in dehydration or shock. Weak and irregular pulses are common in older patients. The pulse may be irregular secondary to atrial fibrillation. Circulatory compromise may make it difficult to feel a radial pulse on an older patient, and other pulse points may need to be considered.

Blood pressure tends to be higher in older people. A geriatric patient who has a blood pressure in a normal adult range could be hypotensive. Hypertension could signal impending stroke. Try to confirm if the patient has missed taking any medications for hypertension.

Capillary refill is not a good assessment tool in older adults because of skin changes and reduced circulation to the skin.

The respiratory rate should be in the same range as in a younger adult, but remember that chest rise will be compromised by increased chest wall stiffness. Be sure to auscultate breath sounds to listen for crackles associated with pulmonary edema, rhonchi associated with pneumonia, and wheezes associated with asthma.

Careful interpretation of pulse oximetry data is necessary in older adults because the pulse oximetry device requires adequate perfusion to get an accurate reading. Older adults may have poor circulation, vasoconstriction, hypotension, hypothermia, lack of red blood cells, or carbon monoxide poisoning that could result in an inaccurate reading. Adhesive probes, if available and in local protocol, might help confirm accuracy of the data.

Try to determine what the patient's normal blood pressure is. Your baseline blood pressure on this patient and any change from the patient's normal baseline can alert you to a potential problem.

Reassessment

Reassess the geriatric patient often because the condition of an older adult may deteriorate quickly. Repeat the primary assessment. Reassess the vital signs and the patient's complaint. Recheck interventions. Identify and treat changes in the patient's condition.

An older patient with a complaint of shortness of breath will want to sit up or assume the tripod position. Accommodate positioning requests when possible. The patient's position may be maintaining a patent airway. Forcing a patient who is short of breath into a supine position may result in respiratory distress or failure. Allow the patient to maintain a position of comfort unless contraindicated. Assist ventilation as needed.

Other interventions include administration of glucose in a patient with diabetes who has altered mental status and a manageable airway. In specific cases, you may also assist with nitroglycerin, aspirin, or inhalers. Pharmacologic interventions require medical direction and are based on local protocol (see Chapter 11, *Principles of Pharmacology*).

Administration of oxygen may be a useful therapy for many geriatric problems, including vague complaints of weakness or dizziness if the Spo_2 level indicates hypoxia. When administering oxygen, be mindful of monitoring the level of consciousness in a patient with chronic obstructive pulmonary disease and the risks of providing a prolonged high concentration of oxygen. Be prepared to ventilate if breathing becomes inadequate.

Words of Wisdom

In general, allow the patient to maintain a position of comfort unless contraindicated. If immobilization on a backboard is necessary, remember to pad the void spaces. You may have to weigh the risk of supine immobilization versus respiratory distress or failure. Be sure to document the reasons for your decision.

Last, and critically important in older adults, is providing emotional support. An older person is often fearful of what may be happening and that he or she may never return home from the hospital. Listen to your patient, respond to your patient, and provide reassurance. This is an important component of patient advocacy.

Communicate your findings and the interventions you used to ED personnel. Remember to document all history, medication, assessment, and intervention information.

A summary of the special considerations to keep in mind when assessing a geriatric patient can be found in Table 35-4.

YOU are the Provider — PART 4

You advise the patient that she should be transported to the hospital for evaluation; however, she is reluctant to go. Her daughter reassures her that everything will be okay and that she will meet her at the hospital. After several minutes of deliberation, the patient consents to transport. Your partner increases the oxygen flow rate to 15 L/min by nonrebreathing mask as you reassess the patient's vital signs.

Recording Time: 15 Minutes	
Level of consciousness	Conscious but confused
Respirations	22 breaths/min; labored
Pulse	84 beats/min; weak and irregular
Skin	Hot to the touch; pink and dry
Blood pressure	152/90 mm Hg
Spo_2	94% on 15 L/min via nonrebreathing mask

The patient's blood glucose level is assessed and is noted to read 98 mg/dL. You place her onto the stretcher, place her in a position of comfort, load her into the ambulance, and begin transport to the hospital. Her daughter tells you that she will follow you to the hospital in her own vehicle.

7. Why do older patients commonly refuse EMS transport?

8. On the basis of the patient's past medical history and signs and symptoms, what do you suspect as the cause of her problem?

Table 35-4 Geriatric Patient Assessment Guidelines

- When entering the home, take note of issues that would make it environmentally unsafe.
- Introduce yourself, show respect, and use patience to gain an older patient's confidence.
- Assessment of an older patient can be complicated by multiple medical or traumatic conditions, alterations in level of consciousness, and hearing and vision impairments.
- Airway, breathing, circulation, and vital signs are changed by the normal process of aging.
- Many older patients use multiple medications. Be aware of the possibility of overdose, underdose, and drug interactions.
- An older person's body does not have the flexibility or reserves of a younger person's body when facing illness or injury.
- Older people are more easily affected by poor nutrition.
- Older people cannot thermoregulate easily and tend to be cold.
- The memory and cognition of an older person may be impaired.
- The skin of an older adult may be fragile and can tear easily. Consider patient transfer options that are safe and appropriate.

Trauma and Geriatric Patients

In general, the risk of serious injury or death is more common in older patients who experience trauma than in younger patients. Slower homeostatic compensatory mechanisms, limited physiologic reserves, normal effects of aging on the body, and existing medical issues create risk and complicate the assessment of geriatric patients. Physical findings in an older adult may be more subtle and more easily missed. The mechanisms that cause serious injury in older people are usually much more minimal than in younger people. There is also the consideration that recuperation from trauma is longer and often less successful in older people. For that reason, many injuries in older people are undertriaged and undertreated.

Older pedestrians are more likely to have life-threatening complications after being struck by a vehicle because of changes in the body, such as more fragile bones. Although older pedestrians commonly suffer injury to the legs and arms, other injuries can be caused by a secondary crash onto the street, often involving the head. Any of these mechanisms can cause fractures, traumatic brain injury, spinal injury, and paralysis.

Older people are more likely to experience burns because of altered mental status, inattention, and a compromised neurologic status. Their risk of mortality from burns is increased when preexisting medical conditions exist, the immune system is weakened, and fluid replacement is complicated by renal compromise.

There is higher mortality from penetrating trauma in older adults, especially in the case of gunshot wounds. Penetrating trauma can easily cause serious internal bleeding. An older patient's limited physiologic reserves and more subtle presentation can affect proper management and transportation options.

Finally, falls are the leading cause of fatal and nonfatal injuries in older adults. Nearly half of fatal falls in geriatric patients result in traumatic brain injury. Unfortunately, physical abuse is another common cause of trauma in older adults. Elder abuse will be discussed later in the chapter.

Anatomic Changes and Fractures

Changes in pulmonary, cardiovascular, neurologic, and musculoskeletal systems make older patients more susceptible to trauma. The brain shrinks, leading to higher risk of cerebral bleeding following head trauma. Skeletal changes cause curvature of the upper spine that often requires additional padding during spinal immobilization. Loss of strength, sensory impairment, and medical illness all increase the risk of falls.

A geriatric patient's overall physical condition may lessen the ability of the patient's body to compensate for the effects of even simple injuries. For example, the aging body has a heart that no longer can beat faster when it needs to compensate for blood loss, vessels that cannot constrict due to atherosclerosis, and lungs that do not exchange oxygen as well. Additional changes in the circulatory system leave the geriatric patient's body unable to maintain normal vital signs during hemorrhage. Also, a geriatric patient's blood pressure drops sooner than in a younger adult patient during a traumatic emergency.

Words of Wisdom

The inability of the blood to clot normally can become a big issue in trauma and will be seen in patients who take warfarin (Coumadin), heparin, or other blood-thinning medications.

As a result of bone loss from osteoporosis, older patients are prone to fractures, especially of the hip. Hip fractures are much more common among women. People with osteoporosis may fracture a hip from a standing fall. This is considered a pathologic fracture because it would not occur in a person with normal bone density. However, not all hip fractures are the result of trauma, and may in fact result from the stresses of ordinary activity such as getting in and out of a chair. Other contributing factors include vitamin D and calcium deficiencies, metabolic bone diseases, and tumors. Injuries to the hip also tend to be recurring. A previous fracture increases the likelihood of a future injury.

Older people with osteoporosis are also at risk for pelvic fractures **Figure 35-5**. A pelvic fracture may also be caused by a low-energy mechanism or a standing fall. The person may sustain this injury when getting out of the bathtub or descending stairs. These injuries do not usually damage the structural integrity of the pelvic ring but may fracture an individual bone.

Recovering from these kinds of injuries can be complicated for an older person, especially one with a compromised immune system or diabetes. The fact that the person will be bedridden for a considerable amount of time may inhibit his or her ability to continue to live independently.

With age, the spine stiffens as a result of shrinkage of disk spaces, and vertebrae become brittle. Compression fractures of the spine are more likely to occur. As with a head injury, you must be suspicious of the possibility of other fractures and complicating issues.

Because brain tissue shrinks with age, older patients are more likely to sustain closed head injuries, such as subdural hematomas. This is where tiny veins between the surface of the brain and its outer covering (the dura) stretch and tear, allowing blood to collect. In older people, the veins are often already stretched because of brain atrophy (shrinkage) and are more easily injured.

Figure 35-5 Vacuum mattresses that conform to body contours can be a good choice for immobilizing geriatric patients with possible pelvic fractures.

Acute subdural hematomas are among the deadliest of all head injuries. Blood fills the skull very rapidly, compressing brain tissue, which often results in brain injury. This type of bleeding can go unnoticed initially because the blood has a void to fill before it can produce pressure in the skull; only then will the familiar signs of head trauma appear. Also, serious head injuries are often missed in older patients because the mechanism may seem relatively minor. These chronic subdural hematomas may go unnoticed for many days to weeks.

Other factors that predispose an older patient to a serious head injury include long-term abuse of alcohol, recurrent falls or repeated head injury, and/ or anticoagulant medication (blood thinners, including aspirin).

Environmental Injury

Internal temperature regulation slows with age owing to a slowed endocrine system. Heat gain or loss in response to environmental changes is delayed by slowed circulation and decreased sweat production in the skin. In addition, thermoregulation can be adversely affected by chronic disease, medication use, and alcohol use, all of which are more common in older people.

Not surprisingly, about half of all deaths from hypothermia occur in older people, and most indoor hypothermia deaths involve geriatric patients. Although living where harsh winters occur is a risk factor, hypothermia can develop at temperatures above freezing when an older person is exposed for a prolonged period.

The death rates from hyperthermia more than double in older people compared with younger people; people older than 85 years are at highest risk. Arizona has an abnormally high rate of heat-related deaths due to its very long, hot summers and large geriatric population.

Special Considerations in Assessing Geriatric Trauma Patients

Trauma is never isolated to a single issue when you are assessing and caring for a geriatric patient. An isolated hip fracture in a healthy 25-year-old adult is rarely associated with overall decline. However, the same injury in an 85-year-old patient can produce a wide-ranging, systemic impact that results in deterioration, shock, and life-threatening hypoxia.

Scene Size-up

As with all scenes, ensure your own safety first. Take standard precautions. Consider the number of patients, especially in the case of a motor vehicle crash. Determine if you need additional or specialized resources.

Gather information on the mechanism of injury (MOI). As with any call, look for clues that indicate your patient's traumatic incident may have been preceded by a medical incident like syncope, a cardiac problem, or a diabetic issue. Bystander information may help determine if a loss of consciousness occurred before the incident. You should use the same thought processes when you have a patient who has fallen. Was the fall mechanical, or was an episode of weakness or dizziness a factor?

The MOI is also important in establishing whether an injury is considered critical and it affects treatment and transport considerations.

Primary Assessment

During the primary assessment you will address life threats. Determine whether this is a priority patient and to which facility the patient will be transported. Because patients over the age of 55 have an increased risk of major injury and death, it is recommended that older trauma patients be transported to a trauma center. Once you have determined that the patient has a potentially life-threatening condition, limit any on-scene treatment to that which is absolutely necessary for patient stabilization. Follow your local protocols.

The general impression is an important aspect of all patient assessment. As you approach the patient, note if he or she is generally in stable or unstable condition. Determining neurologic status may be difficult if you do not know the patient's baseline. Try to get information from someone familiar with the patient, if possible. Use the AVPU mnemonic and the Glasgow Coma Scale to determine mental status. An important consideration with any patient is the inability to remember the event.

If the patient is talking to you, the airway is patent. Patients who have noisy respirations may have airway compromise. Older patients may have a diminished ability to cough, so suctioning is important. Suction any blood or foreign material. Dentures may cause an airway obstruction, so assess for the presence of dentures but do not remove them unless they are creating an airway patency problem. It is more difficult to ventilate a patient with no teeth.

In an unresponsive patient, open the airway with a modified jaw-thrust maneuver. Use an oropharyngeal or nasopharyngeal airway as appropriate, and ventilate with a BVM if the patient's respiratory effort is inadequate or absent. Any curvature of the patient's spine will require padding to keep the patient supine and the airway open.

Breathing problems caused by trauma can be made worse by preexisting respiratory disease and the compromised respiratory effort that comes with aging. Remember that minor chest trauma can cause lung injury. Perform a thorough respiratory assessment and physical assessment of the chest, and treat accordingly. Use pulse oximetry to monitor oxygenation.

Manage any external bleeding immediately. Be suspicious of signs and symptoms of internal bleeding. Drinking alcohol and taking anticoagulant medications can make internal bleeding worse, or make external bleeding more difficult to control. Remember that physiologic changes due to aging can worsen the effects of trauma, and older people do not heal as easily as do younger adults. Older patients can more easily go into shock. Also, remember that patients who were hypertensive prior to injury may have a normal blood pressure when they are actually in shock.

Words of Wisdom

Geriatric Patients With Head Trauma

Older people are more predisposed to head injuries, such as subdural hematomas. The mechanism may be minor, thus the severity of these injuries is often underestimated. Consider that the signs and symptoms of head trauma can sometimes mimic the signs and symptoms of a stroke. Be sure to ask about these risk factors during your assessment of a patient with a potential head injury:

- Long-term abuse of alcohol

- Recurrent falls
- Repeated head injury
- Use of anticoagulant medication (blood thinners, including aspirin)

History Taking

Considerations in your assessment of the patient's condition and stability must include past medical conditions, even if they are not currently acute or symptomatic. For example, you respond to a call for a patient with a history of unstable angina who sustains a simple isolated fracture of the ankle. You must consider this patient to have the potential for an unstable condition and provide prompt transport before the stress of the simple trauma worsens the angina and an unstable overall scenario develops. In these patients, the remainder of the assessment can be performed en route to the ED.

Be sure to get a history of risk factors when you assess a geriatric patient with a potential head injury. If a patient shows signs and symptoms of increased intracranial pressure, ask about recent head trauma.

Secondary Assessment

The physical examination should be performed on a geriatric trauma patient in the same manner as for any adult but with consideration of the higher likelihood of damage from trauma. Remember that any head injury can be life threatening in an older adult. When examining the chest, consider that breathing may be impaired. Check lung sounds, and look to see if there is any evidence of a pacemaker or previous cardiac surgery. Even though it may appear that the patient has only experienced trauma, keep in mind that this does not mean he or she may not also be having medical problems **Figure 35-6**. When assessing the abdomen, remember that older patients have a flaccid abdominal wall and may not present with pain and rigidity in the abdomen when trauma has been sustained. Decreased muscle size in the abdomen may mask abdominal trauma. Look for bruising and other evidence of trauma. Injury to the liver or spleen may present with diffuse abdominal pain, or pain may refer to the left shoulder.

Assess the pulse, blood pressure, and skin signs. Capillary refill is unreliable in older people because of compromised circulation. Remember that some older people take beta-blockers, which will inhibit their heart from becoming tachycardic as you would expect in shock. Even a heart rate in normal ranges may be high for someone taking beta-blockers. Try to determine if the patient's blood pressure is normal for him or her. Remember that a blood pressure that may be normal for an older adult could indicate shock in a younger patient.

Figure 35-6 Remember that when you treat a geriatric trauma patient, you must assess the injuries and carefully look for the cause of the incident. Always consider medical causes that may have led to syncope.

Reassessment

Reassessment of primary assessment, level of consciousness, vital signs, and interventions should be performed and documented as with any patient, but remember that a geriatric patient has a higher likelihood of decompensating after trauma. Be prepared.

Safety Tips

Falls in the geriatric population, even those with apparently minor mechanisms, can cause life-threatening or debilitating problems. Assess the patient's environment for potential hazards, and recommend changes.

Broken bones are common and should be splinted in a manner appropriate to the injury. Because of the amount of flexion that occurs in the spinal column, hips, and knees of older patients, effective application of conventional splints and backboards to immobilize them may be difficult or impossible unless a large amount of padding is used. What is considered a normal anatomic position for children and adults is often very abnormal for some geriatric trauma patients. Trying to force a patient into a normal anatomic position can harm the patient **Figure 35-7**. Some devices, such as traction splints, simply do not work on patients with flexed hips and knees and should not routinely be used to treat hip fractures. Splinting devices, such as vacuum mattresses that conform to body contours, may be a good choice for immobilization when indicated. In hip and pelvic fractures, avoid log rolling the patient because you risk causing the patient increased pain. When immobilization is indicated, patients with kyphosis will often need padding **Figure 35-8**. In general, padding should be done for comfort and to help decrease the likelihood of decubitis ulcer formation. Consider also that patients with chronic cardiac or respiratory disorders, particularly congestive heart failure, may have immense difficulty lying supine. An alternative solution may be to consider a spinal immobilization device like a KED intended for a patient in a seated position.

Figure 35-7 When applying a cervical collar to a geriatric patient, do not attempt to straighten out the patient's neck.

Remember that older people do not have the mechanisms that help keep them warm. Provide blankets and heat to prevent hypothermia.

Communication with older people can be challenging in any situation, but it can become even more complicated when the patient is in pain or is experiencing fear from trauma. Older people also tend to fear that a trauma may end their mobility and independence. Remember to provide psychological support, as well as medical treatment. Document assessment, treatment, and reassessment, including any changes in the patient's status.

Figure 35-8 Placing padding in void space between the patient's body and the backboard is an important component of immobilizing a geriatric patient. **A.** Pad the void space below the kyphotic spine. The pillows and blankets should be as wide as the backboard to allow for effective immobilization and support. **B.** Place blankets and pillows under an injured extremity to provide support to a fracture site.

Assessment of Falls

As mentioned, falls are a leading cause of injury in geriatric patients. Falls can be caused by a medical condition such as fainting, a cardiac rhythm disturbance, or a medication interaction. Safety and environment factors such as poor lighting, loose floor coverings, and lack of handrails are often responsible for falls. Physiologic factors include vision and balance issues, decreased visual acuity, and decreased strength.

Whenever you assess a geriatric patient who has fallen, it is critically important to find out why the fall occurred. Was it simply a mechanical fall, or was it preceded by a medical event (pathologic)? Was the patient dizzy before the fall? Does the patient remember the fall? Did a fainting episode cause the fall and injury, or did the patient trip on something and lose his or her balance? Cardiac, neurologic, and metabolic issues can create weakness, dizziness, or syncope, resulting in a fall. Traumatic and medical factors are much more interconnected in older people. Sometimes, a recent history of starting or stopping blood pressure medication is enough to cause a patient to become dizzy and fall.

Consider that the fall may have been caused by a life-threatening medical condition, and look carefully for clues from the patient, bystanders, and the environment. In motor vehicle crashes, be alert to the possibility that a medical emergency may have caused the incident, especially in single vehicle crashes with no apparent cause.

Response to Nursing and Skilled Care Facilities

With many of your geriatric patients with whom you interact, the call will occur at a nursing home or other skilled care facility. Relatively healthy and active seniors live in age-restricted active adult communities that offer resort-type amenities. A less expensive option is age-restricted apartments that provide seniors with the physical and emotional security that comes with living with other seniors. A similar type of facility, but one that also provides communal meals, social events, and other types of support, is an independent living facility. People living in this type of facility are more likely to have minor health problems. Assisted living residential facilities support residents with activities of daily living and provide 24-hour assistance. Residents get assistance with daily medication administration, and some facilities address specialized patient issues like Alzheimer disease and dementia.

Nursing homes, also called convalescent homes or long-term care facilities, are facilities that serve patients who need 24-hour care and are sometimes a step down from an acute care hospital. Patients require assistance with daily living and need therapeutic or rehabilitation services.

Calls to these types of facilities can sometimes be challenging. Patients often have an altered level of consciousness and may not be able to give you a nature of illness or MOI. The staff is usually spread thin and may not be familiar with what needs to be done to assist you when transport is necessary. The caregiver who greets you may not even be familiar with the patient. The most important piece of information you need to establish immediately is, "What is wrong with the patient that is new or different today that made you call 9-1-1?" As soon as possible, establish the baseline status of the patient by talking to the staff who directly care for the patient on a daily basis.

With potentially limited information, you need to do an assessment to determine if the patient's problem is life threatening and/or requires ALS level care. Optimally, the facility will provide you with a transfer record that provides critical information on the patient's history, medications, allergies, and current complaint. This information is critical because the ED staff needs to know how to best manage the patient. Ideally, and when appropriate, transport the patient to the acute care facility where the patient has been treated before and his or her records are available.

Infection control needs to be a high priority when you visit these facilities. You not only need to protect yourself, but good handwashing and standard precautions can inhibit the spread of infectious pathogens to older people who already have compromised immune systems. You should also be cognizant of potential airborne pathogens. Something as simple as a cold or flu virus could result in a life-threatening pneumonia for a compromised older adult. An infection in an older patient can lead to life-threatening sepsis. Be sure to mask yourself if you have an upper respiratory infection, and mask the patient if he or she has one. Some risks to these patients and EMTs are described next.

Methicillin-resistant Staphylococcus aureus (MRSA) infections are common among people who live in close quarters like nursing homes. The organism can be found in decubitus ulcers (bedsores), on feeding tubes, and on indwelling urinary catheters. The symptoms of MRSA depend on the type of infection. It can cause mild infections on the skin or invade the bloodstream, lungs, or the urinary tract. MRSA is primarily spread by broken skin-to-skin contact but is also acquired by touching objects that have the bacteria on them. To protect yourself and reduce the spread of MRSA infections, you should wash your hands before and after every patient contact, properly dispose of or disinfect all medical equipment, and take appropriate standard precautions with every patient.

Similarly, many infections in hospitals are caused by **vancomycin-resistant enterococci (VRE)**. Enterococci are bacteria that are normally present in the human intestines and the female reproductive tract. Under the right circumstances, these bacteria can cause infection. Some of the enterococci have become resistant to vancomycin, the antibiotic commonly used to treat these infections.

The **respiratory syncytial virus (RSV)** causes an infection of the upper and lower respiratory tracts. Although more typically seen in children, the virus can also cause serious illness in older people, especially those with lung disease or weakened immune systems. The symptoms are similar to the common cold but can be more severe and last longer. The virus is highly contagious and is found in discharges from the nose and throat of an infected person. Respiratory syncytial virus is also transmitted by direct contact with droplets from coughs or sneezes and by touching a contaminated surface.

MRSA and respiratory syncytial virus infections can be life threatening, especially in an immune-compromised patient. Look for isolation signs or ask about contagious disease when you approach a patient. Be sure to wear appropriate personal protective equipment and decontaminate your ambulance and diagnostic equipment after contact with nursing home residents whether a history of infectious disease is known or not. Be sure to document the infection control issue; advise the receiving facility; and, depending on local protocol, report an infectious disease to your company or the local health department.

Clostridium difficile (C diff) is a bacterium responsible for the most common cause of hospital-acquired infectious diarrhea and regularly causes sporadic cases of diarrhea in nursing homes. It is a bacterium that normally grows in the intestines. Antibiotic use may account for the rapid increase in toxic strains that ultimately cause illness. Health care workers may carry this bacterium following contact with contaminated feces. It can also be found on environmental surfaces like furniture, floors, toilets, sinks, and bedding. The symptoms from the resultant colitis can range from minor diarrhea to a life-threatening inflammation of the colon. Typical alcohol-based hand sanitizers do not inactivate or kill *C diff*. Contact precautions with gowns and gloves and handwashing with soap and water after each and every patient contact is essential to prevent transmission.

Dying Patients

As older patients are living longer, more terminally ill patients are choosing to die at home rather than in a hospital. Many have family support and/or hospice support. Often the patient comes to terms with his or her impending death before the family does. Dying patients receive what is called palliative, or comfort, care. Palliative care recognizes that death is a normal part of the life cycle. Palliative care does not hasten or prolong death, but focuses on relieving pain and providing emotional support and comfort for the patient and his or her loved ones.

You may be called on to interact with a dying patient. One thing to remember is that this interaction will have a long-term effect on the family. Be understanding, sensitive, and compassionate, although the situation may be uncomfortable for you as well. Determine if the family wishes the patient to go to the hospital or stay in the home.

Advance Directives

Many people today make use of **advance directives**. Also called living wills, advance directives are specific legal papers that direct relatives and caregivers about what kind of medical treatment may be given to patients who cannot speak for themselves. Dealing with advance directives has become more common for EMS providers because more people are electing to use hospice services and spend their final days at home.

Advance directives may also take the form of a do not resuscitate (DNR) order. A DNR order gives you permission not to attempt resuscitation for a patient in cardiac arrest. However, for a DNR order to be valid, the form must be signed by the patient or legal surrogate and by one or more physicians or other licensed health care providers. In the presence of a DNR order, if the patient is still alive, you are obligated to provide supportive measures that may include oxygen delivery, pain relief, and comfort. DNR does not mean do not treat. Basic airway, breathing, and circulatory support should be provided; however, cardiopulmonary resuscitation may not.

A health care power of attorney is an advance directive that is exercised by a person who has been authorized by the patient to make medical decisions for him or her. Be sure to follow your service's protocol when faced with any advance directive.

Although advance directives may be in place, family members or caregivers who are faced with the final moments of life or worsening of the patient's condition often become alarmed and call 9-1-1. Family members and caregivers may then become upset when you take resuscitative action and begin transportation to the hospital.

Another common situation is the transportation of patients from nursing facilities. Specific guidelines vary from state to state; however, you should consider the following general guidelines:

- Patients have the right to refuse treatment, including resuscitative efforts, provided that they are able to communicate their wishes.

- A DNR order is valid in a health care facility only if it is in the form of a written order by a physician.
- You should periodically review state and local protocols and legislation regarding advance directives.
- When you are in doubt or when there are no written orders, you should try to resuscitate the patient.

Every service should also provide training on the actions you should take when presented with advance directives. When in doubt, your best course of action is to take resuscitative action that is appropriate to the situation and to practice sound medical treatment.

Elder Abuse and Neglect

Trauma in older people can also be caused by abuse. Reports and complaints of abuse, neglect, and other related problems among the nation's older population are on the rise. **Elder abuse** is defined as any action on the part of an older person's family member, caregiver, or other associated person that takes advantage of the older person's person (for example, physical abuse), property, or emotional state. Abuse can result from acts of commission (words or actions that cause harm), such as verbal, physical, or sexual assault. Abuse can also result from acts of omission (failure to act), such as denying an older person adequate nutrition or medical care.

The exact extent of elder abuse is not known for several reasons, including the following:

- Elder abuse is a problem that has been largely hidden from society.
- The definitions of abuse and neglect among the geriatric population vary.
- Victims of elder abuse are often hesitant to report the problem to law enforcement agencies or human and social welfare personnel.

YOU are the Provider — PART 5

During transport, the patient remains conscious, although confused. You reassess her vital signs and then call your radio report to the hospital. During your radio report, the nurse asks you if the patient is normally confused. You inform her that the patient has Alzheimer disease and that this is her baseline mental status.

Recording Time: 30 Minutes	
Level of consciousness	Conscious, but confused
Respirations	22 breaths/min; labored
Pulse	70 beats/min; weak and irregular
Skin	Hot to the touch; pink and dry
Blood pressure	148/88 mm Hg
Spo_2	95% on 15 L/min via nonrebreathing mask

During the remainder of the transport, you reassure the patient that the hospital staff will take good care of her. Although confused, she looks at you and smiles. You deliver her to the hospital, transfer patient care to the emergency department staff, and return to service.

9. How does dementia differ from delirium? Is dementia a normal part of the aging process?

10. What strategies should you use when communicating with older patients?

The abused person may feel traumatized by the situation or be afraid that the abuser will punish him or her for reporting the abuse. The abused person may be frail and have multiple chronic medical conditions or dementia. The person may sleepwalk, have an impaired sleep cycle, and periodically shout at others. The person may also be incontinent and dependent on others for activities of daily living.

Elder abuse occurs most often in women older than 75 years. The physical and emotional signs of abuse, such as rape, spouse beating, and nutritional deprivation, are often overlooked or not accurately identified. Older women in particular are not likely to report incidents of sexual assault to law enforcement agencies. Patients with sensory deficits, dementia, and other forms of altered mental status, such as drug-induced depression, may not be able to report abuse.

Abusers of older people are sometimes products of child abuse, and the abuse that is inflicted on the older person may be retaliatory. Most of these abusers are not trained in the particular care that older people require and have little relief time from the constant care demands of their own family, children, and spouse. Their lives are significantly complicated by the constant, demanding needs of the older person they have to care for.

The abuser may also have marked fatigue, be unemployed with financial difficulties, or abuse one or more substances.

With a careful eye, you can recognize the clues to these stressful situations and help guide the family toward programs in their community that are geared to helping the whole family. Programs such as adult day care, Meals on Wheels, and many local individualized programs help to decrease the stress put on the family and lower the chances of abuse.

Abuse is not restricted to the home. Environments such as nursing and convalescent homes and continuing care centers are also sites where older people sustain physical, psychologic, financial, or pharmacologic harm. Often, care providers in these environments consider older people to be management problems or categorize them as obstinate and undesirable patients. Consult local authorities, but in general you should assume that you have the same obligation to report suspected elder abuse as you do suspected child abuse. Notify receiving hospital personnel of your concerns, report to the proper authorities based on local protocols, and factually document your findings. If you are in doubt, err on the side of caution and make a report. Note that it is not your responsibility to prove that the abuse occurred, only to report your findings according to protocols.

Assessment of Elder Abuse

Abuse comes in many forms and may include physical assault. Be aware of the environment and conditions a patient lives in, and take note of soft-tissue injuries that cannot be explained by the person's lifestyle and physical condition.

While assessing the patient, try to obtain an explanation of what happened. You should suspect abuse when answers to questions about what caused the injury are concealed or avoided.

You must also suspect abuse when you are given unbelievable answers. Be suspicious if you think "Does this make sense?" or "Do I really believe this story?" while reviewing the patient's history. As an EMT, you may be the first health care provider to observe the signs of possible abuse. Information that may be important in assessing possible abuse includes the following:

- Caregiver apathy about the patient's condition
- Overly defensive reaction by caregiver to your questions
- Caregiver does not allow patient to answer questions
- Repeated visits to the emergency department or clinic
- A history of being accident-prone
- Soft-tissue injuries
- Unbelievable, vague, or inconsistent explanations of injuries
- Psychosomatic complaints
- Chronic pain without medical explanation
- Self-destructive behavior
- Eating and sleep disorders
- Depression or a lack of energy
- A history of substance and/or sexual abuse

You should remember that many patients who are being abused are so afraid of retribution that they make false statements. A geriatric patient who is being abused by family members may lie about the origin of abuse for fear of being thrown out of the home. In other cases of elder abuse, sensory deprivation or dementia may hinder adequate explanation.

Repeated abuse can lead to a high risk of death. As an EMT, you can help to reduce additional maltreatment of the patient by identifying the abuse Table 35-5. This preventive measure may allow for referral and protective services of human, social, and public safety agencies.

Table 35-5	Categories of Elder Abuse
Physical	■ Assault ■ Neglect or abandonment ■ Dietary (malnutrition) ■ Poor maintenance of home ■ Poor personal hygiene ■ Sexual assault
Psychological	■ Benign neglect ■ Verbal ■ Treating the person as an infant ■ Deprivation of sensory stimulation
Financial	■ Theft of valuables ■ Embezzlement

Signs of Physical Abuse

Signs of abuse may be quite obvious or subtle. Injuries may be the result of acute or chronic abuse or neglect. Inflicted bruises are usually found on the buttocks and lower back, genitals and inner thighs, cheeks or ear-lobes, neck, upper lip, and inside the mouth. Pressure bruises caused by the human hand may be identified by oval grab marks, pinch marks, or handprints. Human bites are typically inflicted on the upper extremities and can cause lacerations and infection. You should inspect the patient's ears for indications of twisting, pulling, or pinching and evidence of frequent blows to the outer ears. You should also investigate multiple bruises in various states of healing by asking the patient and reviewing the patient's activities of daily living.

Words of Wisdom

As with other legally complex and emotionally charged issues, the possibility of elder abuse demands particularly careful documentation. Be thorough, objective, and factual, avoiding unsupported opinions and personal judgments. You may be called on to explain your report in a legal proceeding. Report your suspicions to the appropriate authorities and follow local protocols. Typically, the authorities will want to know specifics (name, contact information, etc) about the person you suspect is being abused and why you suspect abuse.

Burns are a common form of abuse. If you see burns, especially cigarette burns or physical marks that indicate that certain parts of the patient's body have been scalded systematically, you must suspect abuse. Typical abuse from burns is caused by contact with cigarettes, matches, heated metal, forced immersion in hot liquids, chemicals, and electrical power sources.

It may be difficult to see a failure to thrive in an older patient who has been abused. You should observe the patient's weight and try to determine whether the patient appears undernourished or has been unable to gain weight in the current environment. Does the patient have a ravenous appetite? Has medication been withheld? Is money being withheld, so the patient cannot buy food or medicine? You should also check for signs of neglect, such as evidence of a lack of hygiene, poor dental hygiene, poor temperature regulation, or lack of reasonable amenities in the home **Figure 35-9**.

You must regard injuries to the genitals or rectum with no reported trauma as evidence of sexual abuse in any patient. Geriatric patients with altered mental status may never be able to report sexual abuse. In addition, many women do not report cases of sexual abuse because of shame and the pressure to remain silent and forget.

Figure 35-9 Signs of neglect include evidence of a lack of hygiene, poor dental hygiene, poor temperature regulation, or lack of reasonable amenities in the home.

YOU are the Provider SUMMARY

1. As an EMT, why is it important for you to understand the physiologic changes that occur with aging?

Understanding the normal anatomic and physiologic changes that occur with aging is important when you are assessing and treating an older patient who is experiencing an illness or injury. You do not want to mistake these changes for signs of illness and provide treatment when it is not indicated, nor do you want to attribute them to "just getting old" and fail to provide treatment when it is indicated.

2. How does the process of aging affect a person's respiratory system?

The decreased muscle mass in older patients means they have less help from the muscles in the chest wall during respiratory distress.

Airway mechanisms, such as the cough and gag reflexes, decrease with age, resulting in a decreased ability of older adults to clear secretions from the airway. These upper and lower airway changes decrease the patient's ability to cough, which increases the risk of a respiratory infection.

The elasticity of the alveoli in older patients decreases, making it harder for the patient to exhale. As a result, pulmonary respiration—the exchange of oxygen and carbon dioxide in the lungs—decreases.

3. What is the GEMS diamond? How can it facilitate your overall care of an older patient?

The GEMS diamond serves as a useful mnemonic for the issues to consider when assessing every older patient. The four components of the GEMS diamond are: G-geriatric patients; E-environmental assessment; M-medical assessment; and S-social assessment. It provides an organized way for you to remember the important issues when assessing older patients.

4. Based on the patient's current condition, how appropriate is the current oxygen therapy?

The amount of oxygen being delivered to the patient should be increased. The patient reports dyspnea and has abnormal lung sounds. Despite being placed on 2 L/min of oxygen, the Spo_2 level is only 92%. Current guidelines for oxygen therapy state the Spo_2 level should be maintained at or above 94%.

5. What should concern you about patients who take numerous medications?

The risks of inadvertent overdosing or negative medication interactions increase when patients take numerous medications. Furthermore, the physiologic changes that occur with aging make an older patient susceptible to drug toxicity—even if the patient takes all of his or her medications as prescribed. Medications tend to stay in the body for longer periods.

When numerous medications are combined, it is impossible to predict how they may interact with each other. Some medication interactions can produce acute, life-threatening emergencies. When caring for a patient who takes numerous medications, consider the possibility of an interaction as the underlying cause of, or a contributor to, his or her problem.

6. What other assessments, if any, should be performed for this patient?

The patient history revealed she has not been eating lately. The daughter stated her mother's level of consciousness has been altered more than usual over the last couple of days. Based on the patient's fever, multiple medications, decreased appetite, and altered LOC, you should assess her blood glucose level if consistent with your local protocol.

7. Why do older patients commonly refuse EMS transport?

The most common reason why older patients are resistant to EMS transport is fear. They often fear that when they are loaded into an ambulance and leave the safety of their own home, they will be moved to a nursing home or, even worse, never leave the hospital. As an EMT, you are always obligated to treat the patient to the best of your abilities, but you must acknowledge and respect the older patient's need for independence and the emotional attachment that he or she may have to the home.

8. On the basis of the patient's past medical history and signs and symptoms, what do you suspect as the cause of her problem?

On the basis of the patient's past medical history, which includes emphysema, and her current presentation—fever, chills, worsened shortness of breath, and coarse rhonchi—you should suspect pneumonia.

The presence of a preexisting lower respiratory disease (eg, chronic obstructive pulmonary disease), coupled with age-related deterioration of the respiratory and immune systems, makes older patients especially prone to pneumonia.

9. How does dementia differ from delirium? Is dementia a normal part of the aging process?

Dementia is a slow onset of progressive disorientation, as well as a progressive loss of cognitive function, psychomotor skills, and social skills. It is a chronic, generally irreversible condition that develops slowly—typically over a period of years—and is the result of a progressive deterioration in cerebral function. There are a number of causes of dementia, such as Alzheimer disease. In contrast, delirium is an acute change in mental status or cognitive function. It is marked by the inability to focus, think logically, and maintain attention, and signals the onset of a new health problem. Unlike dementia, many causes of delirium are reversible. In older patients, delirium is commonly the result of a urinary tract infection, hypoglycemia or hyperglycemia, dehydration, bowel obstruction, fever, and vitamin deficiencies. Other causes include acute alcohol intoxication, drug overdose, withdrawal from drugs or alcohol, hypoxia, and hypovolemia, among others.

Any change in a patient's level of consciousness or mentation, regardless of his or her age, is abnormal. Confusion, abnormal behavior, and other changes in cognitive function do not come automatically with age; they should be regarded as an indicator of an underlying illness or injury.

10. What strategies should you use when communicating with older patients?

Speak respectfully when you introduce yourself, and identify yourself as a medical professional. This helps establish a rapport with the patient. Asking the patient how he or she prefers to be addressed is a trust-building technique.

Look directly at the patient and speak slowly and distinctly. Do not assume that the patient is hearing-impaired simply because of his or her age.

When you ask the patient a question, allow adequate time for him or her to respond, unless the condition is urgent or critical. When the patient responds, listen carefully to what he or she is saying.

Explain what you are going to do before you do it. Use simple terms to explain the use of medical equipment and procedures, and avoid medical jargon and slang.

Do not talk about the patient in front of him or her as though he or she was not there. This can potentially give the patient the feeling that he or she does not have a say in decisions about his or her care.

EMS Patient Care Report (PCR)

Date: 11-28-16	**Incident No.:** 013309	**Nature of Call:** Shortness of breath		**Location:** 644 Yolanda St.	
Dispatched: 0625	**En Route:** 0626	**At Scene:** 0630	**Transport:** 0652	**At Hospital:** 0705	**In Service:** 0716

Patient Information

Age: 82 **Sex:** F **Weight (in kg [lb]):** 48 kg (105 lb)	**Allergies:** Erythromycin **Medications:** Plavix, Digoxin, Aricept, Verapamil, Celebrex, Albuterol, Flovent **Past Medical History:** Emphysema, atrial fibrillation, Alzheimer disease, rheumatoid arthritis, hypertension **Chief Complaint:** Difficulty breathing

Vital Signs

Time: 0635	**BP:** 158/88	**Pulse:** 68	**Respirations:** 22	**Spo_2:** 92%
Time: 0645	**BP:** 152/90	**Pulse:** 84	**Respirations:** 22	**Spo_2:** 94%
Time: 0700	**BP:** 148/88	**Pulse:** 70	**Respirations:** 22	**Spo_2:** 95%

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Position of comfort; emotional support

Narrative

Medic 53 dispatched to a residence for a woman with respiratory distress. Arrived on scene and found the patient, an 82-year-old woman, sitting in a chair in her living room. She was conscious but confused. Her airway was patent, and her breathing was labored. The patient had a blanket wrapped around her and was shivering. Her daughter, who was present at the scene, advised that the patient has a history of emphysema and that her usual shortness of breath has worsened during the past few days. The patient was currently receiving home oxygen at 2 L/min via nasal cannula. The daughter further stated that the patient has been running a fever, 101°F (38°C), and has had a cough, which is producing thick green sputum. Other past medical history significant for A-Fib, Alzheimer disease, hypertension, and rheumatoid arthritis. Inquired about patient's current mental status (confused) and was advised by the daughter that her mother has been more confused than normal over the last couple of days. Further assessment revealed bilateral basilar rhonchi on auscultation of breath sounds. Obtained vital signs, and increased oxygen flow rate to 15 L/min by nonrebreathing mask. Advised patient that transport to the hospital for evaluation was necessary; however, she stated that she did not want to go. The patient's daughter reassured her and advised that she would follow the ambulance to the hospital. After reassurance by the daughter and EMS, the patient consented to transport. Placed patient onto stretcher, placed her in a position of comfort, loaded her into the ambulance, and began transport. En route, patient's condition remained unchanged; she remained confused and short of breath, and her vital signs remained stable. Continued to provide emotional support and reassurance to the patient; she was able to answer some questions but had difficulty with others. Delivered patient to emergency department staff, gave verbal report to staff nurse, and transferred patient care. Medic 53 returned to service at 0716.**End of report**

Prep Kit

Ready for Review

- With changes in the respiratory system, such as a decreased ability to cough, geriatric patients are more likely to present with pneumonia.
- Changes in the cardiovascular system can lead to atherosclerosis, aneurysm, stiffening heart valves, orthostatic hypotension, venous stasis, deep venous thrombosis, heart attack, heart failure, and stroke.
- Many patients do not present with the classic symptom of chest pain when experiencing a heart attack. Atypical presentations are seen mostly in women, older patients, and patients with diabetes.
- Dementia and delirium are both abnormal processes and must be carefully evaluated in geriatric patients.
- As the body ages, the bones become more fragile. This leads to a higher risk of fracture in geriatric patients.
- Polypharmacy and changes in medications can cause serious problems for geriatric patients.
- Depression is treatable with medication and therapy but is a risk factor for suicide if it remains untreated in geriatric patients.
- Although assessment of geriatric patients involves the same basic approach as that for any other patient, you must take a more wary approach.
- Assessing an older person can be challenging because of communication issues, hearing and vision deficits, alteration in consciousness, complicated medical history, and the effects of multiple medications.
- To obtain an accurate history for a geriatric patient, patience and good communication skills are essential. A slow, deliberate approach to the patient history, with one EMT asking questions, is generally the best strategy.
- The risk of serious injury or death is more common in geriatric patients who experience a traumatic injury.
- When you treat a geriatric trauma patient, assess the injuries and carefully look for the cause of the injury. A medical condition such as fainting could actually be the cause of a fall. The injuries from the fall and the medical condition will need to be addressed.
- When responding to nursing and skilled care facilities, you should determine the patient's chief complaint on that day and what initial problem caused the patient to be admitted to the facility.
- Be aware of signs of abuse and neglect. Carefully document these signs, and report suspected elder abuse or neglect according to your local protocols.

Vital Vocabulary

abdominal aortic aneurysm (AAA) A rapidly fatal condition in which the walls of the aorta in the abdomen weaken and blood leaks into the layers of the vessel, causing it to bulge.

advance directives Written documentation that specifies medical treatment for a competent patient should the patient become unable to make decisions; also called a living will or health care directive.

aneurysm An abnormal enlargement of a part of an artery, resulting from weakening of the arterial wall.

arteriosclerosis A disease that causes the arteries to thicken, harden, and calcify.

ascites Fluid in the abdomen.

atherosclerosis An accumulation of fat and cholesterol in the arteries.

cataracts Clouding of the lens of the eye or its surrounding transparent membranes.

decubitus ulcers Sores caused by the pressure of skin against a surface for long periods; can range from a pink discoloration of the skin to a deep wound that may invade into bone or organs; also known as bedsores.

deep venous thrombosis The formation of a blood clot within the larger veins of an extremity, typically following a period of prolonged immobilization.

delirium A sudden change in mental status marked by the inability to focus, think logically, and maintain attention; this condition is generally acute and reversible.

dementia The slow onset of progressive disorientation, shortened attention span, and loss of cognitive function; this condition is generally chronic and irreversible.

dyspnea Shortness of breath or difficulty breathing.

elder abuse Any action on the part of an older person's family member, caregiver, or other associated person that takes advantage of the older person's person, property, or emotional state.

geriatrics The assessment and treatment of disease in someone who is 65 years or older.

hemoptysis The coughing up of blood.

jugular vein distention A visual bulging of the jugular veins in the neck that can be caused by fluid overload, pressure in the chest, cardiac tamponade, or tension pneumothorax.

kyphosis A forward curling of the back caused by an abnormal increase in the curvature of the spine.

melena Black, foul-smelling, tarry stool containing digested blood.

methicillin-resistant Staphylococcus aureus (MRSA) A bacterium that causes infections in different parts of the body and is often resistant to commonly used antibiotics; can be found on the skin and in surgical wounds, the bloodstream, lungs, and urinary tract.

neuropathy A group of conditions in which the nerves leaving the spinal cord are damaged, resulting in distortion of signals to or from the brain.

osteoporosis A generalized bone disease, commonly associated with postmenopausal women, in which there is a reduction in the amount of bone mass leading to fractures after minimal trauma in either sex.

peptic ulcer disease An abrasion of the stomach or small intestine.

pneumonia An inflammation of the lung from a bacterial, viral, or fungal cause.

polypharmacy The use of multiple medications on a regular basis.

presbycusis An age-related condition of the ear that produces progressive bilateral hearing loss that is most noted at higher frequencies.

pulmonary embolism A condition that causes a sudden blockage of the pulmonary artery by a venous clot.

respiratory syncytial virus (RSV) A highly contagious virus that causes an infection of the upper and lower respiratory system.

syncope A fainting spell or transient loss of consciousness, often caused by an interruption of blood flow to the brain.

urinary tract infection (UTI) A bacterial infection that affects the urinary tract.

vancomycin-resistant enterococci (VRE) A bacterium that is normally present in the human intestines and the female reproductive tract, but which can cause infection and which is resistant to the antibiotic vancomycin.

Assessment *in Action*

It is 0300 hours and you and your partner are called to a private residence for an 86-year-old man reporting a sudden onset of shortness of breath. On arrival, you observe an older home in need of repair. When you enter the home, you find that there are seven cats, and there is the strong odor of stale cat food and litter boxes.

1. You find your patient sitting upright in his bed with four pillows behind him. He is having difficulty speaking because of a previous stroke. Which interview technique should you use when addressing the patient?

   A. Speak loudly and slowly.
   B. Listen carefully to the answers the patient provides.
   C. Refer to the patient by his first name.
   D. Have both you and your partner ask questions.

2. The patient explains that he was awakened by a sudden feeling of suffocation and respiratory distress. What are his symptoms a characteristic of?

   A. Orthopnea
   B. Exertional dyspnea
   C. Intermittent sleep apnea
   D. Paroxysmal nocturnal dyspnea

3. What assessment question should you ask to help clarify his symptoms of a sudden feeling of suffocation and respiratory distress?

   A. "How many hours of sleep do you get each night?"
   B. "In what position do you normally sleep?"
   C. "How many pillows do you sleep on?"
   D. "Do you take any medication to help you sleep at night?"

4. On auscultation of the patient's lungs, your partner hears crackles. These lung sounds are caused by air passing through:

A. constricted airways.
B. thick secretions in the airways.
C. fluid in the alveoli.
D. inflamed airways.

5. The pulse oximeter is unable to provide an accurate reading. What is a possible cause for this finding?

A. Poor circulation
B. Hypertension
C. Fever
D. Increased red blood cell count

6. Observing and documenting the condition in which you find the home is part of the GEMS ___________ assessment.

A. general
B. environmental
C. medical
D. social

7. Which condition is considered to be a risk factor for congestive heart failure?

A. Coronary artery disease
B. Emphysema
C. Dementia
D. Diabetes

8. Explain the importance of performing a social assessment when caring for a geriatric patient.

9. Your patient tells you that he takes numerous medications every day for his heart and blood pressure; however, he cannot remember their names. He points to a plastic bag by the bedside that contains 11 prescription bottles with similar medications, and some of the medications were not prescribed to him. What problems might this situation pose?

CHAPTER
36

Patients With Special Challenges

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National EMS Education Standard Competencies

Special Patient Populations

Applies a fundamental knowledge of growth, development, and aging and assessment findings to provide basic emergency care and transportation for a patient with special needs.

Patients With Special Challenges

Recognizing and reporting abuse and neglect (Chapter 34, *Pediatric Emergencies*, and Chapter 35, *Geriatric Emergencies)*

Health care implications of

› Abuse (Chapter 34, *Pediatric Emergencies*, and Chapter 35, *Geriatric Emergencies*)
› Neglect (Chapter 34, *Pediatric Emergencies*, and Chapter 35, *Geriatric Emergencies*)
› Homelessness (p 1339)

› Poverty (p 1339)
› Bariatrics (pp 1331–1332)
› Technology dependent (pp 1333–1337)
› Hospice/terminally ill (p 1338)
› Tracheostomy care/dysfunction (pp 1333–1334)
› Home care (p 1338)
› Sensory deficit/loss (pp 1326–1329)
› Developmental disability (pp 1324–1326)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Special Considerations in Trauma

Recognition and management of trauma in
› Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
› Pediatric patient (Chapter 34, *Pediatric Emergencies*)
› Geriatric patient (Chapter 35, *Geriatric Emergencies*)

Pathophysiology, assessment, and management of trauma in the
› Pregnant patient (Chapter 33, *Obstetrics and Neonatal Care*)
› Pediatric patient (Chapter 34, *Pediatric Emergencies*)
› Geriatric patient (Chapter 35, *Geriatric Emergencies*)
› Cognitively impaired patient (pp 1324–1326)

Knowledge Objectives

1. Give examples of patients with special challenges EMTs may encounter during a medical emergency. (p 1323)
2. Explain the special patient care considerations required when providing emergency medical care to patients with intellectual disabilities, including patients with autism spectrum disorder (ASD), Down syndrome, or prior brain injuries. (pp 1324–1326)
3. Describe the different types of visual impairments and the special patient care considerations required when providing emergency medical care for visually impaired patients, depending on the level of their disability. (pp 1326–1327)
4. Describe the various types of hearing impairments and the special patient care considerations required when providing emergency medical care for hard-of-hearing patients, including tips for effective communication. (pp 1327–1329)
5. Describe the various types of hearing aids worn by patients; include strategies to troubleshoot a hearing aid that is not working. (pp 1328–1329)
6. Explain the special patient care considerations required when providing emergency medical care to patients who have cerebral palsy, spina bifida, or paralysis. (pp 1330–1333)
7. Define obesity. (p 1331)
8. Explain the special patient care considerations required when providing emergency medical care to bariatric patients; include the best way to move bariatric patients. (p 1332)
9. Explain the special patient care considerations required when providing emergency medical care to patients who rely on a form of medical technological assistance, including the following: (pp 1333–1337)
   • Tracheostomy tube
   • Mechanical ventilator
   • Apnea monitor
   • Internal cardiac pacemaker
   • Left ventricular assist device (LVAD)
   • External defibrillator vest
   • Central venous catheter
   • Gastrostomy tube
   • Ventricular peritoneal shunt
   • Vagus nerve stimulator

- Colostomy bag, ileostomy bag, or urostomy bag

10. Describe home care, the types of patients it serves, and the services it encompasses. (p 1338)
11. Contrast hospice and palliative care with curative care. (p 1338)
12. Explain the responsibilities of EMTs when responding to calls for terminally ill patients who have DNR orders. (p 1338)
13. Discuss the issues of poverty and homelessness in the United States, their negative effects on a person's health, and the role of EMTs as patient advocates. (p 1339)

Skills Objectives

1. Demonstrate different strategies to communicate effectively with a patient who has a hearing impairment. (p 1328)

Introduction

The approach to health care in the United States continues to focus on decreasing the length of hospitalization. At the same time, medicine and medical technology continue to improve. As a result, the number of children and adults with chronic diseases and injuries who live at home or in environments outside of a hospital setting continues to grow. You should be familiar with the special challenges of patients with chronic diseases and conditions.

Some examples of patients with special challenges include:

- Children who were born prematurely and who have associated respiratory problems
- Infants or small children with congenital heart disease
- Patients with neurologic disease (occasionally caused by hypoxemia at the time of birth, as with cerebral palsy)
- Patients with congenital or acquired diseases resulting in altered body function that requires medical assistance for breathing, eating, urination, or bowel function
- Patients with sensory deficits such as hearing or visual impairments
- Geriatric patients with chronic diseases requiring visitation from a home health care service

You may be called to treat children and adults who live at home and depend on mechanical ventilators, intravenous pumps, or other devices to maintain their lives. You should assess and care for patients with special challenges the same way you care for your other patients. Your priority is the assessment and treatment of the ABCs. Do not be distracted by the noise and mechanics of the medical equipment—focus on the patient the medical equipment may be assisting. If the emergency is the result of medical equipment failure, use the equipment on the ambulance. Some families will have a "go bag," which is a collection of spare equipment and supplies for such situations.

Words of Wisdom

During stressful emergency events, it is imperative to use the TEAM approach (Trust Every Available Member) to collaborate regarding your patient's treatment, which leads to a better standard of care and patient outcome.

Words of Wisdom

Primary caregivers of patients at high risk for cardiac arrest should be trained in CPR. You should advocate for this as part of your community prevention efforts.

YOU are the Provider — PART 1

At 1435 hours, you are dispatched to a residence at 575 Ranger Drive for a 19-year-old man with a fever. You recognize the address because you have responded to this patient on several occasions. He has quadriplegia and is ventilator dependent because of a spinal injury that occurred 2 years ago. You and your partner proceed to the scene; your response time is 5 minutes.

1. How will your assessment and treatment of this patient differ from a patient who is not dependent on a ventilator?
2. What role do the parents or caregivers of patients with special health care needs have in the prehospital setting?

Intellectual Disability

The term **developmental disability** refers to insufficient development of the brain, resulting in some level of dysfunction or impairment. Developmental disabilities can include intellectual, hearing, or vision impairments that surface during infanthood or childhood.

Intellectual disability results in the inability to learn and socially adapt at a normal developmental rate. An intellectual disability may be caused by genetic factors, congenital infections, complications at birth, malnutrition, or environmental factors. Prenatal drug or alcohol use may also cause intellectual disability, such as fetal alcohol syndrome. Other causes that may occur after birth include traumatic brain injury and poisoning (eg, from lead or other toxins).

A person with a slight intellectual impairment may appear slow to understand or have a limited vocabulary. Such patients will often behave immaturely in comparison with their peers. People with severe intellectual disabilities may not have the ability to care for themselves, communicate, understand, or respond to their surroundings.

Speaking to patients and family members will give you a good idea of how well the patient can understand you and how the patient will interact with you. Family or friends of the patient may also be able to supply additional medical information regarding the patient.

Because patients with intellectual disabilities may have difficulty adjusting to change or a break in routine, an emergency call that generates a roomful of strangers can be overwhelming. A patient may become more difficult to interact with as his or her anxiety level increases. Make every effort to respect the patient's wishes and concerns. Take as much time as necessary to calmly and clearly explain the treatment the patient is about to receive.

Patients with intellectual disabilities are susceptible to the same disease processes as other patients, including diabetes, heart attack, and respiratory difficulties. Assess and treat the patient according to the chief complaint. During transport, keep the patient as calm as possible.

Autism Spectrum Disorder

Autism and **autism spectrum disorder (ASD)** are general terms used to describe a group of complex disorders of brain development that vary greatly in signs and symptoms. Autism is a pervasive developmental disorder characterized by impairment of social interaction. Other characteristics can include severe behavioral problems, repetitive motor activities, and verbal and nonverbal language impairment. Some people with autism may be hyper- or hyposensitive to sensory stimuli. They may also show their pain in unusual ways, such as by humming, singing, and removing clothing. The spectrum of disability is wide. Some children with autism will grow up to be independent, whereas others will be unable to care for themselves.

Patients with autism have difficulty using or understanding nonverbal means of communication, such as gestures. They frequently have difficulty making eye contact and resist encouragement to do so. They may have extreme difficulty with tasks that require many steps and do best with simple, one-step directions, such as "Please roll up your sleeve." Some patients with autism tend to become confused during long conversations and have trouble answering open-ended questions (eg, "What sorts of things do you enjoy doing?"). They may talk in robotic or monotonic speech patterns and sometimes repeat phrases over and over again. Many patients with autism confuse pronouns and will say "you" when they mean "I," as in "You are going to the hospital," when they mean, "I am going to the hospital." A small percentage of patients with autism do not speak at all, but instead rely on pulling parents and caregivers around by the hand to get their needs met.

There is no simple explanation as to why autism exists. According to the Centers for Disease Control and Prevention, approximately 1 in every 68 American children is diagnosed with autism. The prevalence in boys is five times the prevalence in girls. Autism is typically diagnosed by age 3. The parents or caregivers often report repetitive motions (hand flapping, twirling objects) or isolated abnormal behaviors. Many children with autism receive special instruction and care in school-based settings, but this was not always the case in the past. It is likely that some older adults with autism have never been diagnosed and have never received any assistance.

Patients with autism generally have medical needs similar to those of their peers without autism. Rely on parents or caregivers for information and involve them in the treatment of the patient. As with any patient, explain what you are going to do before you do it. Move slowly, stay calm, and perform physical examinations from distal to proximal. Demonstrate the examination on a parent or caregiver first to show the patient with autism what he or she can expect.

Down Syndrome

Down syndrome is characterized by a genetic chromosomal defect resulting in mild to severe intellectual impairment **Figure 36-1**. The normal human somatic cell contains 23 pairs of chromosomes. In most cases, Down syndrome, also known as trisomy 21, occurs when the two 21st chromosomes fail to separate, so that the ovum or sperm contains 24 chromosomes. When fertilization occurs, a triplication ("trisomy") of chromosome 21 occurs. The extra chromosome disrupts the normal course of development.

Figure 36-1 A child with Down syndrome.

Increased maternal age and a family history of Down syndrome are known risk factors for this condition. Various physical abnormalities are associated with Down syndrome—a round head with a flat occiput; an enlarged, protruding tongue; slanted, wide-set eyes; folded skin on either side of the nose, covering the inner corners of the eye; short, wide hands; a small face and features; congenital heart defects; thyroid problems; and hearing and vision problems. People with Down syndrome usually do not have all of these signs, but a diagnosis can be made rapidly at birth because several of the signs can be seen. Depending on their level of intellectual disability, people with Down syndrome may lead independent lives. They may be employed, vote, and get involved in their communities.

Patients with Down syndrome are at increased risk for medical complications, including those that affect the cardiovascular, sensory, endocrine, musculoskeletal, dental, and gastrointestinal systems, as well as neurologic development. As many as 40% of these patients have heart conditions and hearing and vision problems.

Because people with Down syndrome often have large tongues and small oral and nasal cavities, airway management may be difficult. These patients may also have misaligned teeth and other dental problems. The enlarged tongue and dental problems can lead to speech abnormalities as well. In an emergency situation, if airway management is necessary, bag-valve mask (BVM) ventilation can be challenging. In the case of airway obstruction, a jaw-thrust maneuver may be all that is needed to clear the airway. In an unconscious patient, either the jaw-thrust maneuver or a nasopharyngeal airway may be necessary.

Some people with Down syndrome have epilepsy. Most of the seizures are tonic-clonic. Patient management is the same as with other patients with seizures. Chapter 17, *Neurologic Emergencies*, discusses the emergency management of seizures in detail.

According to the National Down Syndrome Society, the atlantoaxial joint—where the first two vertebrae meet—is unstable in approximately 15% of people with Down syndrome. This is termed atlantoaxial instability (AAI). Most patients with AAI do not show symptoms; however, they are at increased risk of complications when they experience trauma. Keep this in mind when you receive a call for a musculoskeletal problem or possible neurologic problem in a patient with Down syndrome. If the atlantoaxial joint becomes dislocated, as may occur with trauma, the patient may experience difficulty walking, neck pain or decreased neck mobility, and sensory deficits. Such a dislocation can even cause spinal cord injury.

AAI is diagnosed with a radiograph of the cervical vertebrae.

Patient Interaction

It is normal to feel uncomfortable when initiating contact with a patient with an intellectual disability, especially if you have not encountered such situations frequently. The best plan of action is to treat the patient as you would any other patient.

Approach the patient in a calm, friendly manner, watching for signs of increased anxiety or fear. Remember, you are a stranger and are approaching with a group of people. The patient may not understand your uniform or realize that you and your team are there to help. It may be helpful to have your team members wait until you can establish a rapport with the patient. You can then introduce the team members and explain what they are going to do as you slowly bring them forward.

You might interact with a patient with an intellectual disability as follows: "Hello, Mr. Pemberton. My name is Jerry Booker." Shake Mr. Pemberton's hand if he will allow it. "We're here to help you. Your sister called us. She says you're not feeling well today, and we're here to help you feel better. My partner, Tina, is going to take your blood pressure. Do you remember having that done before?" Allow Mr. Pemberton to see and touch the blood pressure cuff as your partner moves forward. Move slowly but deliberately. Explain beforehand what you are going to do, just as with any other patient. Watch carefully for signs of fear or reluctance from the patient. Make sure you are at eye level with the patient. If the patient is sitting, kneel or sit down. This is important in communicating with all patients; however, it is even more important in making the patient with special challenges comfortable.

Do your best to soothe the patient's anxiety and discomfort as you work through your assessment and provide treatment. By initially establishing trust and communication, you will have a much better chance for a successful outcome.

Brain Injury

A patient with a prior brain injury may be difficult to assess and treat. Chapter 28, *Head and Spine Injuries*, discusses traumatic brain injuries in detail. Patients with brain injuries may face a complex array of challenges related to the injury. In such cases, gathering a complete medical history from the patient, family, and friends will be helpful. Your interaction with patients with brain injuries should be tailored to their specific abilities. Take the time to speak with the patient and family to establish what is considered normal for the patient; for example, determine whether the patient has cognitive, sensory, communication, motor, behavioral, or psychologic deficits.

When you care for a patient with a prior brain injury, talk in a calm, soothing tone, and watch the patient closely for signs of anxiety or aggression. In some cases, the patient may need to be specially positioned or restrained to ensure your safety and the safety of the patient. Do not expect the patient to walk to the ambulance or stretcher. As always, treat the patient with respect, use his or her name, explain procedures, and reassure the patient throughout the process.

Sensory Disabilities

Visual Impairment

Visual impairments may result from many different causes—a congenital defect; disease; injury; or degeneration of the eyeball, optic nerve, or nerve pathway (eg, with aging). The degree of visual impairment may range from partial to total. Some patients have a loss of peripheral or central vision; others can distinguish light from dark or identify general shapes.

Visual impairments may be difficult to recognize. During your scene size-up, look for signs that indicate the patient is visually impaired, such as the presence of eyeglasses, a cane, or a service animal **Figure 36-2**. Immediately introduce yourself when you enter the room. Have your team members introduce themselves so that the patient can identify their voices and locations. In addition, retrieve any visual aids and give them to your patient to make the interaction more comfortable.

YOU are the Provider **PART 2**

You arrive at the scene and find the patient lying supine in a hospital-style bed in the living room. He immediately looks at you when you approach him but does not talk to you. The patient's mother tells you that he began running a fever earlier in the day. She further advises you that the patient's home health nurse was present earlier and contacted his physician, who requested that EMS transport him to the hospital. While your partner gathers additional information, you perform a primary assessment.

Recording Time: 0 Minutes

Appearance	Eyes open
Level of consciousness	Conscious and alert; this is his baseline mental status
Airway	Tracheostomy tube in place; upper airway clear of secretions and foreign bodies
Breathing	14 breaths/min via mechanical ventilator
Circulation	Increased pulse rate (strong and regular); skin is pink, hot, and moist; no gross bleeding

3. What are some conditions that would cause a patient to become dependent on a mechanical ventilator?
4. How does a tracheotomy tube affect a patient’s ability to communicate? How can you determine if your patient is alert?

Figure 36-2

A service dog may be easily identified by its special harness.

Courtesy of the Guide Dog Foundation for the Blind. Photographed by Christopher Appoldt.

A visually impaired patient may feel vulnerable, especially during the chaos of a crash scene. The patient may have learned to use other senses, such as hearing, touch, and smell, to compensate for the loss of sight, and the sounds and smells of the scene may be disorienting. Remember to tell the patient what is happening, identify noises, and describe the situation and surroundings, especially if you must move the patient.

The patient may use a cane or walker to ambulate safely. Even if the patient will be carried on a gurney, remember to take the patient’s cane or walker. Unless the patient is in critical condition, a service animal can remain with the patient and will provide reassurance for the patient and prevent delays in transport; however, in some cases you may need to make arrangements for the care or accompaniment of the animal. A friend of the patient or an animal control officer can be helpful in this situation.

An ambulatory patient may be led by a light touch on the arm or elbow. You may also allow the patient to rest his or her hand on your shoulder, as this may enhance the patient’s sense of balance and security while moving. You may also ask patients which method they prefer to use. Patients should be gently guided but never pulled or pushed. Obstacles need to be communicated in advance. Statements such as, “You’re approaching the stairs. We’re going to take five steps down,” will allow the patient to anticipate and navigate the obstacles safely.

Words of Wisdom

Service animals are not classified as pets and should, by law, be permitted to accompany the patient unless it is a critical situation or the animal is out of control. Review the Service Animals section in the Americans with Disabilities Act for further information.

Hearing Impairment

Recall from Chapter 4, *Communication and Documentation*, that hearing impairment can range from a slight hearing loss to total deafness. Some hard-of-hearing patients may have difficulty with pitch, volume, and speaking distinctly. Some patients learn to speak even though they have never heard sounds. Other patients may have heard speech and learned to speak, but have since sustained partial or total hearing loss, leading them to speak too loudly. Many older people will have some degree of hearing loss.

The two most common forms of hearing loss are sensorineural deafness and conductive hearing loss. **Sensorineural deafness**, or nerve damage, results from a lesion or damage to the inner ear. **Conductive hearing loss** is caused by a faulty transmission of sound waves, which can occur when a person has an accumulation of wax inside the ear canal or a perforated eardrum.

Words of Wisdom

As with all interventions for barriers to communication, you should document the use of an interpreter. Also remember that conclusions based on the information from interpreters may not be valid. Ask the interpreter to report exactly what the patient signs and not to add any commentary, however well intentioned.

During your scene size-up, look for clues that a person could be hard of hearing, including the presence of hearing aids, poor pronunciation of words, or failure to respond to your presence or questions. Some patients may not have their hearing aids in place. Assist the patient with finding and inserting any hearing aids as appropriate, or ask family members to help you. It may be helpful to communicate by writing until the hearing aids are located. Most hard-of-hearing patients can also read lips to some extent. Therefore, face the patient while you communicate so that he or she can see your mouth; do not exaggerate your lip movements or look away. Position yourself approximately 18 inches (46 cm) in front of the patient. Because hard-of-hearing patients typically have more difficulty hearing higher frequency sounds, never shout; instead, try lowering the pitch of your voice.

Ask the patient, "How would you like to communicate with me?" Some patients may prefer written communication or the use of gestures or pictures. American Sign Language may be the patient's preferred method of communication **Figure 36-3**. An interpreter, family member, or friend may be a valuable teammate. If needed, ask the interpreter to accompany the patient to the hospital because this may decrease the stress of communication on the patient, EMS crew, and the hospital staff. If an interpreter is not readily available, call the receiving facility to request one as soon as you are aware of the need.

Figure 36-3 Consider learning common terms in American Sign Language related to illness and injury. **A.** Sick. **B.** Hurt. **C.** Help.

Here are some helpful hints for working with patients with hearing impairments:

- Speak slowly and distinctly into the less-impaired ear, or position yourself on that side.
- Change speakers. Given that 80% of hearing loss is related to an inability to hear high-pitched sounds, it may be helpful to have a team member with a low-pitched voice communicate with the patient.
- Provide paper and a pencil so that you may write your questions and the patient may write responses.
- Have only one EMT ask interview questions, to avoid confusing the patient.
- Try the "reverse stethoscope" technique: put the earpieces of your stethoscope in the patient's ears and speak softly into the diaphragm of the stethoscope to amplify your voice.

Hearing Aids

A hearing aid is essentially a device that makes sound louder. Hearing aids cannot restore hearing to normal, but they do improve hearing and listening ability. Hearing aids can be either external or internal, depending on the type of hearing damage. Several types of hearing aids are available Figure 36-4:

- **Behind-the-ear.** The working parts are contained in a plastic case that rests behind the ear.
- **Conventional body.** This older style is generally used by people with profound hearing loss.
- **In-the-canal and completely in-the-canal.** These hearing aids are contained in a tiny case that fits partly or completely into the ear canal.
- **In-the-ear.** All parts are contained in a shell that fits in the outer part of the ear.

Implantable hearing aids are also an option for patients with less profound hearing loss. To insert a hearing aid, follow the natural shape of the ear. The device needs to fit snugly without forcing. If you hear a whistling sound, the hearing aid may not be in far enough to create a seal or the volume may be too loud. Try repositioning the hearing aid, or remove it and turn down the volume. If you cannot insert the hearing aid after two tries, put it in its box, take it with you, and document the transport and transfer of hearing aids to hospital personnel. Never try to clean hearing aids, and do not get them wet.

If you are able to insert the hearing aid but it is not working, try troubleshooting the problem. First, make sure the hearing aid is turned on. Try a fresh battery, and check the tubing to make sure it is not twisted or bent. Ensure that the switch is set on M (microphone), not T (telephone). For a conventional body-type aid, try a spare cord; the old one may be broken or shorted. Finally, make sure the ear mold is not clogged with wax.

Figure 36-4 Different types of hearing aids. **A.** Behind-the-ear. **B.** Conventional body. **C.** In-the-canal. **D.** In-the-ear. **E.** Completely in-the-canal.

A: © Piotr Marcinski / Shutterstock.; B: Stine Lise Nielsen/Shutterstock; C: Steve Hamblin/Alamy; D: Terry Smith Images/Alamy; E: Jiri Hera/Shutterstock.

Words of Wisdom

Many patients with borderline hearing impairments may not be aware of the extent of their problem. The distracting and noisy EMS environment may worsen the situation. If a patient frequently asks you to repeat things, suspect a hearing impairment.

Words of Wisdom

Some patients who are hard of hearing are sensitive to loud noises close to their ears. Remember to use a normal tone of voice when speaking to these patients.

Physical Disabilities

Cerebral Palsy

Cerebral palsy is a term for a group of disorders characterized by poorly controlled body movement **Figure 36-5**. This disorder is a result of damage to the developing fetal brain while in utero, oxygen deprivation at birth, a traumatic brain injury at birth, or infection such as meningitis during early childhood. Patients with cerebral palsy can have symptoms that range from mild to severe, involving poor posture and uncontrolled, spastic movements of the limbs.

Cerebral palsy is also associated with other conditions such as visual and hearing impairments, difficulty communicating, epilepsy (seizures), and intellectual disabilities. A significant majority of patients with cerebral palsy possess some degree of intellectual impairment, whereas others have a normal intelligence level and are able to live independently with minimal support. Patients with cerebral palsy may have an unsteady gait (ataxia) and may require the assistance of a wheelchair or walker. Transport this type of equipment with the patient, provided it can be secured properly in the ambulance.

As with all patients, assessing the ABCs is of the utmost importance when treating a patient with cerebral palsy. Closely observe the airway status of a patient with cerebral palsy because these patients may have increased secretion production and difficulty swallowing (dysphagia), requiring aggressive suctioning to clear the airway.

Figure 36-5 A person with cerebral palsy.

When you care for a patient with cerebral palsy, note the following:

- Do not assume that patients with cerebral palsy have an intellectual disability. Although 75% of patients have some intellectual disability, many people with cerebral palsy have a normal IQ or only slight intellectual impairment.
- Limbs are often underdeveloped and are prone to injury (eg, a fall from a wheelchair).
- Patients who have the ability to walk may have an unsteady gait and be prone to falls.
- If the patient has a specially made pillow or chair (as many pediatric patients do), the patient may prefer to use it during transport. Remember to pad the patient to ensure his or her comfort, and never force a patient's extremities into any position.
- Whenever possible, transport walkers or wheelchairs with the patient.
- Approximately 25% of patients with cerebral palsy have a seizure disorder. Be prepared to address a seizure if one occurs, and keep a suctioning unit available. Consider requesting additional advanced life support (ALS).

Spina Bifida

Spina bifida is a birth defect caused by the incomplete closure of the spinal column during embryonic or fetal development, resulting in an exposed portion of the spinal cord **Figure 36-6**. The opening can be closed surgically, but the child is often left with spinal and neurologic damage. Adequate maternal intake of vitamin B (folic acid) reduces the risk of spina bifida. Most defects occur before the woman knows she is pregnant, so since 1992, the US government has mandated that foods such as breads, cereals, and grains be fortified with vitamin B. This effort has decreased the incidence of spina bifida, but, unfortunately, it is still one of the most common disabling birth defects in the United States. Some patients with spina bifida also have hydrocephalus, which requires the placement of a shunt to drain excessive amounts of cerebrospinal fluid (CSF) from the brain.

Figure 36-6 Spina bifida is one of the most common disabling birth defects in the United States.

Be aware that some patients with spina bifida have partial or full paralysis of the lower extremities, loss of bowel and bladder control, and an extreme allergy to latex products. Latex-free products should be kept on the ambulance to avoid a severe anaphylactic reaction in patients with spina bifida.

Patients with spina bifida will benefit from the same considerations that you offer when you treat a patient with paralysis or a patient who has difficulty moving. Ask patients how it is best to move them before you transport them. It is highly likely that a patient in your community will have spina bifida.

Paralysis

Paralysis is the inability to voluntarily move one or more body parts. It may be caused by stroke, trauma, or birth defects. Paralysis does not always involve a loss of sensation. Some patients will have normal sensation or even hyperesthesia (increased sensitivity), which may cause the patient to experience touch as pain in the affected area. Paralysis of one side of the face may cause communication challenges.

The diaphragm of some paralyzed patients may not function correctly, requiring the use of a ventilator. Patients may also rely on specialized equipment such as urinary catheters, tracheostomy tubes, colostomy bags, or feeding tubes, which are discussed later in this chapter. Some patients may have difficulty swallowing, creating the need for suctioning. Each type of spinal cord paralysis requires its own equipment and may have its own complications.

Patients who have partial or total loss of sensation in a limb cannot tell you when you are injuring them. Always use a gentle touch and take great care when lifting or moving a paralyzed patient. Ask patients how it is best to move them before you transport them.

Bariatric Patients

Obesity is a complex condition in which a person has an excessive amount of body fat. It is the result of an imbalance between calories consumed and calories used. The solution to the obesity problem may sound simple—reestablish the caloric balance—but, unfortunately, the causes of obesity are not fully understood. Many cases of obesity may be attributed to a low metabolic rate or genetic predisposition.

YOU are the Provider — PART 3

The patient's axillary temperature reads 101.2°F (38.4°C). The patient has a gastrostomy tube and his mother tells you that she administered an appropriate dose of acetaminophen through the tube about an hour ago. Your partner assesses the patient's vital signs while you perform a physical examination, which reveals no obvious abnormalities. You note that the patient has a colostomy bag and an indwelling urinary catheter.

Recording Time: 5 Minutes	
Respirations	14 breaths/min; provided by mechanical ventilator
Pulse	110 beats/min; strong and regular
Skin	Pink, hot, and moist
Blood pressure	118/62 mm Hg
Oxygen saturation (Spo_2)	99% (on oxygen)

5. What are some potential complications that may result from your patient's condition? What can you do to prevent them or minimize the risks?
6. What do you suspect is the patient's underlying problem? What specific treatment should you provide to him?

According to the Mayo Clinic, the term *obese* is used when someone is 30% or more over his or her ideal body weight. This is a good general guideline, except in cases where body weight does not correlate to excess fat, for example in very muscular people. In severe obesity (also called extreme or morbid obesity), the person is two or three times over the ideal weight. The person's quality of life is often negatively affected, and the extra weight can cause a variety of problems, such as mobility difficulties, diabetes, hypertension, heart disease, and stroke.

Interaction With Patients With Obesity

People with obesity are often ridiculed publicly and sometimes become targets of discrimination. Patients with obesity may be embarrassed by their condition or fearful of scorn as a result of past experiences. Some of those negative interactions may have occurred with an insensitive health care professional. As with any patient, work hard to put these patients at ease. Establish the patient's chief complaint and then communicate your plan to help. Many patients with severe obesity have a complex and extensive medical history, so mastering the art of conducting a patient interview will serve you well in your patient interactions.

If transport is necessary, plan early for extra help and do not be afraid to call for additional providers and/or specialized equipment if necessary. In particular, send a member of your team to find the easiest and safest exit to use. Remember, everyone's safety is at stake! You do not want to risk dropping the patient or injuring a team member by trying to lift too much weight. Moves, no matter how simple they may seem, become far more complex when handling a patient with obesity.

Interaction With Patients With Morbid Obesity

Morbid obesity affects about 9 million adult Americans. These patients may overcome mobility difficulties by pulling, rocking, or rolling into a position. The constant strain on their body's structures may leave them with chronic joint injuries or osteoarthritis. When you move a patient with morbid obesity, follow these tips:

- Treat the patient with dignity and respect.
- Ask the patient how it is best to move him or her before attempting to do so.
- Avoid lifting the patient by only one limb, which would risk injury to overtaxed joints.
- Coordinate and communicate all moves to all team members prior to starting to lift.
- If the move becomes uncontrolled at any point, stop, reposition, and resume.
- Look for pinch or pressure points from equipment because this could cause significant soft-tissue injuries or deep venous thrombosis.
- Large patients will often have difficulty breathing in a supine position. When safe and appropriate to do so, elevate the head of the stretcher when transporting patients with obesity.
- There are many types of specialized equipment for patients with obesity, and some areas have specially equipped bariatric ambulances for such patients. Become familiar with the resources available in your area.
- Plan egress routes to accommodate large patients, equipment, and the lifting team members. Remember: Do no harm!
- Notify the receiving facility early to allow special arrangements to be made prior to your arrival to accommodate the patient's needs.

Special Populations

As with older adults and pediatric patients, be alert for the possibility of abuse and neglect when treating patients with special challenges.

Signs of abuse include evidence of multiple injuries in various stages of healing, injuries that do not seem to correspond to the history provided by caregivers, and burns associated with a suspicious history. Injuries related to abuse are often inflicted in areas not readily seen. Make the patient as comfortable as possible, then remove his or her clothing to evaluate skin for signs of abuse. Document all findings and report them to the physician at the emergency department (ED) and any mandated reporting agency in your state.

Signs of neglect include poor hygiene, unkempt hair, male patients who are unshaven, frequent sickness, and inappropriate clothing for the weather.

Patients With Medical Technology Assistance

Tracheostomy Tubes

Recall that a **tracheostomy** is a surgical procedure that creates a **stoma**, or opening, through a patient's skin and into an organ or other structure. A tracheal stoma provides a path between the surface of the neck and the trachea. Often, this stoma is kept open by the insertion of a plastic **tracheostomy tube**. The tube, which can be temporary or permanent, passes from the neck directly into the major airways **Figure 36-7**.

Patients who may breathe through a tracheostomy tube include those who depend on home automatic ventilators and those who have chronic pulmonary conditions. Because these tubes are foreign to the respiratory tract, the body reacts by building up secretions in or around the tube. The tubes are prone to obstruction by mucous plugs or foreign bodies. Routine care that is provided by caregivers includes keeping the inner cannula of the tracheostomy tube clean and dry and suctioning any secretions.

An obstruction of the tracheostomy tube is an emergency that requires you to intervene immediately. This type of emergency can be stressful to deal with, so it is imperative to remember the ABCs and airway management. A useful mnemonic in these situations is DOPE **Table 36-1**. The DOPE mnemonic can help you remember the possible causes of an airway obstruction and correct the problem. Failure to clear an obstructed tracheostomy tube could lead to cardiopulmonary arrest.

Figure 36-7

Some patients require a tracheostomy tube to breathe.

Portex® Blue Line® Ultra Tracheostomy courtesy of Smiths Medical.

Table 36-1 DOPE Mnemonic

D	Displaced, dislodged, or damaged tube
O	Obstructed tube (secretions, blood, mucus, vomitus)
P	Pneumothorax
E	Equipment failure (kinked tubing, ventilator malfunction, empty oxygen supply)

There may be bleeding or air leaking around the tube. This is more likely to happen with new tracheostomies. The tube can become loose or dislodged. Occasionally, the opening around the tube may become infected. Your care of a patient with a tracheostomy tube includes maintaining an open airway, maintaining the patient in a position of comfort, administering supplemental oxygen as needed, and providing transport to the hospital.

Some patients with tracheostomy tubes and special health care needs may have muscle contractions that will not allow you to place them in the typical semi-Fowler position; in these cases, suction the patient in a position of comfort. If trauma is involved, protect the cervical spine.

If suctioning of the tracheostomy tube is necessary, first attempt to use the patient's suction device. It is probably already sized correctly and readily available. If the size of the suction catheter is unknown, estimate the size by doubling the inner diameter of the tracheostomy tube. To determine the length of the suction device, ask a family member or measure the length of a spare tracheostomy tube. If the length of the patient's tracheostomy tube cannot be determined, insert the suction device no more than 1 to 2 inches (3 to 6 cm) deep. The suction unit should be set to 100 mm Hg. You may need to instill 2 to 3 mL of saline before suctioning thick tracheal secretions. Do not suction for more than 10 seconds, and do not force the suction catheter into the cannula. Oxygenate before and after the procedure. Call for ALS backup.

Mechanical Ventilators

Patients who are on a mechanical ventilator at home cannot breathe without assistance **Figure 36-8**. Patients requiring a mechanical ventilator may not have an underlying respiratory drive because of a congenital defect or a chronic lung disease process. Other patients may have a traumatic brain injury, muscular dystrophy, or another disease process that weakens their ability to breathe and requires a permanent tracheostomy and mechanical ventilator.

Figure 36-8 A home ventilator.

Remember that patients with tracheostomies typically do not breathe through their mouth and nose; therefore, a face mask or nasal cannula cannot be used to treat them. If the ventilator malfunctions, remove the patient from the ventilator and apply a tracheostomy collar. This oxygen-delivery device is specifically designed to cover the tracheostomy stoma and features a strap that goes around the neck. Tracheostomy collars are usually available in intensive care units, where many patients have tracheostomies, and may not be available in a prehospital setting. If you do not have a tracheostomy collar, you can improvise by placing a face mask over the stoma **Figure 36-9**. Even though the mask is shaped to fit the face, you can usually achieve an adequate fit over the patient's neck by adjusting the strap.

Patients on home mechanical ventilators require assisted ventilation throughout transport. Remember that the patient's caregivers will know how the mechanical ventilator works and can help you attach the bag and valve from a BVM to the tracheostomy tube in preparation for transport.

Words of Wisdom

Several states have adopted laws that require a backup generator or other devices to prevent the loss of electric supply to the homes of families or institutions that have patients using mechanical ventilators.

Figure 36-9 If you do not have a tracheostomy collar, use a face mask instead.

YOU are the Provider — PART 4

You consult with medical control and receive instructions on how to proceed. The mechanical ventilator is too large to fit in your ambulance, so you prepare the BVM, detach the ventilator circuit from the tracheostomy tube, and begin manual ventilations at 12 breaths/min. You carefully move the patient to your stretcher, secure him properly, and load him into the ambulance. Following medical control's direction, you continue to manually ventilate the patient, reassess his vital signs, and begin transport to the hospital.

Recording Time: 15 Minutes	
Level of consciousness	Conscious and alert
Respirations	12 breaths/min; provided by BVM
Pulse	118 beats/min; strong and regular
Skin	Pink, hot, and dry
Blood pressure	120/60 mm Hg
Spo_2	98% (on oxygen)

7. What is the benefit of allowing the patient's mother to accompany her son to the hospital?

Apnea Monitors

While caring for an infant with special challenges, you may come across an apnea monitor. The apnea monitor is typically used when there is a family history of sudden infant death syndrome or when an infant is born prematurely, has severe gastroesophageal reflux that causes choking episodes, or has experienced an apparent life-threatening event. Chapter 34, *Pediatric Emergencies,* discusses sudden infant death syndrome and apparent life-threatening events in detail. Because the central nervous system is not mature in pediatric patients with special challenges, in infants the apnea monitor is used for 2 weeks to 2 months after birth to monitor the respiratory system. A typical episode of apnea may last for approximately 15 to 20 seconds, during periods of sleep. The apnea monitor is designed to sound an alarm if the infant experiences bradycardia or an episode of apnea occurs.

The apnea monitor is attached with electrodes or a belt wrapped around the infant's chest or stomach. A pulse oximeter may also be used. The apnea monitor will provide a pulse oximetry reading that will help you assess the patient's respiratory status.

The parents or caregivers of pediatric patients with special challenges will be a useful resource when obtaining the patient's medical history and a history of the events leading to the call for assistance. Parents and caregivers become knowledgeable regarding the use of apnea monitors and may be able to provide you and your partner with a computerized printout to share with ALS providers or ED personnel. If possible, bring the apnea monitor to the receiving hospital with the pediatric patient so that it may be evaluated and any stored information may be retrieved for further analysis.

Internal Cardiac Pacemakers

An internal cardiac pacemaker is a device implanted under the patient's skin to regulate the heart rate. These devices are typically placed on the nondominant side of the patient's chest so that normal activities are not hindered. In small or extremely thin patients, the device may be implanted in the abdomen. Some pacemakers include an automated implanted cardioverter defibrillator, which monitors the patient's heart rhythm and is able to slow accelerated heart rates.

Never place defibrillator paddles or pacing patches directly over the implanted device. It can be helpful for the hospital staff if you gather information about the cardiac pacemaker while you obtain the patient's history during the patient assessment process. Some patients will have a pacemaker identification card in their wallets that contains information specific to the device Table 36-2.

Table 36-2 Questions for Patients With Pacemakers

- What type of heart disorder do you have?
- How long has this device been implanted?
- What is your normal baseline rhythm and heart rate?
- Is your heart completely dependent on the pacemaker device?
- At what heart rate will the defibrillator fire?
- How many times has the defibrillator shocked you?

Left Ventricular Assist Devices

A left ventricular assist device (LVAD) is a special piece of medical equipment that takes over the function of one or both heart ventricles. These types of devices are typically used as a bridge to heart transplantation while a donor heart is being located or as a permanent solution for patients who do not qualify for a transplant. In addition to the multiple LVAD devices available for adult patients with heart failure, there is one ventricular assist device that has been approved for use in patients aged 5 to 16 years. It may be difficult to palpate a pulse in patients who use an LVAD. In such cases, assess perfusion by noting level of consciousness, skin color, temperature, moisture, and blood pressure.

If you encounter a patient with an LVAD, you will primarily provide support measures and basic care. The parents or caregivers should be knowledgeable about the device, so use them as a resource during transport. The patient should have a "go bag" that must always be transported with him or her. Risk factors associated with the implantation of an LVAD include excessive bleeding following the surgery, infection, blood clots leading to strokes, and acute heart failure. Be prepared to provide cardiopulmonary resuscitation. Keep in mind that the LVAD may be functioning in the absence of a palpable pulse. If you encounter a patient with this device, contact medical control or follow your local protocols. Understand that CPR will likely dislodge the device or its connections. Notify ALS personnel as soon as possible so that other supportive measures may be initiated.

External Defibrillator Vest

This device is a vest with built-in monitoring electrodes and defibrillation pads, which is worn by the patient under his or her clothing. The vest is attached to a monitor that provides alerts and voice prompts when it recognizes a dangerous rhythm and before it delivers a shock. The device uses high-energy shocks similar to an automated external defibrillator (AED), so avoid contact with the patient if the device warns that it is about to deliver a shock.

Words of Wisdom

Special equipment such as an LVAD often includes a 1-800 number to call for information specific to patient care. Patients and family members typically carry identification cards with necessary phone numbers and may be able to share this information with you.

If the patient is in cardiac arrest, the vest should remain in place while you perform CPR unless it interferes with compressions. Any patient who is wearing a device that has already delivered a shock should be transported to an appropriate hospital for further evaluation. See Chapter 16, *Cardiovascular Emergencies*, for further information.

Central Venous Catheter

A central venous catheter, or central line—a catheter that has its tip placed in the vena cava to provide venous access—is used for many types of home care patients, including those receiving chemotherapy, long-term antibiotic therapy, pain management, total parenteral nutrition (TPN), and hemodialysis **Figure 36-10**. Central venous catheters are often located in the chest, upper arm, or subclavicular area.

Problems associated with central venous catheters include broken lines, infections around the lines, clotted lines, and bleeding around the line or from the tubing attached to the line. If bleeding occurs, apply direct pressure to the tubing and provide prompt transport to the hospital.

Gastrostomy Tubes

Gastrostomy tubes, sometimes referred to as gastric tubes or G-tubes, are placed into the stomach of patients who cannot ingest fluids, food, or medication by mouth **Figure 36-11**. These tubes may be inserted through the nose or mouth into the stomach (using a nasogastric or orogastric tube) or inserted surgically directly into the stomach through the abdominal wall. Gastric tubes may become dislodged during the patient's normal daily activities. If such a situation arises, immediately stop the flow of any fluids being infused through the tube, and assess the patient for signs or symptoms of bleeding into the stomach, such as vague abdominal discomfort, nausea, and vomiting (especially emesis with a "coffee-ground" appearance [older blood] or with bright red blood).

Figure 36-10 Patients who require frequent intravenous medications may have a central line in place.

Figure 36-11 Gastric tubes may be placed through the skin into the stomach for children or adults who cannot be fed by mouth.

© DELOCHE/age fotostock.

Patients who have a gastric tube in place may still be at increased risk of aspiration. Always have suction readily available to clear any materials from the patient's mouth. Stop the flow of any fluids if signs of aspiration are present. Patients with gastric tubes who have difficulty breathing should be transported while sitting or lying on the right side with the head elevated 30 degrees to prevent the contents of the stomach from passing into the lungs. Give supplemental oxygen if the patient has any difficulty breathing.

Patients with diabetes who receive insulin and gastric tube feedings may become hypoglycemic quickly if the gastric tube feedings are discontinued for any reason. Be alert for an altered mental status or a change in the baseline behavior of your patient. Unless the tube is dysfunctional, dislodged, or partially dislodged, continue the tube feeding and transport the pump with you.

Shunts

Some patients with chronic neurologic conditions may have shunts in place. For example, a patient with hydrocephalus will have a shunt. **Shunts** are tubes that drain excess CSF from the ventricles of the brain to keep pressure from building up in the brain.

During your assessment of a patient with a shunt, you will likely feel a device beneath the skin on the side of the head, behind the ear. The device is a fluid reservoir, and its presence should alert you to the possibility that the patient has an underlying shunt. There are different types of shunts, including a ventricular peritoneum shunt and a ventricular atrium shunt. A ventricular peritoneum shunt drains excess fluid from the ventricles of the brain into the peritoneum of the abdomen. A ventricular atrium shunt drains excess fluid from the ventricles of the brain into the right atrium of the heart. A shunt may become blocked or an infection may result in the surrounding tissue. Infections as a result of shunt placement may occur within the first 2 months after shunt insertion. A blocked shunt may present as a medical emergency. If the shunt is unable to drain properly, intracranial pressure may increase, affecting the patient's mental status, and respiratory arrest may occur.

The signs that a patient is in distress include a high-pitched cry or bulging fontanels (in infants), headache, projectile vomiting, altered mental status, irritability, fever, nausea, difficulty with coordination (walking), blurred vision, seizures, redness along the shunt track, bradycardia, and heart dysrhythmias. Emergency medical care includes airway management and artificial ventilation during transport.

Vagus Nerve Stimulators

According to the Epilepsy Foundation, approximately 150,000 patients are diagnosed with epilepsy each year in the United States. Vagus nerve stimulation is a form of treatment used for seizures that are not controlled with anti-epileptic medications or if the patient is not a good candidate for brain surgery. Vagus nerve stimulators stimulate the vagus nerve at predetermined intervals to prevent seizure activity. These devices are used in conjunction with medication to reduce the frequency of seizures. They are not meant to replace medications and are not currently used in children under 12 years. Further studies are being done regarding their effectiveness for seizure disorders. The device, which is about the size of a silver dollar, is surgically implanted under the patient's skin. The stimulator can last for up to 6 years or until the battery runs out. If you encounter a patient with this device, contact medical control or follow your local protocols.

Colostomies, Ileostomies, and Urostomies

A **colostomy** or **ileostomy** is a surgical procedure that creates an opening from the small or large intestine to the surface of the body that allows for elimination of waste products. The special opening is referred to as a stoma. Feces are expelled and collected into a clear external bag or pouch, which is emptied or changed frequently.

If you encounter a patient with a colostomy or ileostomy bag, assess for signs and symptoms of dehydration if the patient reports diarrhea or vomiting. The area around the stoma is prone to infection, so patients and caregivers must be diligent with daily hygiene. Signs of infection include redness, warm skin around the stoma, and tenderness with palpation over the colostomy or ileostomy site.

A **urostomy** is a surgical procedure which connects the urinary system to the surface of the skin, allowing urine to drain through a stoma in the abdominal wall instead of through the urethra. For example, a patient who has had his or her bladder removed due to cancer requires a urostomy.

Contact medical control or follow your local protocols for the care of a patient with a colostomy, ileostomy, or urostomy bag.

Patient Assessment Guidelines

Interaction with the parents or caregivers of a child or adult with special challenges will be an important part of the patient assessment process. The parents, caregivers, or home health care staff members have become experts on the illness or disability, and are trained to use and troubleshoot problems with medical equipment on a daily basis. Assess the patient's baseline vital signs, note any allergies (eg, to medications or latex), medications, and other pertinent medical history. You must first determine the patient's normal baseline status before an assessment of the current condition can be made. It is often helpful to ask, "What is different today?"

Home Care

Home care occurs within a patient's home environment. Patients requiring home services represent a spectrum of special health care populations, including infants and older adults, patients with chronic illnesses, and patients with developmental disabilities. These services are commonly needed among patients older than 65 years.

Services offered by home care agencies include, but are not limited to, meal delivery, house cleaning, laundry, yard maintenance, physical therapy, and personal care, including bathing and wound care. Oftentimes, EMS is called to a residence when a home care provider has found the patient injured or has recognized a change in the patient's health status. Home care personnel are an important resource for you when you are obtaining the patient's baseline health status and the history of the present illness or condition. Home care personnel are usually familiar with the patient's surroundings and can obtain any health care documentation or medications that need to be transported with the patient to the hospital.

Hospice Care and Terminally Ill Patients

Unfortunately, not all illnesses can be cured. As health care providers, you and your team may be called on to assist a patient who has a terminal illness. The patient may be receiving hospice care at a hospice facility or at home.

Patients receiving hospice care are terminally ill, commonly with diseases such as cancer, heart and lung failure, end-stage Alzheimer disease, or acquired immunodeficiency syndrome (AIDS). The patient's physician will have determined that the illness is terminal and in most cases has completed a do not resuscitate (DNR) order or given medical orders for the scope of treatment, outlining the care agreed upon by the patient and/or the family. Hospice care provides comfort care, or palliative care (pain medications), during a person's last days. Comfort care improves the patient's quality of life before death and allows the patient to be with family and friends. If you are called to a facility that provides hospice care or a home with a patient receiving hospice care, you will need to follow your local protocols, the patient's wishes, or legal documents such as a DNR order. All necessary documentation must be brought to the hospital if the patient is to be transported to the hospital and must be noted in the patient care report.

If you are called to the home of a terminally ill patient, the care you give will have a lasting impact on the family. This is a time when empathy and sensitivity are most needed. Some homes with patients receiving hospice care may be chaotic. Family members may be having a difficult time coping with the situation, and they may act angry and hostile. Treat everyone with compassion and understanding. Members of your team may be able to separate family members to speak with them privately to defuse intense emotions and restore order.

Some terminally ill patients who are at home may be receiving outpatient care from a hospice or a home health nurse. You may be called to the home because of a delay in the arrival of the regular care provider or for transport so that a physician can address an immediate need, such as increasing pain. Because terminally ill patients may use a complex variety of pain medications, transdermal patches, or self-administered pain management devices, you may need to consult medical control for guidance.

Even if a DNR order is in place, family members may not understand what to do and they may not be ready to face the death of a loved one. In such cases, obtain a thorough history and compassionately discuss the patient's wishes. Ask to review the DNR order, and contact medical control.

Ascertain the family's wishes about having the patient remain in the home or having the patient transported to the hospital. If a family member asks to accompany the patient, he or she should be allowed to do so. If the family wishes the patient to remain at home, this request should be honored provided it is in accordance with your local or state protocol.

Local protocols for handling the death of a patient vary, so be familiar with your local or state regulations. The protocols identify whether the coroner needs to be called to report the death and, if so, who is responsible for contacting the coroner. Also determine whether a pronouncement of death is required and, if so, who is responsible for the determination.

Poverty and Homelessness

According to a US Bureau of the Census report, in 2013, 14.5% of the US population lived in poverty. People who live in poverty are unable to provide for all of their basic needs such as housing, food, child care, health insurance, and medication. An impoverished person or family may have housing but may go without food or medication in order to pay for that housing. Disease prevention strategies such as dental care, good nutrition, and exercise are likely absent, which increases the probability of disease.

Homelessness occurs when people are unable to acquire and/or maintain affordable housing. According to the National Alliance to End Homelessness, about 600,000 people experience homelessness on any given night in the United States. The homeless population includes people with mental illness, prior brain trauma, victims of domestic violence, people with addiction disorders, and impoverished families. You may be called to care for a person who has experienced sexual or physical assault, mental health problems, overdose, respiratory or heat or cold-related illness, and wound or skin infections.

You are an advocate for all patients. Your job is to provide emergency medical care and transport patients to the appropriate facility. Remember that under the Emergency Medical Treatment and Active Labor Act (EMTALA), all health care facilities *must* provide a medical assessment and required treatment, regardless of the patient's ability to pay. You can also be an advocate by becoming familiar with the social services resources within your community so you can refer patients to these lifelines.

The evolution of Mobile Integrated Healthcare and community paramedicine (MIH-CP) will benefit many patient populations, including patients with special challenges. As EMS services around the country continue to implement these new positions, patients with low-acuity (nonemergency) conditions may be able to be assessed and treated on scene without transport. In addition, EMS roles may expand to include providing telephone advice to 9-1-1 callers, preventive care, chronic disease management, and postdischarge follow-up.

YOU are the Provider — PART 5

You call in your radio report to the ED. During your reassessment, you note that the patient is moving his head around and appears to be fighting your attempts to assist ventilations. You also note an acute change in his vital signs. His mother, who is riding in the back of the ambulance with you, asks you if you know what to do.

Recording Time: 25 Minutes	
Level of consciousness	Conscious; moving his head around; mother advises that he is agitated
Respirations	12 breaths/min; provided by BVM
Pulse	130 beats/min; strong and regular
Skin	Pink, hot, and moist
Blood pressure	134/74 mm Hg
Spo_2	87% (on oxygen)

8. What has most likely happened to your patient? What should you do next?

YOU are the Provider — SUMMARY

1. How will your assessment and treatment of this patient differ from a patient who is not dependent on a ventilator?

The principles of patient assessment and treatment are the same, regardless of the patient's special health care needs and any medical equipment that he or she requires to function or live. As with any patient you encounter, your goal is to maintain the ABCs and safely transport the patient to an appropriate medical facility.

2. What role do the parents or caregivers of patients with special health care needs have in the prehospital setting?

When you care for a patient with special health care needs, it is imperative to listen to the people who take care of the patient. The parents or caregivers provide for the medical needs of the patient *every day*; therefore they are aware of the patient's medical and/or surgical history, his or her baseline mental status, and the names and doses of any medications the patient may be taking.

Parents or caregivers of this patient population are also trained and experienced in the use of any special equipment the patient requires. In many cases, the parent or caregiver will have performed certain interventions prior to calling 9-1-1. It is important to determine what interventions were performed, why they were performed, and what effect they had on the patient's condition.

3. What are some conditions that would cause a patient to become dependent on a mechanical ventilator?

When a person has any acute or chronic condition that impairs his or her respiratory muscles or injures the respiratory centers in the brain, he or she will require the use of a mechanical ventilator.

Your patient has quadriplegia secondary to a spinal injury. If the spinal cord is injured above the level of the fourth cervical vertebra (C4), paralysis of the respiratory muscles will also occur. Without a mechanical ventilator, your patient is unable to breathe at all.

Other conditions that often require mechanical ventilation include traumatic brain injury, muscular dystrophy, cystic fibrosis, and spina bifida. Regardless of why a patient requires mechanical ventilation, the most important thing for you to remember is that without it, he or she is unable to breathe!

4. How does a tracheotomy tube affect a patient's ability to communicate? How can you determine if your patient is alert?

Most patients with tracheostomy tubes are unable to speak. This is especially true if the patient requires mechanical ventilation, because he or she will be unable to breathe if the ventilator is detached from the tracheostomy tube. Tracheostomy patients who are not dependent on ventilators may be able to speak—although not as clearly—if they occlude the opening of the tube.

If patients cannot speak, they may communicate in other ways, such as by nodding the head or blinking the eyes. The parent or caregiver should be able to tell you whether the patient is communicating as he or she typically does and whether he or she is responding to questions appropriately. If the patient responds to questions appropriately, it can be said that he or she is alert.

5. **What are some potential complications that may result from your patient's condition? What can you do to prevent them or minimize the risks?**

Patients with quadriplegia who are dependent on a ventilator are typically confined to a bed for prolonged periods. Prolonged immobilization can cause potentially serious complications, including pressure sores and pulmonary embolism.

Patients who are paralyzed are particularly susceptible to urinary tract infections and pneumonia. Urinary tract infections are typically related to indwelling urinary catheters (Foley catheters). Pneumonia often occurs because of decreased or absent cough reflexes and prolonged immobilization, which increases the risk of pulmonary secretions settling in the lungs and becoming infected.

In patients with indwelling urinary catheters, always maintain the catheter collection bag below the level of the bladder; this position will prevent urine from flowing back into the bladder and therefore minimizes the risk of infection.

Thick mucous plugs can develope in the tubes of patients with tracheostomy tubes, such as your patient, which can impair oxygenation and ventilation. Ask the parent or caregiver when the tube was last suctioned and observe for signs that indicate it may need to be suctioned (eg, restlessness, signs of hypoxemia). Many mechanical ventilators will sound an alarm if there is any obstruction in the ventilator circuit, such as a mucous plug in the tracheostomy tube.

After you have transferred the patient to the ambulance stretcher, ensure that there are no wrinkles or lumps in the sheet or blanket under the patient. This simple step can help prevent pressure sores.

6. **What do you suspect is the patient's underlying problem? What specific treatment should you provide to him?**

The presence of fever suggests infection. In this patient, the infection could have several causes. Furthermore, it may be the result of more than one underlying problem.

Fever is often the only presenting sign of pneumonia in paralyzed patients. This is especially true in patients with quadriplegia because their respiratory muscles are also paralyzed; therefore, outward signs of respiratory distress, such as retractions, are not present. Another possibility is a urinary tract infection.

Infection requires antibiotic therapy, which can be administered only in a hospital setting. Treatment of a patient with a possible infection is mainly supportive: monitor the patient's ABCs, observe standard precautions (eg, gloves, mask if necessary), and transport the patient to the hospital.

7. **What is the benefit of allowing the patient's mother to accompany her son to the hospital?**

The patient's mother should be allowed to accompany her son in the ambulance if she wishes. She can continue to be a source of information en route to the hospital, and could alert you to any changes in the patient's status, which may be obvious only to her.

The patient's mother can also bring supplies that the patient needs which you may or may not carry on your ambulance.

You must also consider the emotional needs of the patient. Unnecessarily separating a patient with special health care needs from his or her primary caregiver can be a source of emotional distress for the patient and the caregiver.

If she prefers to follow the ambulance in her own vehicle, assure her that you will take good care of her son.

8. **What has most likely happened to your patient? What should you do next?**

Your patient's clinical condition has changed. He appears to be fighting the ventilator, which is a sign of agitation. Furthermore, his heart rate has increased and his oxygen saturation level has decreased. You should suspect that he is not receiving adequate ventilation.

Tracheostomy tube obstruction is an emergency that requires immediate intervention; suction the tube and reassess the patient for signs of adequate oxygenation and ventilation.

The DOPE mnemonic can be used to troubleshoot acute deterioration in a patient with a tracheostomy tube. It is critical for you to recognize which problems you can correct and which problems require ALS. For example, if the tracheostomy tube has become dislodged, it must be replaced by a paramedic or physician; EMTs are typically not trained or permitted to perform this procedure. If the patient has a pneumothorax, the patient may require a needle chest decompression, which EMTs are not trained to perform. Follow your local protocols and request an ALS ambulance if necessary and available.

EMS Patient Care Report (PCR)

Date: 1-20-16	**Incident No.:** 013410	**Nature of Call:** Fever		**Location:** 575 Ranger Drive	
Dispatched: 1435	**En Route:** 1435	**At Scene:** 1440	**Transport:** 1501	**At Hospital:** 1515	**In Service:** 1523

Patient Information

Age: 19 **Sex:** M **Weight (in kg [lb]):** 52 kg (115 lb)	**Allergies:** Aspirin **Medications:** Acetaminophen (as needed) **Past Medical History:** Quadriplegia from spinal cord injury 2 years ago; ventilator-dependent **Chief Complaint:** Fever

Vital Signs

Time: 1445	**BP:** 118/62	**Pulse:** 110	**Respirations:** 14	**Spo_2:** 99%
Time: 1500	**BP:** 120/60	**Pulse:** 118	**Respirations:** 12	**Spo_2:** 98%
Time: 1510	**BP:** 134/74	**Pulse:** 130	**Respirations:** 12	**Spo_2:** 87%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Emotional support, tracheostomy tube suctioning

Narrative

Medic 53 dispatched to a residence for a 19-year-old man with a fever. On arrival, found the patient lying supine in a hospital-style bed in the living room of his home. The patient has quadriplegia and is ventilator-dependent secondary to a spinal injury he experienced 2 years ago. On presentation, the patient's eyes were open and he acknowledged EMS presence by nodding his head. According to his mother, who is his primary caregiver, his present mental status is consistent with his baseline. The patient has a tracheostomy tube and is receiving mechanical ventilation at 14 breaths/min. According to the patient's mother, he began running a fever earlier in the day, and the last reading was 101.2°F (38.4°C). She administered 500 mg of acetaminophen via his gastrostomy tube about an hour before EMS arrival. The patient's physician, who was contacted by the home health agency who assists the patient's mother in his care, requested transport via ambulance to the ED. Secondary assessment revealed no gross abnormalities. Breath sounds were auscultated and found to be clear and equal bilaterally. Patient also has an indwelling urinary catheter and a colostomy bag. Assessment of these devices revealed no bleeding, redness around the area of the devices, or any other abnormalities. After consulting with medical control, carefully moved the patient to the ambulance stretcher, disconnected him from the mechanical ventilator circuit, and resumed ventilations with a BVM at 12 breaths/min. Moved patient to ambulance, continued BVM ventilations, and reassessed his vital signs. Patient's mother accompanied her son in the back of the ambulance. Began transport to the hospital and continued to monitor the patient en route. Shortly after calling radio report to receiving facility, noted that patient became acutely agitated; his heart rate markedly increased and his oxygen saturation decreased. Suspected obstruction of the tracheostomy tube; provided suctioning one time and reassessed patient. He was now calm and his heart rate and oxygen saturation stabilized. Remainder of transport was uneventful. Delivered patient to ED and gave verbal report to attending physician. Medic 53 cleared the hospital and returned to service at 1523.**End of report**

Prep Kit

Ready for Review

- Medicine and medical technology continue to improve, and the number of children and adults with chronic diseases or injuries who are living at home or in environments outside of the hospital setting continues to grow.
- You may find children and adults who are living at home dependent on mechanical ventilators, intravenous pumps, or other medical devices to maintain their lives.
- Assess and care for patients with special challenges in the same manner as all other patients.
- Intellectual disability is caused by insufficient development of the brain, resulting in the inability to learn and socially adapt at a normal developmental rate.
- People with Down syndrome often have large tongues and small oral and nasal cavities, so intubation of these patients may be difficult.
- Visual impairments may be difficult to recognize. During your scene size-up, look for signs that indicate the patient is visually impaired, such as the presence of eyeglasses, a cane, or a service animal. Immediately introduce yourself when you enter the room, and have your team members introduce themselves so that the patient can identify their locations and voices.
- Hearing impairment may range from a slight hearing loss to total deafness. Clues that a person could be hard of hearing include the presence of hearing aids, poor pronunciation of words, or failure to respond to your presence or questions.
- Cerebral palsy is associated with other conditions such as visual and hearing impairments, difficulty communicating, epilepsy, and intellectual disability. Patients may also have an unsteady gait (ataxia) and may require the assistance of a wheelchair or walker.
- Patients with spina bifida will have either partial or full paralysis of the lower extremities, loss of bowel and bladder control, and an extreme allergy to latex products.
- Patients with obesity may be embarrassed by their condition or fearful of scorn as a result of past experiences. If transport is necessary, plan early for extra help and do not be afraid to call for more providers or special equipment if necessary. In particular, send a member of your team to find the easiest and safest exit.
- Patients who depend on home automatic ventilators or those who have chronic pulmonary medical conditions may breathe through a tracheostomy tube.
- Patients who are on a mechanical ventilator at home cannot breathe without assistance. If the ventilator malfunctions, remove the patient from the mechanical ventilator and begin ventilations with a bag-valve mask (BVM).
- An apnea monitor is typically used when there is a family history of sudden infant death syndrome or when an infant is born prematurely, has severe gastroesophageal reflux that causes episodes of choking, or has experienced an apparent life-threatening event. The apnea monitor is designed to sound an alarm if the infant experiences bradycardia or if apnea occurs.
- An internal cardiac pacemaker is a device implanted under the patient’s skin to regulate the heart rate.
- A left ventricular assist device (LVAD) is a special piece of medical equipment that takes over the function of one or both heart ventricles. These types of devices are used as a bridge to transplantation while a donor heart is being located or as a permanent solution for patients who do not qualify for a transplant.
- Gastrostomy tubes are placed into the stomach for feeding in patients who cannot ingest fluids, food, or medication by mouth. These tubes may be inserted through the nose or mouth or placed through the abdominal wall surgically.
- External defibrillation vests are worn under a patient’s clothing. They monitor the patient’s cardiac rhythm and provide an audible warning before administering a shock to correct the dysrhythmia.
- Shunts are tubes that extend from the ventricles in the brain to the abdomen to drain excess cerebrospinal fluid (CSF) that may accumulate near the brain.
- A colostomy or ileostomy is a surgical procedure that creates an opening from the small or large intestine to the surface of the body to allow for elimination of waste products. Feces are expelled and collected into a clear external bag or pouch, which is emptied or changed frequently. Similarly, a urostomy drains urine.
- You and your team may be called on to assist a patient who is terminally ill. Terminally ill patients may be in a hospice facility or at home.
- Under the Emergency Medical Treatment and Active Labor Act (EMTALA), all health care facilities *must* provide a medical assessment and required treatment, regardless of the patient’s ability to pay.

Vital Vocabulary

autism spectrum disorder (ASD) A group of complex disorders of brain development, characterized by difficulties in social interaction, repetitive behaviors, and verbal and nonverbal communication.

cerebral palsy A group of disorders characterized by poorly controlled body movement.

colostomy A surgical procedure to create an opening (stoma) between the colon and the surface of the body.

conductive hearing loss Hearing loss caused by a faulty transmission of sound waves.

developmental disability Insufficient development of the brain, resulting in some level of dysfunction or impairment.

Down syndrome A genetic chromosomal defect that can occur during fetal development and that results in intellectual impairment as well as certain physical characteristics, such as a round head with a flat occiput and slanted, wide-set eyes.

ileostomy A surgical procedure to create an opening (stoma) between the small intestine and the surface of the body.

obesity A complex condition in which a person has an excessive amount of body fat.

sensorineural deafness A permanent lack of hearing caused by a lesion or damage of the inner ear.

shunts Tubes that drain excess cerebrospinal fluid (CSF) from the brain to another part of the body outside of the brain, such as the abdomen; lowers pressure in the brain.

spina bifida A development defect in which a portion of the spinal cord or meninges may protrude outside of the vertebrae and possibly even outside of the body, usually at the lower third of the spine in the lumbar area.

stoma An opening through the skin and into an organ or other structure.

tracheostomy A surgical procedure to create an opening (stoma) into the trachea; a stoma in the neck connects the trachea directly to the skin.

tracheostomy tube A plastic tube placed within the tracheostomy site (stoma).

urostomy A surgical procedure to create an opening (stoma) which connects the urinary system to the surface of the skin and allows urine to drain through the abdominal wall.

Assessment *in Action*

You and your partner are traveling to headquarters for your monthly in-service training session when you are dispatched to the home of an 18-year-old woman with a high fever. The dispatcher tells you the patient has autism.

1. Upon arrival at the home, what is the first question you should ask the parent or caregiver?

   A. "Could you please leave the room?"
   B. "Can you give me a detailed history of the patient's autism?"
   C. "What can you tell me about the patient's normal functional level? What makes her feel secure?"
   D. "Can you please head to the hospital?"

2. Which of the following techniques should you use when you are communicating with a patient who has autism?

   A. Exaggerate your lip movements.
   B. Speak normally and provide simple, one-step directions.
   C. Speak loudly into the patient's ear.
   D. You and your partner should talk to the patient together.

3. The patient is cautious around new people. How should you proceed with your assessment?

   A. Start at the head.
   B. Start distal to proximal.
   C. Do not perform a patient assessment in this case.
   D. Take the patient's blood pressure first.

4. When asking the patient questions, you should:

   A. ask her open-ended questions.
   B. ask her multiple questions in a row.
   C. ask her simple, direct questions.
   D. direct all questions to the parent or caregiver.

5. If you are having difficulty gaining the patient's trust, you should:

A. look around for a favorite toy or object and ask the patient about it.
B. let the parent or caregiver talk on behalf of the patient.
C. transport the patient without intervention.
D. obtain a signed refusal from the patient.

6. While you are attempting to take the patient's blood pressure, another call comes across your radio. The patient covers her ears and starts to cry. What does this indicate?

A. Tactile sensitivity
B. Auditory sensitivity
C. Poor patient management
D. Abuse

7. If transport is required in this case, you should:

A. move quickly.
B. use restraints to secure the patient to the stretcher.
C. take the patient by the arm to lead her to the ambulance.
D. use gestures the patient can understand and explain what is happening.

8. The patient starts to perform a self-stimulating activity. You should:

A. allow the patient to continue as long as she does not hurt herself.
B. speak loudly and tell her to stop.
C. restrain her.
D. turn on a radio to distract her.

9. Explain what the "reverse stethoscope" technique is and when it is used.

10. Why might airway management be difficult in a patient with Down syndrome?


SOUTHWES
EMT

SECTION
9

EMS Operations

CHAPTER 37

Transport Operations

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National EMS Education Standard Competencies

EMS Operations

Knowledge of operational roles and responsibilities to ensure patient, public, and personnel safety.

Principles of Safely Operating a Ground Ambulance

› Risks and responsibilities of emergency response (pp 1363–1376)
› Risks and responsibilities of transport (pp 1366–1376)

Air Medical

› Safe air medical operations (pp 1376–1381)
› Criteria for utilizing air medical response (pp 1376–1377)

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

Infectious Diseases

Awareness of
› How to decontaminate equipment after treating a patient (pp 1367–1368)
› How to decontaminate the ambulance and equipment after treating a patient (pp 1367–1368)

Knowledge Objectives

1. List the nine phases of an ambulance call; include examples of key tasks EMTs perform during each phase. (pp 1353–1368)
2. Name the medical equipment carried on an ambulance; include examples of supplies that are included in each main

category of the ambulance equipment checklist. (pp 1354–1360)
3. Name the safety and operations equipment carried on an ambulance; include examples of how each item might be used by EMTs in an emergency. (pp 1360–1361)
4. Discuss the importance of performing regular vehicle inspections; include the specific parts of an ambulance that should be inspected daily. (pp 1361–1362)
5. List the minimum dispatch information required by EMS to respond to an emergency call. (p 1363)
6. Describe some high-risk situations and hazards during both pretransport and transport that may affect the safety of the ambulance and its passengers. (pp 1363–1366, 1368–1376)
7. Discuss the specific considerations required to ensure scene safety; include personal safety, patient safety, and traffic control. (pp 1363–1366)
8. Describe the key elements that must be included in the written patient report upon patient delivery to the hospital. (pp 1366–1367)
9. Summarize the tasks EMTs must complete in the postrun phase. (pp 1367–1368)
10. Define the terms cleaning, disinfection, high-level disinfection, and sterilization. (p 1367)
11. Discuss the guidelines for safely and defensively driving an ambulance. (pp 1368–1370)
12. Identify key steps EMTs should take to improve safety while en route to the scene, the hospital, and the station. (pp 1368–1376)
13. List the three factors that dictate the use of lights and siren to the scene and to the hospital; include the risk-versus-benefit factors regarding their use. (pp 1370–1371)
14. Describe the specific, limited privileges that are provided to emergency vehicle operators by most state laws and regulations. (pp 1374–1376)
15. Explain the additional risks and special considerations posed by the use of police escorts, and the hazards and special considerations posed by crossing intersections. (pp 1375–1376)
16. Describe the capabilities, protocols, and methods for accessing air ambulances. (pp 1376–1380)
17. Describe key scene safety considerations when preparing for a helicopter medivac, including establishing a landing zone, securing loose objects, reducing onsite hazards, and approaching the aircraft. (pp 1378–1381)

Skills Objectives

1. Demonstrate how to perform a daily inspection of an ambulance. (pp 1361–1362)
2. Demonstrate how to present a verbal report that would be given to receiving personnel at the hospital upon patient transfer. (pp 1366–1367)
3. Demonstrate how to write a written report that includes all pertinent patient information following patient transfer to the hospital. (pp 1366–1367)
4. Demonstrate how to clean and disinfect the ambulance and equipment during the postrun phase. (pp 1367–1368)

Introduction

During the late 1700s, Napoleon Bonaparte commissioned one of the more advanced professional emergency medical patient care systems in the world. At that time, horse-drawn ambulances already were in use in major cities throughout the United States **Figure 37-1**. American hospitals initiated their own professional ambulance services during the late 1860s. Ambulance attendants traveled with limited medical supplies, including brandy, a few tourniquets, several assorted bandages and sponges, basic splinting material, and blankets.

Today's ambulances are stocked with standard medical supplies. Many are equipped with state-of-the-art technology, including defibrillators and monitors that can transmit information directly to the emergency department (ED), blood and oxygen testing equipment, automatic ventilators, automated cardiopulmonary resuscitation (CPR) machines, global positioning systems (GPS), and computer-aided dispatch consoles. Even when following all safety guidelines, the emphasis on rapid response places the EMT in great danger while responding to calls. Although technology can greatly aid in directing the route and mode of response of the ambulance, it is also distracting and, therefore, potentially places the crew at higher risk for crashes. It is very important that the EMT in the passenger's seat operate the mobile data terminal (MDT) and GPS device and does the actual communicating via radio or cell phone, so the driver is freed up to focus solely on the road, particularly when responding on a call. Anything that takes the driver's attention away from the road for even a second greatly increases the risk of a crash.

Figure 37-1 Horse-drawn ambulances were used in major cities throughout the United States during the 1800s.

Safety Tips

We know texting and driving can lead to serious injuries and/or death, but no one thinks about the use of "necessary" distractions in the ambulance. Talking on the radio, looking at the map on an MDT, or any other action that takes your attention away from driving can also be dangerous.

This chapter discusses ambulance design and how to equip and maintain an ambulance. It focuses on the techniques and judgment that you will need to drive an ambulance or ambulance service vehicle, which include parking considerations, emergency vehicle control and operation, the effects of weather on driving, and common hazards that are encountered while driving an ambulance. Finally, the chapter describes how to work safely with air ambulances.

YOU are the Provider — PART 1

At 1730 hours, you are dispatched to 1245 Chance Place for a "fall." It is a bright sunny spring weekday and the traffic is heavy. You have completed an emergency vehicle operator course and have been cleared by your supervisor to drive the ambulance in emergency mode. You and your partner respond to the scene, which is located a short distance away.

1. What attributes should an emergency vehicle operator possess?
2. What factors should you consider before responding to the scene?

Emergency Vehicle Design

An **ambulance** is a vehicle that is used for treating and transporting patients who need emergency medical care to a hospital. The first use of motor-powered ambulances occurred in the late 1800s. For many decades after that, a hearse was the vehicle that was most often used as an ambulance because it was the only vehicle with enough room for a person to lie down. Few supplies were carried on board, and there was little space for attendants.

The hearse-ambulance has gone the way of its horse-drawn predecessor. Ambulance designs today are based on the *NFPA 1917 Standard for Automotive Ambulances* and, in large part, on suggestions from the ambulance industry and from EMS personnel **Figure 37-2**. One of the most significant developments in ambulance design has been the enlargement of the patient compartment. Another development is the use of **first-responder vehicles** **Figure 37-3**, which respond initially to the scene with personnel and equipment to treat the sick and injured until an ambulance can arrive.

The modern ambulance is a vehicle for emergency medical care that has the following features:

- A driver's compartment
- A patient compartment that can accommodate two EMTs and usually two supine patients (one on the stretcher, one on a bench or area designed with swivel seats to accommodate a backboard) positioned so at least one of the patients can receive CPR during transport
- Equipment and supplies to provide emergency medical care at the scene and during transport, to safeguard personnel and patients from hazardous conditions, and to carry out light extrication procedures

Figure 37-2 Ambulances are crash tested by manufacturers while being designed.

Courtesy of AEV. Used with permission.

- Two-way radio communication so ambulance personnel can speak with the dispatcher, the hospital, public safety authorities, and online medical control
- Design and construction that ensure maximum safety and comfort

Each state establishes its own standards for licensing or certifying ambulance operators. Many agencies now use the federal specifications (NFPA 1917) that cover the following three types of basic ambulance designs **Figure 37-4** **Table 37-1**.

Figure 37-3 First responders, such as firefighters **(A)** and law enforcement personnel **(B)**, are often the first to arrive at a scene.

Figure 37-4 **A.** The conventional, truck cab-chassis has a modular ambulance body that can be transferred to a newer chassis (type I). **B.** The standard van ambulance has a forward-control integral cab body (type II). **C.** The specialty van ambulance has a cab that is mounted on a cut-away van chassis (type III).

A: © Jones & Bartlett Learning. Courtesy of MIEMSS; B: Courtesy of Captain David Jackson, Saginaw Township Fire Department; C: © Kevin Norris/ShutterStock.

The six-pointed **Star of Life** emblem **Figure 37-5** identifies vehicles as ambulances. It is often affixed to the sides, rear, and roof of the ambulance. Local or state regulatory authorities determine what emblems may be displayed on the side of a prehospital care ambulance. **Figure 37-6** illustrates some of the required features of a licensed or certified ambulance.

Phases of an Ambulance Call

An ambulance call has nine phases: preparation, dispatch, en route, arrival at scene, transfer of patient to ambulance, en route to receiving facility (transport), at receiving facility (delivery), en route to station, and postrun, as shown in **Table 37-2**. These nine phases address the vehicle and its crew and their roles when responding to a medical emergency. The details of patient care are not included in these nine phases.

The Preparation Phase

Making sure equipment and supplies are in their proper places and ready for use is an important part of preparing for the call. If items are missing or do not work, they are of no use to you or the patient. It is very important that you are trained to use equipment before using it. New equipment should be placed on an ambulance only after proper instruction is given on its use and care, and, additionally, after approval by the medical director.

Table 37-1 Basic Ambulance Designs

Type I	Conventional, truck cab-chassis with a modular ambulance body that can be transferred to a newer chassis as needed
Type II	Standard van, forward-control integral cab-body ambulance
Type III	Specialty van cab with a modular ambulance body that is mounted on a cut-away van chassis

Figure 37-5 The Star of Life.

Courtesy of National Highway Traffic Safety Administration.

Figure 37-6 Warning lights and public address systems are necessary on licensed or certified ambulances.

Table 37-2 Phases of an Ambulance Call

1. Preparation for the call
2. Dispatch
3. En route
4. Arrival at scene
5. Transfer of the patient to the ambulance
6. En route to the receiving facility (transport)
7. At the receiving facility (delivery)
8. En route to the station
9. Postrun

Equipment and supplies should be durable and, to the extent possible, standardized. This makes it easy to quickly exchange equipment with other ambulances or with the ED, thus saving time during patient transfer.

Figure 37-7 Store equipment and supplies in the ambulance according to how urgently and how often they are used.

Store equipment and supplies in the ambulance according to how urgently and how often they are used **Figure 37-7**. Give priority to items that are needed to care for life-threatening conditions. These include equipment for airway management, artificial ventilation, and oxygen delivery. Place these items within easy reach, at the head of the primary stretcher. Place items for cardiac care, control of external bleeding, and monitoring blood pressure at the side of the stretcher. Make sure batteries are fresh and equipment is functioning properly. The most common cause of AED malfunction is a dead battery.

Storage cabinets and kits should open easily. They should also close securely so they do not fly open while the ambulance is in motion. The fronts of cabinets and drawers should be transparent so you can quickly identify the contents inside; if they are not, be sure to label each container **Figure 37-8**.

Medical Equipment

As an EMT, you have access to a large variety of medical equipment and supplies, far more than can be described here. Certain items on the ambulance must be available at all times, as dictated by state and jurisdictional requirements.

Figure 37-8 Containers should be placed in cabinets and drawers with transparent fronts for quick identification.

Basic Supplies. Table 37-3 lists the common supplies carried on ambulances. These include basic items such as disposable gloves and sharps, airway and ventilation equipment, basic wound care supplies, splinting supplies, childbirth supplies, an automated external defibrillator, patient transfer equipment, medications, communication equipment, and other regionally appropriate supplies.

Airway and Ventilation Equipment. Airway management equipment that should be carried on ambulances includes the following:

- Oropharyngeal airways for adults, children, and infants
- Nasopharyngeal airways for adults and children
- Equipment for advanced airway procedures if your service is authorized by state regulation and the medical director to perform these

It is important that two portable artificial ventilation devices that operate independently of an oxygen supply are carried on the ambulance: one for use in the ambulance and one for use outside the ambulance or as a spare. These devices include disposable pocket masks and bag-valve masks (BVMs). In addition, BVMs capable of oxygen enrichment and, when attached to an oxygen supply with the oxygen reservoir in place, able to supply almost 100% oxygen should also be carried on the ambulance. Masks for these devices come in a variety of sizes, from neonatal to adult, and are necessary materials to carry on the ambulance. Oxygen-powered devices are also available to provide ventilation to a patient but may quickly deplete available oxygen sources. You should follow local guidelines to identify the specific ventilation equipment carried on the ambulance.

The ambulance should carry portable and mounted suctioning units Figure 37-9. These units must be powerful enough to generate a vacuum of 300 mm Hg when the tube is clamped. The suctioning force must be adjustable for use on infants and children. The units should include large-bore, nonkinking suction tubing with semirigid tips available. The installed unit should include a suction yoke, an unbreakable collection canister, suction catheters, water for rinsing the suction tips, and suction tubing, all easily accessible when you are sitting at the head of the stretcher. The tubing must reach the patient's airway, regardless of the patient's position. All components of the suctioning unit must be disposable or made of material that is easily cleaned and **decontaminated**.

YOU are the Provider — PART 2

Upon arrival you are led to the backyard where a 62-year-old man is lying beside an overturned stepladder, holding his left arm. He tells you he fell from the third step from the bottom and caught himself on his left hand. He has obvious deformity to his left forearm.

Recording Time: 0 Minutes	
Appearance	Appears healthy; holding left arm; grimacing in pain
Level of consciousness	Alert and oriented
Airway	Open; clear of secretions or foreign bodies
Breathing	Normal rate; adequate depth
Circulation	Increased pulse rate, but strong and regular; skin is pink, warm, and dry

3. Based on the mechanism of injury and patient presentation, what equipment do you anticipate needing?

Table 37-3 Ambulance Equipment Checklist

Basic Supplies

Pillows and pillowcases
Sterile sheets
Blankets
Towels
Disposable emesis bags or basins
Boxes of disposable tissue
Bedpan (optional)
Urinals (one each for men and women; optional)
Blood pressure cuffs (pediatric, adult, large adult)
Stethoscope
Disposable drinking cups
Unbreakable container of water
Wet wipes
Chemical cold/hot packs
Sterile irrigation fluid
Restraining devices
Plastic bags for waste or severed parts
Hypoallergenic nitrile, vinyl, or other disposable hypoallergenic gloves (various sizes)
Sharps container
Set of hearing protectors

Airway and Ventilation Equipment

Infection control kits (goggles, masks, waterproof gowns)
Oropharyngeal airways and nasopharyngeal airways of various sizes
Advanced airway supplies, if local protocol permits (laryngeal mask airway, Combitube, King airways), with secondary placement confirmation devices
BVMs (adult, child, and infant)
Mounted suction unit and a portable suction unit
Assorted oxygen delivery devices (adult and pediatric)
Oxygen supply units (both portable and installed)
Disposable humidifier (for mounted oxygen system)

Basic Wound Care Supplies

Trauma shears
Sterile sheets
Sterile burn sheets
Adhesive tape in several widths
Self-adhering, soft roller bandages, 4 in. × 5 yd
Self-adhering, soft roller bandages, 2 in. × 5 yd
Sterile dressings, gauze, 4 in. × 4 in.
Sterile dressings, abdominal or laparotomy pads, usually 6 in. × 9 in. or 8 in. × 10 in.
Sterile universal trauma dressings, usually 10 in. × 36 in., folded into 9 in. × 10 in. packages
Sterile, occlusive, nonadherent dressings (aluminum foil sterilized in original package)
Occlusive dressings, or chest seals
Assortment of adhesive bandages
Tourniquets

Splinting Supplies

Adult-size traction splint
Child-size traction splint
A variety of arm and leg splints, such as inflatable, vacuum, cardboard, plastic, foam-covered wire-ladder or aluminum alloy, or padded board (the number and type of splints should be determined by state regulations and your medical director)
A variety of triangular bandages and roller bandages
Short backboard/short immobilization device
Long backboard
Cervical collars in an adjustable size or a variety of sizes
Head immobilization devices

Childbirth Supplies

Emergency obstetric kit, including:

- Surgical scissors
- Hemostats or special cord clamps
- Umbilical tape or sterilized cord
- Small rubber bulb syringe
- Towels
- Gauze sponges
- Sterile gloves
- Sanitary napkins
- Plastic bag
- Baby blanket
- Baby stocking cap

Automated External Defibrillator

Semiautomated defibrillation equipment

Patient Transfer Equipment

Wheeled ambulance stretcher
Wheeled stair chair
Other devices also carried on ambulances include:
Scoop stretcher
Portable/folding stretcher
Flexible stretcher
Transfer tarp or slide board
Basket stretcher

Medications and Other Supplies

Activated charcoal
Drinkable water and cups
Oral glucose
Oxygen
Supplies for irrigating the skin and eyes
Aspirin and epinephrine (in some areas)
DuoDote or other regional equipment, depending on the area and local protocol
Portable radio or cell phone

Figure 37-9 The ambulance should carry both a mounted suctioning unit **(A)** and a portable unit **(B)**.

The ambulance should carry at least two oxygen supply units: one portable and one installed on board. The portable unit should be located near a door or in the jump kit, for easy use outside the ambulance. It should have a minimum capacity of 500 L of oxygen and be equipped with a yoke, pressure gauge, flow-meter, oxygen supply tubing, nonrebreathing mask, and nasal cannula. This unit must be able to deliver oxygen at a variable rate between 1 and 15 L/min. At least one extra portable 500-L cylinder should be kept on the ambulance. Many services equip the backup cylinder with its own yoke, gauge, regulator, and tubing so it can be used for a second patient.

The mounted oxygen unit should have a capacity of 3,000 L of oxygen **Figure 37-10**. It should also be equipped with visible flowmeters that are capable of delivering 1 to 15 L/min that are accessible when you are at the head of the stretcher. Oxygen masks, with and without nonrebreathing bags, should be transparent, disposable, and in sizes for adults, children, and infants.

Ambulance services that often transport patients on runs lasting longer than 1 hour should consider using a disposable, single-use humidifier for the mounted oxygen system. On runs of less than 1 hour, humidification is not usually necessary. Humidification may increase a patient's risk of infection unless the equipment is disposable and used on a single patient.

Word of Wisdom

Regardless of their location, portable oxygen tanks must always be secured by fixed clasps or housings to prevent accidental damage and to prevent the cylinder from becoming a projectile.

Figure 37-10 An oxygen unit with a capacity of 3,000 L of oxygen should be mounted on the ambulance.

CPR Equipment. A CPR board provides a firm surface under the patient's torso so you can give effective chest compressions **Figure 37-11A**. It also assists in establishing an appropriate degree of head tilt **Figure 37-11B**. Only a few ambulances across the country carry this item. Use a tightly rolled sheet or towel to raise the patient's shoulders 3 to 4 inches; this will also keep the patient’s head in a position of maximum backward tilt and keep the shoulders and chest in a straight position. *Caution:* Do not use this roll to hyperextend the neck if you suspect a spinal injury.

Figure 37-11 **A.** A CPR board may be carried on the ambulance. **B.** A patient on a CPR board has the appropriate degree of head tilt for effective artificial ventilation.

Mechanical devices that operate on compressed gas and deliver chest compressions and ventilations are also available.

Basic Wound Care Supplies. Basic supplies for dressing open wounds should be carried on the ambulance. These include a pair of trauma shears; sterile sheets; sterile burn sheets; adhesive tape in several widths; self-adhering, soft roller bandages; sterile dressings; gauze; abdominal or laparotomy pads; sterile universal trauma dressings; sterile, occlusive, nonadherent dressings (aluminum foil sterilized in original package); an assortment of adhesive bandages; and tourniquets.

Figure 37-12 Supplies for splinting fractures and dislocations should be carried on the ambulance.

Figure 37-13 A sterile emergency obstetric kit must be carried on the ambulance.

© Mark C. Ide.

Splinting Supplies. Examples of supplies for splinting fractures and dislocations that may be carried on ambulances are shown in **Figure 37-12**. These include an adult-size and a child-size traction splint; a variety of arm and leg splints, such as inflatable, vacuum, cardboard, plastic, foam wire-ladder, or padded board; a variety of triangular bandages and roller bandages; a short backboard; a long backboard; head immobilization devices; and cervical collars in an adjustable size or a variety of sizes.

Childbirth Supplies. You must carry at least one sterile emergency obstetric kit **Figure 37-13** that includes the supplies listed in Table 37-3, including a pair of surgical scissors, hemostats or special cord clamps, umbilical tape or sterilized cord, a small rubber bulb syringe, towels, gauze sponges, pairs of sterile gloves, plastic wrap, sanitary napkins, a plastic bag, a baby stocking cap, and a baby blanket.

Automated External Defibrillator. Modern-day EMS was ushered in by the first-ever prehospital use of the defibrillator by a St. Vincent's Hospital ambulance in New York City under the direction of Dr. William Grace in the early 1970s. Now a prehospital standard of care, semiautomated defibrillation equipment or manual monitor/defibrillators that have automated external defibrillation capability, as permitted by regulation and the local medical director, should always be carried on the ambulance **Figure 37-14**.

Patient Transfer Equipment. Each ambulance should carry the following patient transfer equipment:

- A primary wheeled ambulance stretcher
- A wheeled stair chair for use in narrow spaces
- A long backboard
- A short backboard or short immobilization device

You should be able to tilt the head of the stretcher upward to at least a 60-degree angle semisitting position. Stretchers must be provided with fasteners to secure them firmly to the floor or side of the ambulance during transport. Stretcher restraints should be capable of holding the stretcher in place in case the vehicle rolls over. Make certain that the wheeled stretcher is properly locked into position, because injuries can occur to the patient and you if the stretcher becomes loose while the ambulance is in motion **Figure 37-15**. Make sure there are at least three restraining devices for the patient, such as deceleration or stopping straps over the shoulders, to prevent the patient from continuing to move forward in case the ambulance suddenly slows or stops. Regardless of the equipment used, it is important to perform proper lifting techniques to avoid injuries. Chapter 8, *Lifting and Moving,* discusses proper lifting and moving of patients.

Figure 37-14 Every ambulance should carry an automated external defibrillator.

LIFEPAK® 1000 Defibrillator (AED) courtesy of Physio-Control. Used with Permission of Physio-Control, Inc., and according to the Material Release Form provided by Physio-Control.

Other patient transfer devices that can be used include the following:

- A scoop stretcher
- A portable/folding stretcher
- A flexible stretcher
- A basket stretcher

Medications. It is important that the ambulance carry valid and appropriate medications. Keep the telephone number and radio frequency of online medical control or the local poison control center with you on the ambulance. The back of your clipboard is a good place to keep this information.

The Jump Kit. The ambulance must be equipped with a portable, durable, and waterproof jump kit that you can carry to the patient **Figure 37-16**. Think of the **jump kit** as the *5-minute kit,* containing anything you might need in the first 5 minutes with the patient except for the semiautomated external defibrillator, possibly the oxygen cylinder, and portable suctioning unit. The jump kit must be easy to open and secure. **Table 37-4** lists the items that are typically contained in a jump kit.

Figure 37-15 The wheeled ambulance stretcher should be locked into place at an appropriate height.

Courtesy of Rhonda Hunt.

Figure 37-16 A portable jump kit should contain practically anything you will need during the first 5 minutes with the patient.

Table 37-4 Items Carried in a Jump Kit

- Nitrile, vinyl, or other disposable gloves
- Face shield or mask with goggles
- Triangular bandages
- Trauma shears
- Adhesive tape in various widths
- Universal trauma dressings
- Self-adhering soft roller bandages, 4 in. × 5 yd and 2 in. × 5 yd
- Oropharyngeal airways in adult, child, and infant sizes*
- BVM with masks for adults, children, and infants*
- Blood pressure cuff
- Stethoscope
- Penlight
- Sterile gauze dressings, 4 in. × 4 in.
- Sterile dressings (abdominal pads), 6 in. × 9 in. or 8 in. × 10 in.
- Adhesive strips
- Oral glucose
- Activated charcoal
- Other medications allowed by local protocols

*These might be carried in a separate airway kit, along with the portable oxygen cylinder.

Safety and Operations Equipment

In addition to medical equipment, a properly stocked ambulance carries several kinds of equipment for responder safety, rescue operations, and locating emergency scenes. To do the job effectively, your team will need the following equipment:

- Personal protective equipment (PPE)
- Equipment for work areas
- Preplanning/navigation guides

- Extrication equipment

Figure 37-17 The ambulance should have a weatherproof compartment that can be reached from outside the patient compartment. It should hold equipment for safeguarding patients and EMTs, controlling traffic, and illuminating work areas.

© Jones & Bartlett Learning. Courtesy of MIEMSS.

Personal Safety Equipment. Along with your ANSI 2 reflective vest, you should always carry PPE that allows you to work safely in a limited variety of hazardous or contaminated situations. These situations include the edges of a structural fire or explosion, vehicle extrication, and in crowds. The equipment should protect you from exposure to blood and other potentially infectious body fluids. You will not be equipped to face all hazardous materials (HazMat) and other exposure situations that you may encounter; this is the job of specially trained HazMat technicians and response teams. Your equipment might include the following:

- Face shields
- Gowns, shoe covers, caps
- Turnout gear
- Helmets with face shields or safety goggles
- Safety shoes or boots

Equipment for Work Areas. A weatherproof compartment that you can reach from outside the patient compartment should hold equipment for safeguarding patients and EMTs, controlling traffic and bystanders, and illuminating work areas **Figure 37-17**. The following items are recommended:

- Warning devices that flash intermittently or have reflectors (Road flares can pose an additional hazard, such as ignition of flammable liquids or gases.)
- Two high-intensity halogen 20,000 candlepower flashlights of the recharging battery-powered, standup type

- Fire extinguisher, type ABC, dry chemical, 5-lb (2.3-kg) minimum
- Hard hats or helmets with face shields or safety goggles
- Portable floodlights

Preplanning and Navigation Equipment. GPS devices and MDTs are standard equipment in modern ambulances. The addresses of area hospitals and nursing homes should be stored for easy access. Enter the location of the hospital into the GPS device before initiating transport to the hospital. If you are alone in the front of the vehicle, you should never turn your attention away from driving to use a device of any type. Make sure you also have detailed street and area maps in the driver's compartment of the ambulance. Familiarize yourself with the roads and traffic patterns in your town or city so you can plan alternative routes to frequent destinations. Pay particular attention to ways around frequently opened bridges, congested traffic, and blocked railroad crossings. Often, switching to an alternative route will save more time than driving faster. Also be familiar with special facilities and locations within your regional operating area, such as other medical facilities, airports, arenas and stadiums, detention facilities, and chemical or research facilities that might pose unusual problems (staging areas may be predefined for emergency operations).

Extrication Equipment. A weatherproof compartment outside the patient compartment should contain equipment that is needed for simple, light extrication, even if an extrication and rescue unit is readily available. Table 37-5 lists the items that may be included in the compartment.

If rescue and extrication services are not readily available, additional equipment may be needed.

Personnel

Every ambulance must be staffed with at least one EMT in the patient compartment whenever a patient is being transported. Certain situations may require more assistance, such as performing CPR. Some EMS systems may allow non-EMT drivers to operate the ambulance when warranted by patient condition with two EMTs in the patient compartment. In these instances the driver is usually a firefighter or law enforcement official who is properly trained to operate the vehicle in emergency situations.

Table 37-5 Extrication Equipment

- 12-in. wrench, adjustable, open-end
- 12-in. screwdriver, standard square bar
- 8-in. screwdriver, Phillips head #2
- Hacksaw with 12-in. carbide wire blades
- Vise-grip pliers, 10-in.
- 5-lb. hammer with 15-in. handle
- Fire ax, butt, 24-in. handle
- Wrecking bar with 24-in. handle. This may be a combination tool with a hammer and ax.
- 51-in. crowbar, pinch point
- Bolt cutter with 1-in. to 1.25-in. jaw opening
- Folding shovel, pointed blade
- Tin snips, double action, 8-in. minimum
- Gauntlets, reinforced, leather covering past midforearm, one pair per crew member
- Rescue blanket
- Ropes, 5,400-lb. (2,449-kg.) tensile strength in 50-ft. lengths in protective bags
- Mastic knife (able to cut seat belt webbing)
- Spring-load center punch
- Roll of duct tape (for window application prior to center punch use)
- Pruning saw
- Heavy-duty 2-in. × 4-in. and 4-in. × 4-in. shoring (cribbing) blocks, various lengths

Daily Inspections

Being fully prepared means you and your team must inspect both the ambulance and equipment daily to ensure all items are in proper working order. The ambulance inspection should include the following:

- Fuel level
- Oil level
- Transmission fluid level

- Engine cooling system and fluid levels
- Batteries
- Brake fluid
- Engine belts
- Wheels and tires, including the spare, if there is one. Check inflation pressure and look for signs of unusual or uneven wear.
- All interior and exterior lights
- Windshield wipers and fluid
- Horn
- Siren
- Air conditioners and heaters
- Ventilating system
- Doors. Make sure they open, close, latch, and lock properly.
- Communication systems, vehicle and portable
- All windows and mirrors. Check for cleanliness and position.

Check all medical equipment and supplies daily, including all the oxygen supplies, the jump kit, splints, dressings and bandages, backboards and other immobilization equipment, and the emergency obstetrics kit. Is the equipment functioning properly? Are the supplies clean? Are there enough of them? All battery-operated equipment, including the defibrillator, should be operated and checked each day **Figure 37-18**. Rotate the batteries according to an established schedule.

Safety Precautions

A final part of the preparation phase is reviewing safety precautions. These precautions, which include standard traffic safety rules and regulations, should be followed on every call. Check safety devices, such as seat belts (in the cab and patient compartment), to ensure they are in proper working order. Regardless of their location, portable oxygen tanks must always be secured by fixed clasps or housings. Never attempt to secure a tank to the stretcher or bench, unless you are using a commercially manufactured device specifically designed for this purpose; tanks may become projectiles if the ambulance is involved in a motor vehicle crash. In fact, all equipment in the cab, the rear, and in compartments needs to be secured appropriately.

Words of Wisdom

Because mechanical aspects of emergency work such as driving and moving patients strongly impact your safety and that of others, your service should have specific procedures for daily inspections. Following them protects you physically, and documenting your compliance is an important legal protection. Procedures should call for dating and either signing or initialing the check sheets and for storing them where they can be found later if needed.

Figure 37-18 Always check the defibrillator at the beginning of each day.

YOU are the Provider — PART 3

After assessing the patient you determine he is hemodynamically stable. He did not have a loss of consciousness. He has deformity and crepitus to his left forearm with severe pain on palpation. He has a history of hypertension and is allergic to wasp stings and iodine. Even though he does not have neck or back pain, and his mechanism of injury (MOI) is not significant, he agrees to spinal immobilization as a precautionary measure.

Recording Time: 5 Minutes	
Respirations	20 breaths/min; adequate depth
Pulse	98 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	138/86 mm Hg
Oxygen saturation (Spo_2)	99% (on room air)

4. What assessment and treatment should be performed on scene and what should be delayed until you are in the ambulance and en route to the hospital?
5. How would you determine whether to use lights and sirens during transport of this patient?

The Dispatch Phase

Dispatch must be easy to access and in service 24 hours a day **Figure 37-19**. It may be operated by the local EMS or by a shared service that also covers law enforcement and the fire department. The dispatch center might serve only one jurisdiction, such as a single city or town, or it might be an area or regional center serving several communities or an entire county. In either case, it should be staffed by trained personnel who are familiar with the agencies they are dispatching and the geography of the service area. For every emergency request, the dispatcher should gather and record the following minimum information:

- The nature of the call
- The name, present location, and call-back telephone number of the caller
- The location of the patient(s)
- The number of patients and some idea of the severity of their conditions
- Any other special problems or pertinent information about hazards or weather conditions

Many areas implement emergency medical dispatching, which provides the caller with prearrival instructions for patient care before the ambulance arrives. The emergency medical dispatcher follows a set of guidelines to determine the type of information given and then guides the caller through basic care such as bleeding control.

Figure 37-19 The dispatcher is the key communications link throughout all phases of the ambulance run.

En Route to the Scene

In many ways, the en route or response phase of the call is the most dangerous for responders. Crashes between motor vehicles and emergency vehicles cause many serious injuries among EMS personnel. As you and your partner prepare to respond to the scene, make sure you fasten your seat belts and shoulder harnesses before you move the ambulance. You should inform dispatch that your unit is responding and confirm the nature and location of the call. This is also an excellent time to ask for any other available information about the location. For example, you might learn that the patient is on the third floor or that the best door to use is around the side of the house.

While en route to the call, the team should prepare to assess and care for the patient. Review dispatch information about the nature of the call and the location of the patient. Assign specific initial duties and scene management tasks to each team member, and decide what type of equipment to take initially. Depending on your operating procedures, you may also decide which stretcher to take to the patient. Arriving at the scene safely and safely transporting the patient are two of the most challenging aspects of being an EMT. Refer to the defensive ambulance driving section discussed later in this chapter for techniques on safely driving and operating an ambulance.

Arrival at the Scene

On arrival at the incident, you will perform a scene size-up. After you complete your size-up, report to dispatch the nature of the incident if this is part of your local protocol. If other units are en route, provide dispatch with your size-up information to help determine whether the units should continue to the scene. For example, if your size-up determines that the patient is potentially violent, the police unit should continue to the incident scene.

If you are the first to arrive on the scene of a mass-casualty incident, you should inform dispatch that you have arrived and give a brief report of what you see. Also report any unexpected situations, such as the need for additional units, a heavy rescue unit, or a HazMat team **Figure 37-20**. Do not enter the scene if there are any hazards to you. If there are hazards at the scene, the patient should be moved somewhere safe before you begin care. The patient may have to be moved by others if you are not appropriately equipped.

Immediately size up the scene by using the following guidelines:

- Look for safety hazards to yourself, your partner, bystanders, and your patient(s).

Figure 37-20 If you are the first to arrive on the scene of a mass-casualty incident, you should report to dispatch and ask for additional units, such as rescue, or HazMat units as needed.

- Evaluate the need for additional units or other assistance.

- Determine the MOI in trauma patients or the nature of the illness on medical calls.
- Evaluate the need to immobilize the spine.
- Follow standard precautions. The type of care that you expect to give will dictate the personal protective equipment you should wear.

If you are the first EMT at the scene of a mass-casualty incident, quickly estimate the number of patients, and communicate with the incident commander **Figure 37-21**. Inform dispatch that additional units are needed at the scene. Mass-casualty incidents involve complex organization of personnel under the incident command system (see Chapter 38, *Incident Management*). In this system, individual EMTs may be assigned roles, for example, to begin the triage process, assist in treating patients, and load patients for transportation to a hospital.

Safe Parking

In assessing the situation, you must decide where to park the ambulance. Pick a position that will allow for efficient traffic control and flow around a crash scene. Do not park alongside the scene, as you may block the movement of other emergency vehicles. Instead, park in front of or behind the scene, depending on whether other responders have arrived. If other vehicles such as firefighters or law enforcement officers are on scene, they should position their vehicles before the scene, while the EMS vehicle is parked about 100 feet beyond the scene.

Figure 37-21 At a mass-casualty incident, follow instructions from the incident commander assigning your roles, which may include assisting with triage, treating patients, or loading patients for transportation to the hospital.

The first vehicle to arrive on scene should park about 100 feet before the scene on the same side of the road **Figure 37-22**. The first vehicle should create a barrier between the scene and oncoming traffic; if other responders have not arrived on scene, the ambulance can be positioned to block the scene to prevent oncoming traffic from getting too close to the scene or emergency personnel rather than to leave yourself and the scene exposed. It is best to park uphill and/or upwind of the scene if smoke or hazardous materials are present. Always leave on your warning lights or devices, and use extra caution if you must park on the backside of a hill or curve. Do the same when parking at night. When you park, always provide a cushion of space between your vehicle and operations at the scene. Assume someone may collide with your vehicle and strike personnel on the scene **Figure 37-23**.

Safety Tips

When parking at a scene at night you should leave on warning lights but turn off your headlights. This prevents you from blinding oncoming traffic and creating further hazards. Parking lights may also be utilized.

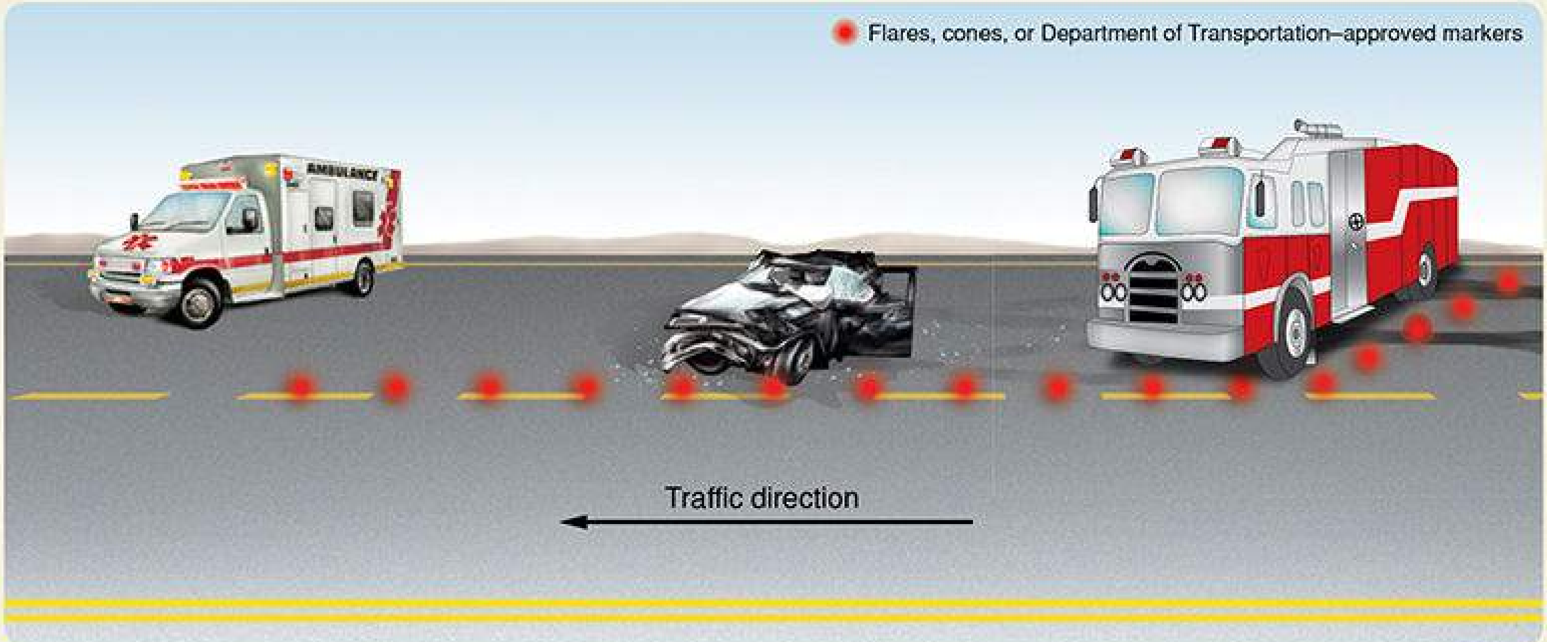

Figure 37-22 Park the ambulance about 100 feet past the scene on the same side of the road.

Figure 37-23 Unsafe parking of an ambulance can result in a crash with other vehicles and injury of personnel.

Stay away from any fires, explosive hazards, downed wires, and structures that might collapse. Be sure to set the parking brake. If your vehicle is blocking part of the roadway, leave on the emergency warning lights. Some motorists tend to drive toward emergency vehicles with flashing red or red and white lights. Turn off headlights to prevent impairing the vision of oncoming traffic. Within these safety guidelines, you should try to park your ambulance as close to the scene as possible to facilitate emergency medical care. If necessary, you can temporarily block traffic to unload equipment and to load patients quickly and safely. If you must do this, try to do it quickly so traffic is not blocked any longer than necessary. Also, you should park in a location that does not hamper leaving the scene. Remember to lock all doors when leaving the ambulance and ensure the designated driver has the keys.

Traffic Control

After you ensure your safety, your first responsibility at a crash scene is to care for the patients. Only after all the patients have been treated and the emergency situation is under control should you be concerned with restoring the flow of traffic. If the police are slow to arrive at the scene, you might then need to take action to control the scene and limit access by other vehicles.

The purposes of traffic control are to ensure an orderly traffic flow and to prevent another crash. Under ordinary circumstances, traffic control is difficult. A crash or disaster scene presents serious additional problems. Passing motorists often slow down and stare, paying little attention to the roadway in front of them. Some curiosity seekers may park down the road and return on foot, creating additional hazards. As soon as possible, place appropriate warning devices, such as reflectors, on both sides of the crash. Remember, the main objectives in directing traffic are to warn other drivers, to prevent additional crashes, and to keep vehicles moving in an orderly manner so care of injured people is not interrupted.

▶ The Transfer Phase

Many patients have said one of the most frightening parts of being suddenly ill or injured is the ambulance ride to the hospital. Already anxious, a patient may be made more so by a fast, bumpy ride with a siren blaring. Sometimes, such a ride is truly lifesaving. However, in most cases, excessive speed is unnecessary and dangerous and may prevent the provider in the back of the ambulance from rendering appropriate care. What is necessary is that the patient be safely transported to an appropriate medical care facility in the shortest practical time. This takes common sense and defensive driving techniques. Speed is no substitute for these qualities. In almost every case, you will provide lifesaving care right where you find the patient, before moving the patient to the ambulance. You may then begin less critical measures, such as bandaging and splinting. Next, you must package the patient for transport, securing him or her to a device such as a backboard, a scoop stretcher, or the wheeled ambulance stretcher. Then move to the ambulance, and properly lift the patient into the patient compartment.

No matter how careful the ambulance driver may be, riding to the hospital while lying down on a stretcher can be uncomfortable and even dangerous. So be sure to secure the patient with at least three straps across the body Figure 37-24. Use deceleration or stopping straps over the shoulders to prevent the patient from continuing to move forward in case the ambulance suddenly slows or stops. This is especially important if the patient is lying flat or secured to a backboard.

Figure 37-24 Secure the patient appropriately for protection during transport.

The Transport Phase

Inform dispatch when you are ready to leave with the patient. Report the number of patients you have, the name of the receiving hospital, and, in some jurisdictions, the beginning mileage of the ambulance. In most cases, even though you have already assessed and treated the patient, you should continue to monitor the patient's condition en route. These ongoing assessments may reveal changes in the patient's vital signs and overall condition. Recheck the patient's vital signs en route. The frequency of checking vital signs depends on the situation, but checking them every 15 minutes for a stable patient and every 5 minutes for an unstable patient is a practice that many services use. In addition, it is important that you continually reassess the patient's clinical situation and record and address new problems and the patient's responses to earlier treatment.

At this time, contact the receiving hospital. Inform online medical control about the patient(s) and the nature of the problem(s). Depending on the number of EMTs and how much care the patient needs, you might also want to begin working on your written report while en route.

Most important, do not abandon the patient emotionally. Do not become so involved in paperwork and ongoing assessments that you ignore the patient's fears. You are there to help the patient, so use this time to reassure him or her.

Some patients, such as very young or older people, may benefit from added attention during transport. Be aware of your patient's level of need.

The Delivery Phase

Inform dispatch as soon as you arrive at the hospital and, depending on your jurisdiction, your ending mileage as well. Then follow these steps to transfer the patient to the receiving hospital:

1. Report your arrival to the triage nurse or other arrival personnel.
2. Physically transfer the patient from the stretcher to the bed directed for your patient.
3. Present a complete verbal report at the bedside to the nurse or physician who is taking over the patient's care.
4. Complete a detailed report, obtain the required signatures, and leave a copy with an appropriate staff member. Electronic reports are commonly used. Your service should have a method for printing or sending electronic reports as well as obtaining electronic signatures.

Figure 37-25 After transferring the patient and relating patient information to the hospital staff, you should restock any items that were used during the run.

The patient care report (PCR) should include a summary of the history of the patient's current illness or injury with pertinent positives and negatives, MOI, and findings on your arrival. In addition, list vital signs and briefly mention relevant past medical or surgical history, as well as information regarding medication and allergies. Also, be sure to include any treatment and its effect during the prehospital setting.

While at the hospital, you may be able to restock any items that were used during the call, such as oxygen masks or dressings and bandages **Figure 37-25**. Remember that your priority is transfer of the patient and patient information to the hospital staff; restocking the ambulance comes second.

En Route to the Station

Once you leave the hospital, inform dispatch whether you are in service and where you are going. As soon as you are back at the station, you should do the following:

- Clean and disinfect the ambulance and any equipment that was used, if you did not do so before leaving the hospital **Figure 37-26**.
- Restock any supplies you did not get at the hospital.

The Postrun Phase

During the postrun phase, complete and file any additional reports and again inform dispatch of the unit status, location, and availability.

Each crew member is responsible for maintaining the ambulance so it is safe and available on a moment's notice. This means you should perform routine inspections and refuel the vehicle. Use a written checklist to document needed repairs or replacement of equipment and supplies.

Figure 37-26 Clean and disinfect the ambulance and equipment at the station if you did not do so at the hospital.

You should know the meanings of the terms "cleaning," "disinfection," "high-level disinfection," and "sterilization," as follows:

- **Cleaning**. The process of removing dirt, dust, blood, or other visible contaminants from a surface or equipment.
- **Disinfection**. The killing of pathogenic agents by directly applying a chemical made for that purpose to a surface or equipment.
- **High-level disinfection**. The killing of pathogenic agents by the use of potent means of disinfection.
- **Sterilization**. A process, such as the use of heat, which removes all microbial contamination.

A basic rule is to do the following after every call:

1. Immediately strip used linens from the stretcher after use, and place them in a plastic bag or in the designated receptacle in the ED.
2. Discard in an appropriate receptacle all disposable equipment used for care of the patient that meets your state's definition of medical waste. Most items will be considered general trash. Discard disposable equipment that is bloody or

contaminated by body fluids in an OSHA-approved biohazard container. Discard noncontaminated disposable equipment used for care of the patient following OSHA and local guidelines.

3. Wash contaminated areas with soap and water. For disinfection to be effective, cleaning must be done first.
4. Disinfect all nondisposable equipment used in the care of the patient. For example, properly clean and disinfect stethoscopes, nondisposable blood pressure cuffs, pulse oximetry probes, and other reusable equipment.
5. Clean the stretcher with an EPA-registered germicidal/virucidal solution or bleach and water at 1:100 dilution.
6. Clean up any spillage or other contamination that occurred in the ambulance, with the same germicidal/virucidal or bleach/water solution.
7. Create a schedule for routine full cleaning for the vehicle.
8. Have a written policy/procedure for cleaning each piece of equipment. Refer to the manufacturer's recommendations as a guide.

Words of Wisdom

Complete your daily duties, such as cleaning quarters, after the ambulance has been checked, cleaned, and restocked. Once these tasks are completed there is usually down time between calls. This is an excellent time to review local protocols and standing orders. Many EMTs also use this time to study for upcoming skills assessments or other courses required for recertification.

Defensive Ambulance Driving Techniques

According to the National Highway Traffic Safety Administration, between 1992 and 2011 (20 years), there were approximately 4,500 motor vehicle traffic crashes involving an ambulance each year. Of these, 65% resulted in damage to property only, 34% resulted in one or more injuries, and 1% (or 45 per year) resulted in one or more fatalities. These statistics show the impact of these crashes on pedestrians, motorists, ambulance passengers, and EMS personnel **Figure 37-27**. Learning how to properly operate your vehicle is just as important as learning how to care for patients when you arrive on the scene. An ambulance that is involved in a crash delays patient care, at a minimum, and may take the lives of the EMTs, or other motorists, or pedestrians, at worst. The following section is provided to introduce you to safe driving techniques; however, you cannot become a proficient and safe ambulance driver without specialized training and practice. You are strongly encouraged to participate in a certified defensive driving program, such as those offered through your EMS organization, before attempting to operate an emergency vehicle.

Figure 37-27 Each year, ambulance crashes are the cause of thousands of injuries to pedestrians, motorists, ambulance passengers, and EMS personnel.

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Driver Characteristics

Not everyone who drives a motor vehicle is qualified to drive an emergency vehicle. In some states, you must successfully complete an approved emergency vehicle operations course before you are allowed to drive the ambulance on emergency calls. In any state, due diligence and caution are important characteristics, as are a positive attitude about your ability and tolerance of other drivers.

Many crashes occur as a result of physical impairment of the driver. Do not drive if you are taking medications that may cause drowsiness or slow your reaction time. These include cold remedies, analgesics, and tranquilizers, among others. And, of course, you should never drive or provide medical care after drinking alcohol. While most employers have guidelines that require an employee to stop drinking at least 10 to 12 hours prior to the start of his or her shift, many factors affect the rate of alcohol metabolism, so it is possible to stop drinking for this period of time and still be impaired.

Working long shifts or multiple consecutive shifts also puts drivers at risk for delayed reaction time and/ or falling asleep behind the wheel. While many services have regulations against working beyond a specific number of hours, most do not consider EMTs who may work for more than one service. It is your responsibility to notify your employer if you have previously worked a shift and feel unable to safely operate an emergency vehicle.

Words of Wisdom

Driving an ambulance does not automatically give you the authority to ignore basic traffic laws or operate the vehicle without due regard for the safety of others. The good judgment needed to drive an ambulance requires practice—even for the best drivers.

Another requirement is emotional fitness. Emotions should not be taken lightly. A person's personality often changes once he or she gets behind a steering wheel. Emotional maturity and stability are closely related to the ability to operate under stress. In addition to knowing exactly what to do, you must be able to do it under difficult conditions.

Having the proper attitude is very important for the driver of an ambulance. Never get behind the wheel of an emergency vehicle thinking you can drive in any manner that pleases you simply because you have on lights and siren. You must operate the vehicle with due regard for the safety of others and preservation of property. A greater responsibility is placed on the driver of an ambulance, and generally a lower burden of proof is needed to find that an EMT has caused a crash. As a rule, whenever lights and siren are used on an emergency call and there is a crash, the actions of the emergency vehicle operator fall under the most scrutiny.

Words of Wisdom

Ambulance crashes that kill EMTs, patients, or occupants of other vehicles are disturbingly common. Most of them could have been prevented by the driver of the ambulance. Thoroughly attending to your own driving skills, driving according to established standards, and addressing any obvious lack of skills in your partner's driving are all crucial to your safety on the job.

Safe Driving Practices

The first rule of safe driving in an emergency vehicle is that speed does not save lives; good care does. The second rule is that the driver and all passengers must wear seat belts and shoulder restraints at all times. These are the most important safety equipment items on every ambulance. You should wear restraints en route to the scene and whenever you are not performing direct patient care. Patients should also be properly restrained. Studies show fewer than half of all EMTs wear seat belts while the vehicle is in emergency mode, and few wear lap belts in the rear compartment while patient care is being rendered. If you must remove your seat belt to care for the patient, fasten the belt again as soon as possible. Also, unrestrained or improperly restrained patients and medical equipment (especially portable oxygen tanks) may become airborne during a crash and place you and your patient at an additional risk. All equipment and cabinets must be secured, as well as the patient and any passengers accompanying the patient.

YOU are the Provider — PART 4

The hospital you are transporting to is 12 miles away. The patient's vital signs are normal and he states his pain is a "5" on a 1 to 10 scale. After traveling approximately 5 miles, you realize the ambulance is slowing down. Your partner tells you he has just heard on the radio that there is a motor vehicle crash a couple of miles ahead, and traffic is at a standstill. He says he can turn on the lights and siren and try to get through.

Recording Time: 12 Minutes	
Level of consciousness	Alert and oriented
Respirations	18 breaths/min; adequate depth
Pulse	98 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	136/88 mm Hg
Spo_2	100% (at room air)

6. What should you consider when deciding whether it is appropriate to turn on the lights and siren to maneuver through traffic?
7. If you are in an unfamiliar area and do not know an alternate route, what are your options?

Learn how your vehicle accelerates, corners, sways, and stops. Understand exactly how each particular vehicle will respond to steering, braking, and accelerating under various conditions.

Getting a feel for the proper brake pressure comes with experience and practice. Each vehicle has a different braking action. For example, the brakes on types I and III vehicles have a heavier feel than the brakes on a type II vehicle. The braking system on a diesel-powered unit will be different from the braking system on an identically equipped gasoline-powered unit. Certain heavy vehicles use air brakes, which have yet another feel. Get to know each vehicle you drive, and be sure you understand its braking characteristics and the best downshifting techniques.

When driving an ambulance on a multilane highway, you should usually stay in the extreme left-hand (fast) lane. This allows other motorists to move over to the right when they see or hear the ambulance approach.

Table 37-6 lists further guidelines to follow when en route to a call.

Words of Wisdom

Centrifugal force is the tendency for objects to be pulled outward when rotating around a center. Vehicles are subject to this force when making a turn. If you must brake on a turn, brake gently while making the turn.

Siren Risk-Benefit Analysis

Whether responding to a call or transporting a patient from the scene to the hospital, the decision to activate the emergency lights and siren will depend on several factors such as local protocols, patient condition, and the anticipated clinical outcome of the patient. Some local protocols require that all responses to the scene use emergency lights and siren, whereas other systems incorporate response modes based on the information received from dispatch. Regardless of your jurisdictional requirements, as the driver of the ambulance, you need to evaluate the risk versus benefit of your response mode. Numerous studies have been conducted to determine whether the use emergency lights and siren save time getting to the patient or getting the patient from the scene to the hospital. The findings of these studies show that while time is saved, the time that you do save is minimal.

As an EMT, you will also need to consider the patient's condition before activating emergency lights and siren. For example, patients who have experienced a seizure may have another seizure as a result of the rapid flash pattern of the emergency lighting. In cases such as this, it may be better to transport your patient without lights and siren activated to minimize external stimuli and to prevent making your patient's condition worse.

Table 37-6 Guidelines for Safe Ambulance Driving

1. Select the shortest and least congested route to the scene at the time of the dispatch.
2. Avoid routes with heavy traffic congestion; know alternative routes to each hospital during rush hours.
3. Avoid one-way streets; they may become clogged. Do not go against the flow of traffic on a one-way street, unless absolutely necessary.
4. Watch carefully for bystanders as you approach the scene. Curiosity seekers rarely move out of the way.
5. Park the ambulance in a safe place once you arrive at the scene. If you park facing into traffic, turn off your headlights so they do not blind oncoming motorists unless they are needed to illuminate the scene. If the vehicle is blocking part of the road, keep on your warning lights to alert oncoming motorists.
6. Drive within the speed limit while transporting patients, except in the rare extreme emergency.
7. Go with the flow of the traffic.
8. Always drive defensively.
9. Always maintain a safe following distance. Use the "4-second rule": stay at least 4 seconds behind another vehicle in the same lane.
10. Maintain an open space or cushion in the lane next to you as an escape route in case the vehicle in front of you stops suddenly.
11. Use your siren if you turn on the emergency lights.
12. Always assume other drivers will not hear the siren or see your emergency lights.
13. Always exercise due regard for person and property.

Driver Anticipation

Always assume that motorists around your vehicle do not hear your siren/public address (PA) system or see your vehicle until proven otherwise by their actions. Drivers of ambulances often make the mistake of assuming that motorists and pedestrians will do what is expected of them when an emergency vehicle is in the area. Motorists may indeed pull over to the right and stop or drive as close to the curb as possible, but you cannot take this behavior for granted. At any time, a motorist might stop suddenly in front of the ambulance or pull to the left. Both of these motorist responses may result in a crash. Aggressive ambulance driving may have an opposite effect on motorists, as you may not allow enough time for motorists to respond to your vehicle, or they may become nervous and not react in a rational manner. Whenever a motorist yields the right-of-way, the emergency vehicle operator should attempt to establish eye contact with the other driver. When anticipating how motorists may respond to your lights and siren, always assume that they will react in a manner that may cause a crash. You can also look at the direction of the other vehicle's front tires to get an early indication of which way the vehicle will turn.

It is often quite difficult for motorists to hear instructions called out over the ambulance's PA system, especially when their windows are rolled up. The PA system may actually make the situation worse because motorists may hesitate or make unexpected moves in the attempt to hear or follow instructions. Moreover, when the driver of the ambulance is shouting to motorists and pedestrians over the PA system, he or she is now distracted from the business of driving and forced to handle the microphone when both hands should be on the steering wheel. You should avoid using the ambulance's PA system during emergency driving.

Most important, you must always drive defensively. Never rely on what another motorist will do unless you get a clear visual signal. Even then, you must be prepared to take defensive action in the case of a misunderstanding, panic, or careless driving on the part of the other driver.

The Cushion of Safety

To safely operate an emergency vehicle, you must maintain a safe following distance from the vehicles in front of you and avoid being tailgated from behind. You also must ensure the **blind spots** in your vehicle's rearview and side mirrors do not prevent you from seeing vehicles or pedestrians on either side of the ambulance. Keeping a safe distance between your vehicle and the one in front of you, checking for tailgaters behind your ambulance, and keeping aware of vehicles potentially hiding in your mirrors' blind spots are considered maintaining a **cushion of safety**. To ensure you have enough reaction time and stopping distance from the vehicle in front of you, follow at a safe distance, allowing the motorist enough time to move over to the right. If the motorist does not move, you will need to allow for enough time to avoid the vehicle. This means driving about 4 or 5 seconds behind a vehicle traveling at an average speed.

While operating in emergency mode, tailgaters may follow your vehicle dangerously close in congested areas simply to use your ambulance to get through traffic. This poses a threat to the crew and patient. If the ambulance stops suddenly to avoid a crash (which should not happen if a cushion of safety was maintained), the tailgating vehicle could smash into the rear of the ambulance, possibly causing you to lose control and strike other vehicles or pedestrians. Always scan your rearview and side mirrors for vehicles following too closely. Instruct your partner to stay alert for such vehicles while he or she is in the rear compartment rendering care and to inform you about any tailgaters.

If you are being tailgated, never speed up to create more distance. The tailgater may, in turn, increase his or her speed to continue to follow you through traffic, thereby decreasing your cushion of safety and reaction time and increasing the time and distance needed to avoid a crash. Slamming on your brakes to scare the other driver usually does not work either and may also cause a crash. The best method for distancing yourself from the vehicle is to slow down. Generally tailgaters are impatient and will speed up past you. You can also have your dispatcher contact the local police to let them know that someone is driving recklessly behind you.

Never, under any circumstance, get out of the ambulance to confront a driver. This will only delay your response or transport of the patient and can lead to a dangerous situation. It is also unprofessional for you to become involved in a verbal argument with any member of the public and may lead to disciplinary actions or termination, depending on your service's conduct regulations.

Finally, there are three blind spots around the ambulance that you cannot see with side or rearview mirrors:

- The rearview mirror creates a blind spot, obstructing the view ahead and preventing the driver from seeing objects such as a pedestrian or vehicle. Many new ambulance drivers will not be used to the larger mirrors on ambulances, which create a special hazard that the driver should be aware of. To eliminate this blind spot, you should lean forward in your seat so the mirror does not obstruct the view, especially when making turns at intersections.
- The rear of the vehicle cannot be seen fully through the mirror and is therefore a blind spot. Because of the configuration of today's ambulances and the relative height of the vehicle, the rearview mirror generally gives the driver only a view of the patient compartment and is not intended to be used for alerting the driver of a vehicle behind the ambulance. Because of this blind spot, many crashes occur when the ambulance driver is backing up. It is highly recommended, and required in many jurisdictions, that a **spotter** be used to help you back up the vehicle. Rear-facing cameras are also helpful and much more common; however, they do not replace the use of a spotter if one is available.
- The side of the vehicle often cannot be seen through the side view mirrors at a certain angle. Entire vehicles may not be seen in the mirror, even though they are right next to the ambulance. To eliminate this problem, many EMS systems place small rounded mirrors on the side mirrors to assist you in visualizing this blind spot. However, if these mirrors are not available, you need to lean forward or backward in the seat to help eliminate the blind spot. This is an especially important technique to use when shifting lanes or making turns. Remember, just because you are turning from the

appropriate lane does not mean that another motorist will not try to cut in beside the ambulance or that there is not a bicyclist riding on the side of the road next to you.

Scan your mirrors frequently for any new hazards, so you maintain your cushion of safety; however, keep in mind that your mirrors can give you a misleading view and may block people or vehicles. Adjust your position in the driver's seat to avoid blind spots in your mirrors. Always use a spotter whom you can see from the driver's side mirror and agreed on hand signals when backing up the ambulance.

The Problem of Excessive Speed

Even in extreme life-and-death emergencies, excessive speed is not indicated. In most cases, if you properly assess and render appropriate treatments at the scene, speeding during transport is unnecessary and undesirable. No matter what the situation, you should never travel at a speed that is unsafe for the given road conditions.

Excessive speeds, in addition to being unnecessary, do not increase a patient's chance of survival. More often, using excessive speed while driving to and from the scene has resulted in crashes in which the EMT, the patient, and occupants of other vehicles are killed. It also makes it very difficult for the EMT attending to the patient to be able to provide care because of the rough ride typically created by the excessive speed and maneuvering. Excessive speed also cuts down on the driver's reaction time and increases the time and distance needed to stop the ambulance. While many state laws allow emergency vehicles to travel beyond the posted speed limits in emergencies, they offer little or no protection against prosecution should the driver become involved in a motor vehicle crash. The legal ramifications of driving an emergency vehicle will be covered later in this section.

Recognition of Siren Syndrome

The siren may have a psychological effect on EMS providers as well as on other drivers. Recognizing that the siren may increase the anxiety of other drivers will help you become aware of your or other drivers' tendencies to drive faster in the presence of sirens. Although a siren signifies a request for drivers to yield the right-of-way, drivers do not always do so. The adrenaline rush you experience may cause you to have limited focus and also interfere with your ability to judge distance or the potential actions of others. One of the biggest mistakes you can make as an EMT is to assume motorists will hear the siren and take proper action.

Vehicle Size and Distance Judgment

Vehicle length and width are critical factors when maneuvering, driving, and parking an emergency vehicle. They are especially important with types I and III vehicles, which are wider than they look from behind the steering wheel. To brake and pass effectively, you must know the width and length of your vehicle. Crashes often occur when the driver is backing up the vehicle. Always use someone outside the ambulance as a ground guide when you are backing up to avoid any incidents. Vehicle size and weight greatly influence braking and stopping distances. Good peripheral vision and depth perception will help you judge distances, but they are no substitute for intensive training, experience, and frequent evaluation of the vehicle.

Road Positioning and Cornering

Road position means the position of the vehicle on the roadway relative to the inside or outside edge of the paved surface. To corner efficiently, you must know the vehicle's present position and its projected path. The aim is to take the corner at the speed that will put you in the proper road position as you exit the curve **Figure 37-28**. Whereas the fastest path through a curve is to enter high in the lane (positioned to the outside of the lane), apex low in the lane (to the inside of the lane), and exit high, these actions can result in misjudgment of speed and position, creating the danger of ending up in the opposing lane or off the road if you are traveling too fast. The safest path is to enter high in the lane (to the outside), and exit low (to the inside). This allows room for error if you enter the turn too fast.

Weather and Road Conditions

Whereas most ambulance crashes occur on clear days with dry roads, there are certain conditions that can limit your ability to control your vehicle. Ambulances do not handle the same as motor vehicles. Ambulances have a longer braking time and stopping distance. In addition, the weight of the ambulance is unevenly distributed, which makes it more prone to roll over. These factors, in addition to bad environmental conditions, greatly increase the chance that a crash may occur. Therefore, you should be alert to changing weather, road, and driving conditions **Figure 37-29**. Whether traveling to or from an emergency, you must modify your speed according to road conditions. Take warnings of ice or hazardous conditions seriously, and be prepared to take an alternative route, if necessary. During a major disaster, all public safety and emergency services should be coordinated. If you run into unexpected traffic congestion, notify the dispatcher so other emergency vehicles can select alternative routes.

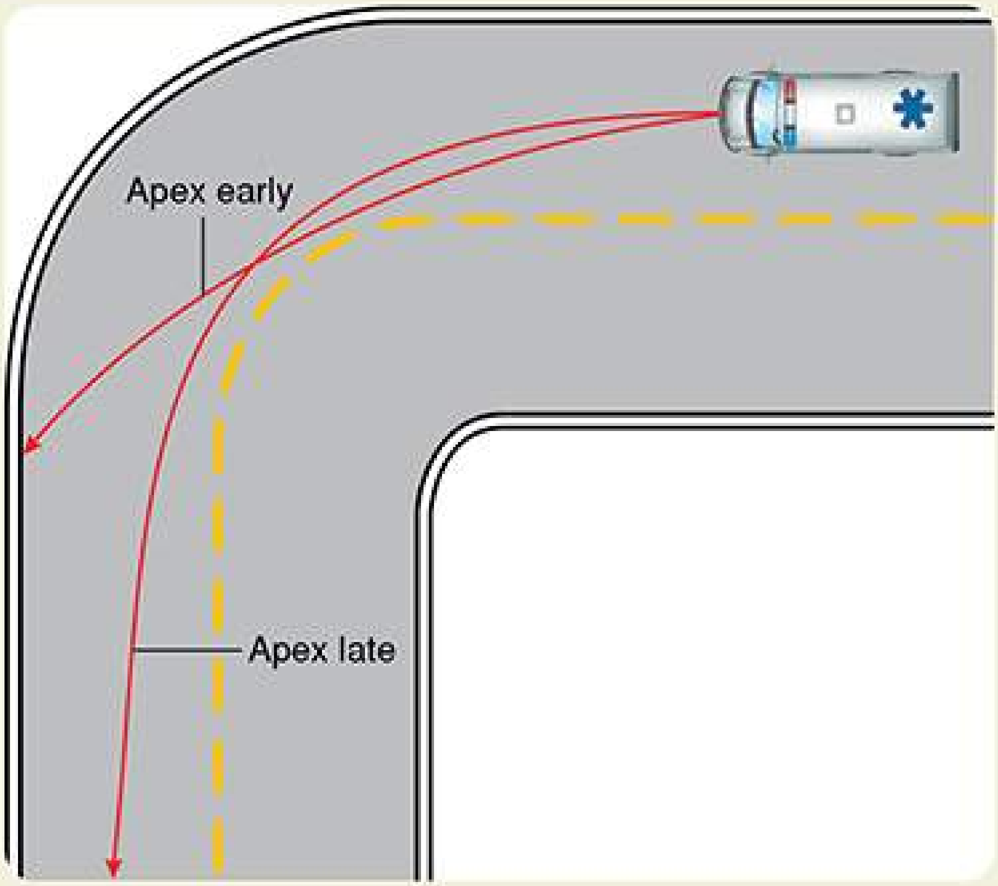

Figure 37-28 To keep the ambulance in the proper lane on a curve, you must know the vehicle's present position and projected path and take the corner at the correct speed.

Even the most careful drivers will occasionally run into unexpected situations that may require special driving skills. However, if you drive at a speed that is appropriate for the weather and road conditions and maintain an adequate cushion of safety, you will minimize these situations. Therefore, it is safer if you decrease your speed in bad weather conditions such as fog, rain, snow, or ice. The following are examples of conditions that require the emergency vehicle operator to decrease speed, increase following distance, and be alert.

Hydroplaning. On a wet road surface, tires are designed to move the water out of the way and stay in direct contact with the road. However, at speeds of greater than 30 mph, tires may be lifted off the road as water "piles up" underneath; the vehicle may then feel as if it is floating. This problem is known as **hydroplaning**. At higher speeds on wet roadways, the front wheels may actually be riding on a sheet of water, robbing the driver of control of the vehicle. If hydroplaning occurs, you should gradually slow down without jamming on the brakes.

Figure 37-29 Modify your speed according to changing weather, road, and driving conditions.

Water on the Roadway. Wet brakes will not slow the vehicle as efficiently as dry brakes, and the vehicle may pull to one side or the other. If at all possible, avoid driving through large pools of standing water; often, you cannot tell how deep they are. If you must drive through standing water, slow down and turn on the windshield wipers. After driving out of the water, lightly tap the brakes several times until they are dry. If the vehicle is equipped with antilock brakes, apply a steady, light pressure to dry the brakes. Driving through moving water should be avoided at all times.

Decreased Visibility. In areas where there is fog, smog, snow, or heavy rain, slow down after warning vehicles behind you by turning your emergency lights on. At night, use only low headlight beams for maximum visibility without reflection. You should always use headlights during the day to increase your visibility to other drivers. Also, watch carefully for stopped or slow-moving vehicles.

Ice and Slippery Surfaces. A light mist on an oily, dusty road can be just as slippery as a patch of ice. Good all-weather tires and an appropriate speed will significantly reduce traction problems. If you are in an area that often has snowy or icy conditions, consider using studded snow tires or tire chains, if they are permitted by law. You should be especially careful on bridges and overpasses when temperatures are close to freezing. These road surfaces will freeze much faster than surrounding road surfaces because they lack the warming effect of the ground underneath.

Words of Wisdom

Although preventing skids and sliding is ideal, you are likely to skid or slide occasionally, especially if you live in climates with ice and snow.

Your training should include the technique for correcting slides during turns. If you are likely to drive on ice and snow, practice control maneuvers until they become automatic—at low speeds in an area where there is no danger of crashes. Remember that four-wheel-drive and front-wheel-drive vehicles behave differently than rear-wheel-drive vehicles when sliding. It is also important to remember that although four-wheel-drive vehicles have better traction for acceleration in slippery conditions, they do not stop any faster than two-wheel-drive vehicles.

Laws and Regulations

Regulations regarding vehicle operations vary by state and by city, but some regulations are the same regardless of location. Drivers of emergency vehicles have certain limited privileges in every state. However, these privileges do not lessen their liability in a crash. In fact, in most cases, the driver is presumed to be guilty if a crash occurs while the ambulance is operating with warning lights and a siren. Motor vehicle crashes comprise a large number of lawsuits against EMS personnel and services.

While on an emergency call, emergency vehicles typically are exempt from normal vehicle operations. If you are on an emergency call and you are using your warning lights and siren, you may be allowed to do the following:

- Park or stand in an otherwise illegal location
- Proceed through a red traffic light or stop sign, but never without stopping first.
- Drive faster than the posted speed limit
- Drive against the flow of traffic on a one-way street or make a turn that is normally illegal
- Travel left of center to make an otherwise illegal pass

Remember that these exemptions vary by state and local jurisdiction. Therefore, you should check your local statutes for regulations in your area.

An emergency vehicle is *never* allowed to pass a school bus that has stopped to load or unload children and is displaying its flashing red lights or extended “stop arm.” If you approach a school bus that has its lights flashing, you should stop before reaching the bus and turn off your siren. Next, you should wait for the bus driver to make sure the children are safe, close the bus door, and turn off the flashing lights. Only then may you carefully proceed past the stopped school bus.

Use of Warning Lights and Siren. Three basic principles govern the use of warning lights and siren on an ambulance:

1. The unit, to the best of your knowledge, must be on a true emergency call.
2. Audible and visual warning devices must be used simultaneously.
3. The unit must be operated with due regard for the safety of all others, on and off the roadway.

Carefully consider when to use or not use your siren. In general, the siren does not help you as you drive, nor does it really help other motorists. Motorists who drive at the speed limit with the windows up, the radio on, and the air conditioner or heater set on high may not hear the siren until the ambulance is very close. If the radio is loud, they may not hear the siren at all.

If you do have to turn on the siren, tell the patient before you do. Be especially mindful not to increase the speed of the ambulance just because the siren is in use. Always travel at a speed that allows you to stop safely at all times, especially so you are prepared for drivers who do not give you the right-of-way. Never assume that warning lights and siren will allow you to drive through a congested area without stopping or slowing down. Slow down to ensure all drivers are stopping as you approach an intersection, and proceed with caution. Remember, the siren is a request that other drivers give you the right-of-way: it does not magically clear traffic. However, driving through a busy intersection against a directional signal without using the siren may also be dangerous and may violate your state law. In these high-risk situations, use all tools at your disposal to ensure nearby traffic is aware of your presence and that the danger is decreased to the greatest degree possible.

Some ambulance headlights are equipped with a high-beam flasher unit. These are very visible, effective warning devices for clearing traffic in front of the vehicle.

Right-of-Way Privileges. State motor vehicle statutes or codes often grant an emergency vehicle, such as an ambulance, the right to disregard the rules of the road when responding to an emergency. However, in doing so, the operator of an emergency vehicle must not endanger people or property under any circumstances.

Consider this case: An ambulance is approaching an intersection that is controlled by a four-way stop sign. The ambulance, with lights and siren turned on, proceeds through the intersection without slowing or stopping and crashes into a vehicle coming from its right. Did the operator of the ambulance act appropriately by going through the intersection in this manner?

Right-of-way privileges for ambulances vary by state. Some states allow you to proceed through a red light or stop sign after you stop and make sure it is safe to go on. Other states allow you to proceed through a controlled intersection "with due regard," using flashing lights and siren. This means you may proceed only if you consider the safety of all people who are using the highway. If you fail to use due regard, your service may be sued. If you are found to be at fault, you may personally have to pay punitive damages or face civil and criminal sanctions.

Get to know your local right-of-way privileges. Exercise them only when it is absolutely necessary for the patient's well-being. The use of lights and audible warning devices is a matter of state and local practice and protocol.

Use of Escorts. Using a police escort is an extremely dangerous practice. When other motorists hear a siren and see a police vehicle passing, they might assume the police vehicle is the only emergency vehicle and not see the ambulance. The only time an escort is justified is when you are in an unfamiliar area and truly need a guide more than an escort. In such cases, vehicles using warning lights or siren should use different tones to alert other motorists and be prepared to stop if needed. If you are being guided, follow at a safe distance. Assume nearby traffic will not be aware of your presence.

Intersection Hazards. Intersection crashes are the most common and usually the most serious type of crash that ambulances are involved in. Always be alert and careful when approaching an intersection. If you are on an urgent call and cannot wait for traffic lights to change, you should still come to a brief stop at the light; look around for other motorists and pedestrians before proceeding into the intersection.

Motorists who "time the traffic lights" present a serious hazard. You may arrive at an intersection while the light is green. At the same time, a motorist who is timing the lights on the cross street arrives at the intersection. The motorist has a red light but knows it is about to turn green and is expecting to go through. This creates the possibility for a serious crash to occur.

Another common intersection hazard occurs when the driver of one emergency vehicle follows another emergency vehicle through an intersection without carefully assessing the situation. A motorist who has yielded the right-of-way to the first vehicle may proceed into the intersection without expecting a second vehicle. You should exercise extreme caution in these situations. To signal motorists that a second unit is approaching, use a siren tone that is different from that of the first vehicle.

Highways. When you are responding to an emergency call and you must travel on the highway, you should turn off your emergency lights and siren until you have reached the far left lane. Turning off your emergency devices minimizes the possibility that other drivers will get confused and not know what to do or where to go.

When driving on a highway with your emergency devices activated, you should always travel in the far left-hand lane. Also known as the "passing lane," this allows the ambulance to safely pass vehicles, while still leaving a safety corridor on the left side of the ambulance in case of emergency or unexpected obstacles.

When you exit the highway, you should follow the same procedures as when you entered the highway: turn off all emergency devices, move onto the off-ramp, and then turn on the emergency lights and siren if necessary.

Unpaved Roadways. When you are required to drive the ambulance on an unpaved roadway, special care must be taken. Unpaved roadways often have uneven surfaces, as well as large potholes. While responding on this type of roadway, you must operate the vehicle at a lower speed and maintain a firm grip on the steering wheel to maintain complete control of the ambulance at all times.

School Zones. When you respond through a school zone with your emergency lights turned on, it is important to remember that lights and sirens tend to attract children to the roadway and create a potential hazard. In many states, it is unlawful for an emergency vehicle to exceed the speed limit in school zones regardless of the condition of the patient.

Distractions

As technology progresses, so will the distractions you will face while operating the ambulance. While MDTs and GPS devices are necessary to assist EMTs in determining the location of the call, these devices, along with using the vehicle's mounted mobile radio, listening to the stereo, talking on your cell phone, and eating/drinking, create additional driving hazards. While the ambulance is in motion, you should focus on driving and anticipate roadway hazards. Your partner should operate the MDT, GPS device, and portable radios or turn on the siren. Minimizing distractions allows for a safer response and minimizes the potential for mishaps.

Driving Alone

Although driving alone is not a standard practice or even allowable in certain systems, there may be an occasion when you need to respond to a scene by yourself in the ambulance and meet your partner on the scene. When presented with this situation, you have additional duties and responsibilities, such as figuring out the safest route to the call, operating the radios and emergency warning devices, and mentally preparing for the call. Situations such as these demand your complete attention and focus.

Fatigue

Fatigue has many causes, such as stress, working the night shift, and lack of quality sleep in accordance with your body's circadian rhythms. As a result of these causes of fatigue, operating a large vehicle, such as an ambulance, creates a high risk. You must be able to recognize when you are fatigued. Do not be ashamed to admit it to yourself, your partner, or your supervisor. If you feel fatigued, you should be placed out of service for the remainder of the shift or until the fatigue has passed and you feel capable of safely operating the vehicle.

Air Medical Operations

Air ambulances are used to evacuate medical and trauma patients. They land at or near the scene and transport patients to trauma facilities every day in many areas. There are two basic types of air medical units: fixed-wing and rotary-wing, otherwise known as helicopters **Figure 37-30**. Fixed-wing aircraft generally are used for interhospital patient transfers over distances greater than 100 to 150 miles. For shorter distances, ground transport or rotary-wing aircraft are more efficient.

Specially trained medical flight crews accompany all air ambulance flights. Your role in fixed-wing aircraft transfers probably will be limited to providing ground transport for the patient and medical flight crew between the hospital and the airport.

Rotary-wing aircraft have become an important tool in providing emergency medical care. Trauma patient survival is directly related to the time that elapses between injury and definitive treatment. Most helicopters that are used for emergency medical operations fly well in excess of 100 mph in a straight line, without road or traffic hazards, straight to a hospital helipad. The crew may include flight paramedics, flight nurses, specialty providers such as respiratory therapists, and/or physicians.

Familiarize yourself with the capabilities, protocols, and methods for accessing helicopters in your area. Helicopter services provide training for EMS systems, fire services, and first responders in ground operations and safety. The following discussion is an introduction to safe operations and is not intended to be substituted for the more extensive courses available locally.

Figure 37-30 **A.** Fixed-wing aircraft are generally used to transfer patients from one hospital to another over distances greater than 100 to 150 miles. **B.** A rotary-wing aircraft, or helicopter, is used to help provide emergency medical care to patients who need to be transported quickly over shorter distances.

A: © Ralph Duenas/www.jetwashimages.com; B: Courtesy of Ed Edahl/FEMA.

Helicopter Medical Evacuation Operations

A medical evacuation is commonly known as a **medivac** and is generally performed exclusively by helicopters. Most rural and suburban EMS jurisdictions and many urban systems have the capability to perform helicopter medivacs or have a mutual aid agreement with another agency such as police or hospital-based medivac service to provide such service. Familiarize yourself with the medivac capabilities, protocols, and procedures of your particular EMS system because they vary by agency. The following are some general guidelines that you should be familiar with when considering whether to initiate a medivac operation.

Calling for a Medivac

Every agency has specific criteria for the type of patient who may receive medical evacuation and how and when to call for a medivac. These basic guidelines will help you understand the process better.

- **Why call for a medivac?** The transport time to the hospital by ground ambulance is too long considering the patient's condition. Road, traffic, or environmental conditions limit or completely prohibit the use of a ground ambulance. The patient requires advanced care that you are unable to provide, such as administering pain medications or other specialized medications and inserting advanced airways. There are multiple patients who will overwhelm resources at the hospital reachable by ground transport. The helicopter may respond directly to the scene or it may be called to the hospital to transfer a patient to a facility with the capacity to provide definitive care for the patient's condition.
- **Who receives a medivac?** Medical evacuations should be used for patients with time-dependent injuries or illnesses. Patients suspected of having a stroke, heart attack, or serious spinal cord injury, such as injuries sustained in a motor vehicle crash or while diving into a swimming pool or horseback riding, often require medivac service. Serious conditions that may require the use of helicopter medivacs may be found in remote areas and involve scuba diving accidents, near drownings, or skiing and wilderness accidents. Other patients who may require medical evacuation are trauma patients, candidates for limb replantation (for amputations), and patients requiring air transport to a burn center, a hyperbaric chamber center, or a venomous bite center. Because specific criteria vary by service, familiarize yourself with the criteria in your system used to call for this lifesaving service.
- **Whom do you call?** Generally, your dispatcher must be notified first. In some regions, after the medivac has been initiated, the ground EMS crew may be able to access the flight crew on a specially designated radio frequency for one-on-one communications. If available, it is important to keep this frequency clear of chatter and lengthy communications. You may be asked to give a brief presentation or update on the patient's condition. In this case, you should gather your thoughts and speak clearly and concisely, avoiding information that is not pertinent. Another important topic of communication between the ground and flight EMS crews will be where to land the helicopter. This will be covered in the next section.

Safety Tips

The most dangerous phases of air transport are the takeoff and landing. It is very important that at least one person is dedicated to these tasks. This person should not have patient care responsibilities.

Establishing a Landing Zone

Although a helicopter can fly straight up and down, this is the most dangerous mode of operation. The safest and most effective way to land and take off is similar to that used by fixed-wing aircraft. Landing at a slight angle allows for safer operations. Takeoff combines a gradual lift and forward motion to travel up and out on a slight angle.

An important part of conducting a medivac is choosing the best location. Establishing a landing zone is the responsibility of the ground EMS crew. It involves more than simply looking for a clear space. You must be prepared to take action to ensure the flight crew is able to land and take off safely. Things to do and consider when selecting and establishing a landing zone include the following:

- Ensure the area is a hard or grassy level surface that measures 100 feet × 100 feet (recommended) and no less than 60 feet × 60 feet **Figure 37-31**. If the site is not level, notify the flight crew of the steepness and direction of the slope.
- Ensure the area is clear of any loose debris that could become airborne and strike the helicopter or the patient and crew. This includes branches, trash bins, flares, caution tape, and medical equipment and supplies.
- Examine the immediate area for any overhead or tall hazards such as power lines or telephone cables, antennas, and tall

or leaning trees. If you see any of these hazards, immediately inform the flight crew because an alternative landing site may be required. The flight crew may request that the hazard be marked or illuminated by weighted cones or that an emergency vehicle with its lights turned on be positioned next to or under the potential hazard.

- To mark the landing site, use weighted cones or position emergency vehicles at the corners of the landing zone with the headlights facing inward to form an ×. This procedure is essential during night landings as well. It is common for fire suppression personnel to help mark the landing site since they are often called to the scene to stand by. Never use caution tape or ask people to mark the site. You also should not use flares because not only can they become airborne, but they also have the potential to start a fire or cause an explosion.
- Move all nonessential people and vehicles to a safe distance outside of the landing zone.
- If the wind is strong, radio to the flight crew the direction of the wind. They may request that you create some form of wind directional device to aid their approach.

Figure 37-31 A landing area should be a level surface measuring 100 feet × 100 feet.

Landing Zone Safety and Patient Transfer

Helicopter safety is a combination of using good sense and a constant awareness of the need for personal safety. You should stay away from the helicopter and go only where the pilot or crew member directs you. The most important rule is to keep a safe distance from the aircraft whenever it is on the ground and "hot," which means when the helicopter blades are spinning. The rotor blades will usually remain running because the flight crew does not generally expect to remain on the ground for a long time. This means all EMTs should stay outside the landing zone perimeter unless directed to come to the aircraft by the pilot or a member of the flight crew. Usually, the flight crew will come to the EMTs carrying their own equipment and do not require any assistance inside the landing zone. If you are asked to enter the landing zone, stay away from the tail rotor; the tips of its blades move so rapidly that they appear invisible. With the possible exception of a rear-loading aircraft, always approach a helicopter from the front, even if it is not running, and you should approach only after the pilot signals it is clear to do so. If you imagine the front of the helicopter as the number 12 on a clock, then you should enter only the area between the ten o'clock and two o'clock positions. If you must move from one side of the helicopter to another, go around the front. Never duck under the body, the tail boom, or the rear section of the helicopter. The pilot cannot see you in these areas.

Another area of concern is the height of the main rotor blade. On many aircraft, it is flexible and may dip as low as 4 feet off the ground **Figure 37-32**. When you approach the aircraft, walk in a crouched position. Wind gusts can alter the blade height without warning, so protect your equipment as you carry it under the blades. Air turbulence created by the rotor blades can blow off hats and loose equipment. These objects, in turn, can become a danger to the aircraft and personnel in the area.

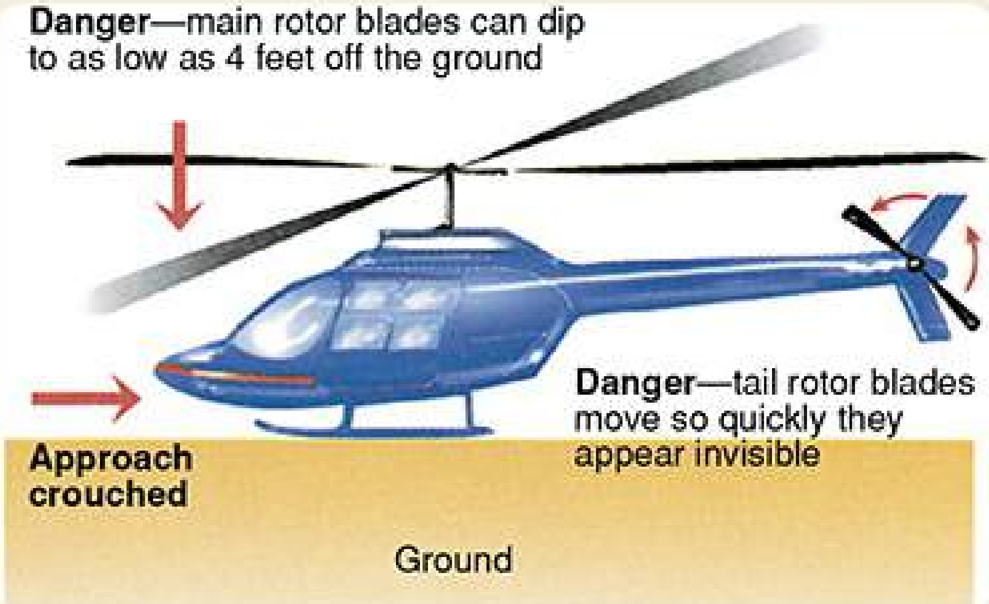

Figure 37-32 The main rotor blade of the helicopter is flexible and may dip as low as 4 feet off the ground.

When accompanying a flight crew member, you must follow directions exactly. Never open any aircraft door or move equipment unless instructed by a crew member. When told to approach the aircraft, use extreme caution and pay constant attention to hazards.

YOU are the Provider — PART 5

After turning around and determining a new route, your partner advises you there is now a 25-minute transport time. Your partner also warns that you are rapidly approaching a stopped school bus with its stop sign out, and children are exiting the bus.

Recording Time: 22 Minutes	
Level of consciousness	Alert and oriented
Respirations	20 breaths/min; adequate depth
Pulse	104 beats/min; strong and regular
Skin	Pink, warm, and dry
Blood pressure	142/90 mm Hg
Spo_2	97% (at room air)

8. When traveling in the emergency mode, how do you respond to a stopped school bus?
9. Where do most serious ambulance crashes occur, and what should you do to help avoid a crash?

Keep the following guidelines in mind when operating at a landing zone:

- Familiarize yourself with helicopter hand signals used within your jurisdiction **Figure 37-33**.

- Do not approach the helicopter unless instructed and accompanied by flight crew.
- Ensure all patient care equipment is properly secured to the stretcher and that the patient is fastened as well. This includes oxygen tanks, cervical collars, and head stabilizers. Any loose articles or belongings such as hats, coats, or bags that belong to the patient or crew should not be brought into the landing zone and will likely need to be transported to the hospital by ground.
- Be aware some helicopters may load patients from the side, whereas others have rear-loading doors. Regardless of where the patient is being loaded, always approach the aircraft from the front unless otherwise instructed by the flight crew. It is very important that the pilot be able to see anyone who comes under the rotors. Always take the same path when exiting away from the helicopter, moving the patient headfirst.
- Smoking, open flames, and flares are prohibited within 50 feet of the aircraft at all times.
- Wear eye protection during approach and take off.

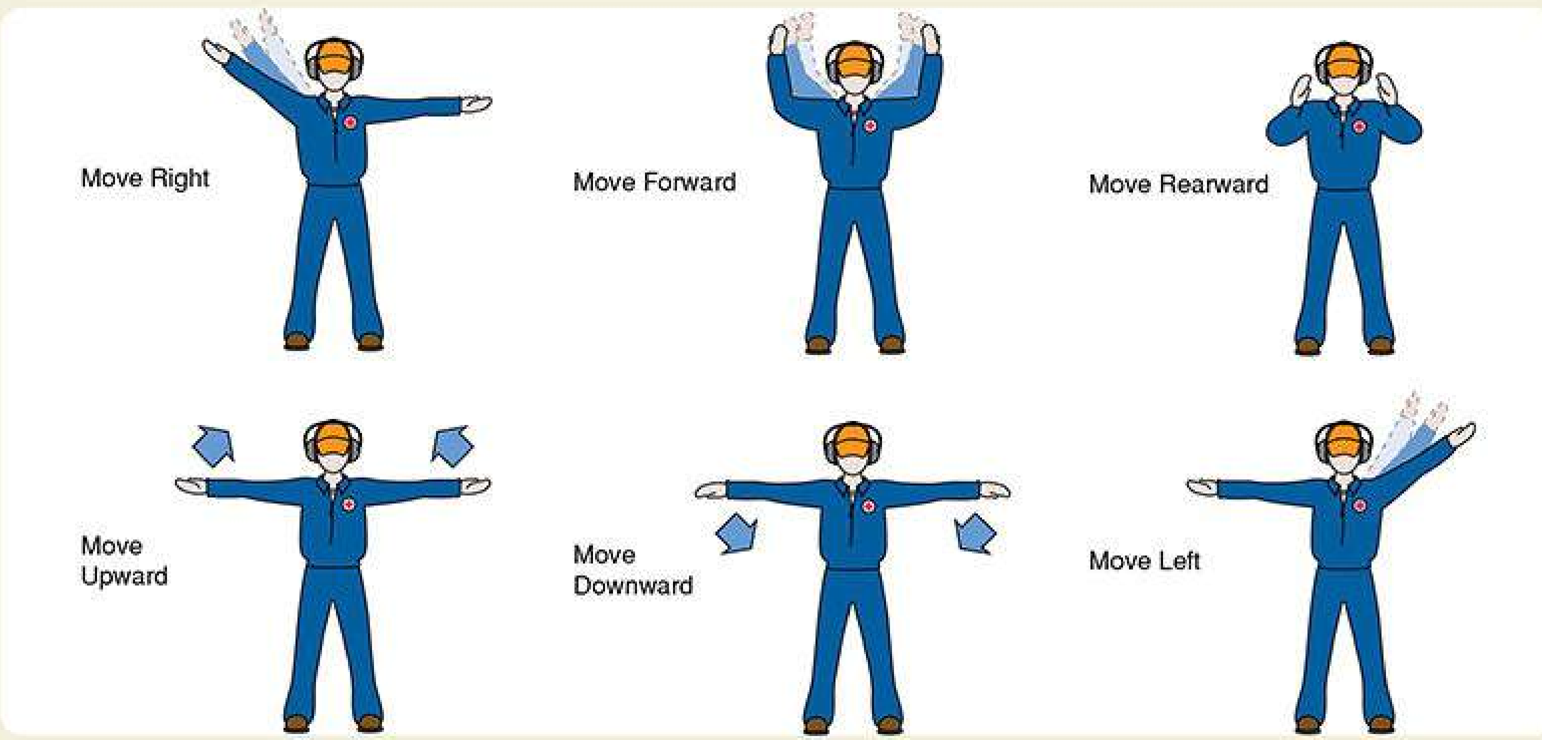

Figure 37-33 Some examples of helicopter hand signals. Be familiar with those used within your jurisdiction.

Communication Issues

When interacting with other agencies, there is always the possibility of communication issues. Medivacs are no exception. While the typical EMS system has its specific and well-defined jurisdiction, medivacs respond to service requests throughout a large, multijurisdictional area. Because of this large area with numerous jurisdictions, the medivac interacts with many services on a multitude of different radio frequencies.

To prevent any miscommunication, when the request is made for a medivac response, the request should include a ground contact radio channel (typically a preestablished mutual aid channel), as well as a call sign of the unit that the medivac should make contact with.

Special Considerations

Night Landings

Nighttime operations are considerably more hazardous than daytime operations because of the darkness. The pilot will generally fly over the area at least twice at varying altitudes with the helicopter's lights on in order to identify potential obstacles and overhead wires, which can be hard to see. Do not shine spotlights, flashlights, or any other lights in the air to help the pilot; they may temporarily blind the pilot. Instead, direct low-intensity headlights or lanterns toward the ground at the landing site from opposite corners to form an × at the center of the landing zone. Turn off all headlights or lanterns that are facing in the direction of the aircraft once it has landed; after the helicopter has landed, you should not aim lights near the aircraft. Always make certain the flight crew is aware of any overhead hazards or obstructions, and illuminate these if possible.

Landing on Uneven Ground

If the helicopter must land on a grade (uneven surface), extra caution is advised. The main rotor blade will be closer to the ground on the uphill side. In this situation, approach the aircraft only from the downhill side or as directed by the flight crew **Figure 37-34**. Do not move the patient to the helicopter until the crew has signaled that they are ready to receive you.

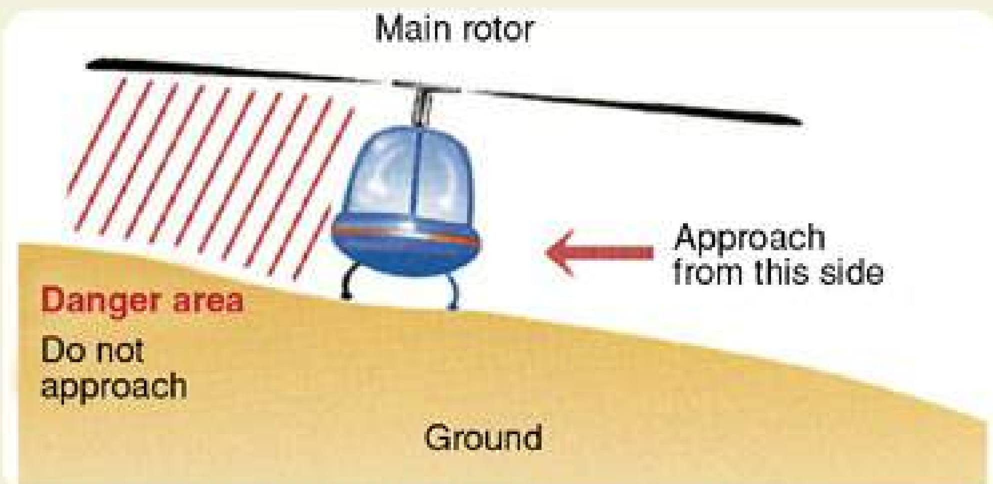

Figure 37-34 Approach a helicopter only on a grade from the downhill side.

Medivacs at Hazardous Materials Incidents

Notify the flight crew immediately of the presence of HazMat at the scene. The aircraft generates tremendous wind and may easily spread any HazMat vapors present. Always consult the flight crew and incident commander about the best approach and distance from the scene for a medivac. The landing zone should be established upwind and uphill from the HazMat scene. Any patients who have been exposed to a HazMat must be properly decontaminated before you load them into the aircraft. For proper procedures at HazMat incidents, refer to Chapter 38, *Incident Management*.

▶ Medivac Issues

While making the decision to request medivac, several important factors need to be taken into consideration. These factors are weather, the environment/ terrain, altitude, airspeed limitations, cabin size, and cost. Typically, helicopters are unable to operate in severe weather conditions such as thunderstorms, blizzards, and heavy rain. The environment may pose a risk as well. In mountainous or desert terrain, there may be too many hazards in the immediate vicinity to safely land the helicopter in the desired location.

As the elevation increases, the air thins, which makes it more difficult for pilots and patients to breathe. Because of this danger, helicopters have a maximum limit on flight elevations. Most helicopter services are limited to flying at 10,000 feet above sea level. This could create a problem if your patient is located at 13,500 feet above sea level. Remember that medivac helicopters are not jets, so it takes time for them to arrive on the scene, because of limitations in airspeed. Typically medivac helicopters fly between 130 and 150 mph.

Because of the helicopter cabin's confined space, helicopters are limited in the number of patients that can be safely transported and by the size of the patient that they can safely transport. Although a helicopter may be able to safely lift off with a 500-lb (227-kg) patient, because of his or her size and girth, it may be impossible to safely fit and secure the patient into the cabin area.

Typical medivac flights are extremely expensive compared to ambulance transports; however, the level of care may be higher and the overall transport time may be much shorter in the helicopter. The decision to request a medivac should not be based on the perceived ability of the patient to pay the bill, but rather on the medical necessity.

YOU are the Provider — SUMMARY

1. What attributes should an emergency vehicle operator possess?

Clearly, not everyone who drives a motor vehicle is qualified to operate an emergency vehicle. In many states, EMTs are required to successfully complete an emergency vehicle operator course before they are allowed to drive the ambulance in emergency mode. Many EMS systems require completion of an emergency vehicle operator course as well as clearance by a supervisor or field training officer.

All the training in the world cannot replace reasonable judgment and common sense; these are the most crucial attributes that any vehicle operator must possess, not just an emergency vehicle operator.

Regardless of your systems' requirements for operating an emergency vehicle, constant care and caution are important qualities for all operators of emergency vehicles, as are a positive attitude about your driving abilities and tolerance of other motorists.

2. What factors should you consider before responding to the scene?

Before you depart your station, you need to consider a number of factors that will ensure an easy, quick, and safe response. First, regardless of what method you use to navigate to the location, you must know exactly where you are going and then notify the dispatcher that you are en route. If there is any question or confusion regarding the location of the call, ask the dispatcher for confirmation. Ask if there is a cross street that you can use as a point of reference. Choose the shortest and least congested route to the scene, considering the time of day. In this case, it is 1730 hours, the traffic is heavy, and it is rush hour on a weekday; therefore, the most obvious route to the scene may not be the quickest and safest.

Another factor to consider before you respond is the weather. Although you must go into "safety mode" prior to responding—regardless of the weather conditions—you must use extra caution during bad weather.

There are numerous other factors to consider before responding—some of which may be unique to your location. However, if safety is at the forefront of your mind, your ability to get to the scene *quickly and safely* will be maximized.

3. Based on the mechanism of injury and patient presentation, what equipment do you anticipate needing?

For this patient you would need the jump kit, which should contain anything you might need within the first 5 minutes after making contact with any patient, including splinting and bandaging supplies. In addition, spinal immobilization requires a backboard, an appropriately sized cervical collar, and some type of cervical immobilization device. If he were unstable, splinting and bandaging should be delayed until you are en route, and all other necessary assessments and treatments are completed.

4. What assessment and treatment should be performed on scene and what should be delayed until you are in the ambulance and en route to the hospital?

This patient is stable with only an isolated injury. There was not a loss of consciousness and vital signs are within normal limits. Since this is not a priority load and go patient, you should complete your secondary assessment on scene and take the time to splint his arm. Apply a spinal immobilization device, if indicated, prior to moving the patient.

Once you are en route to the hospital, repeat the primary assessment, including taking vital signs, and reassess the effectiveness of any interventions. Now would also be the time to manage any minor secondary injuries. Remember that stable patients should be reassessed every 15 minutes, and critical or unstable patients should be reassessed every 5 minutes.

5. How would you determine whether to use lights and siren during transport of this patient?

The transport mode (eg, lights and siren [emergency mode] versus no lights and siren [nonemergency mode]) is determined by the patient's present condition and his or her anticipated clinical outcome. In this case, the patient is stable; he is alert and oriented, his vital signs are stable, and he has no life-threatening conditions (eg, airway problems, uncontrolled bleeding); therefore, the use of lights and siren during transport is not indicated.

6. What should you consider when deciding whether it is appropriate to turn on the lights and siren to maneuver through traffic?

Regulations regarding vehicle operations vary by state and by city, but some regulations are the same regardless of location. Emergency vehicle operators have certain limited privileges in every state. However, these privileges do not lessen your liability in a crash.

Three basic principles govern the use of warning lights and siren on an ambulance:

1. The unit must be, to the best of your knowledge, on a true emergency call.
2. Audible and visual warning devices must be used simultaneously.
3. The unit must be operated with due regard for the safety of all others, on and off the roadway.

In this situation, the patient's condition does not warrant the use of lights and siren. If you choose to use an emergency transport you will put yourself, your partner, your patient, and other motorists at risk. You could also face possible litigation. You have time to take an alternate route and avoid creating more hazards as other drivers try to move out of the way.

7. If you are in an unfamiliar area and do not know an alternate route, what are your options?

The best option would be to use a GPS device to navigate through an unfamiliar area. Another option is to call the dispatcher via radio and ask for street by street directions. As a last resort, a police escort may be requested.

8. When traveling in the emergency mode, how do you respond to a stopped school bus?

Although state motor vehicle statutes or codes often grant an emergency vehicle certain privileges when responding to an emergency, special privileges are not given to emergency vehicles when driving through a school zone or approaching a stopped school bus that is loading or unloading children. In these situations, the emergency vehicle operator is required to obey the law like any other motorist.

An emergency vehicle operator is never allowed to pass a school bus that has stopped to load or unload children and is displaying its red warning lights and extended "stop arm." If you approach a school bus that is loading or unloading children, you should stop before you reach the bus and turn off your siren. Wait for the bus driver to make sure the children are safe, the bus door has been closed, and its red warning lights are turned off. *Only then may you cautiously proceed past the stopped school bus*.

9. Where do most serious ambulance crashes occur, and what should you do to help avoid a crash?

Intersection crashes are the most common—and usually the most serious—type of crash involving ambulances. Therefore, the emergency vehicle operator must be especially careful and alert when approaching an intersection. If you are operating the vehicle in emergency mode and cannot wait for traffic lights to change, you should still come to a complete stop, look around for other motorists and pedestrians, and then cautiously proceed. The same applies if you approach an intersection with stop signs.

EMS Patient Care Report (PCR)

Date: 04-20-16	**Incident No.:** 014522	**Nature of Call:** Fall		**Location:** 1245 Chance Pl	
Dispatched: 1730	**En Route:** 1730	**At Scene:** 1737	**Transport:** 1805	**At Hospital:** 1842	**In Service:** 1902

Patient Information

Age: 62 **Sex:** M **Weight (in kg [lb]):** 79 kg (175 lb)	**Allergies:** Wasp stings, iodine **Medications:** Hydrochlorothiazide **Past Medical History:** Hypertension **Chief Complaint:** Left arm pain

Vital Signs

Time: 1742	**BP:** 138/86	**Pulse:** 98	**Respirations:** 20	**Spo_2:** 99% RA
Time: 1749	**BP:** 136/88	**Pulse:** 98	**Respirations:** 18	**Spo_2:** 100% RA
Time: 1759	**BP:** 142/90	**Pulse:** 104	**Respirations:** 20	**Spo_2:** 97% RA
Time: 1809	**BP:** 140/88	**Pulse:** 100	**Respirations:** 20	**Spo_2:** 98% RA
Time: 1819	**BP:** 136/86	**Pulse:** 94	**Respirations:** 18	**Spo_2:** 98% RA

EMS Treatment (circle all that apply)

Oxygen @ __ L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting** Lt forearm	**Other:** emotional support

Narrative

Dispatched to a residence for a "fall." Arrived on scene to find a 62-year-old man who had fallen approximately 3 feet from a ladder, landing on his outstretched left hand. The patient is alert and oriented and denies any loss of consciousness. Patient reports isolated left arm pain with crepitus and deformity to the left forearm. Vital signs are within normal limits, and secondary assessment was normal. Patient has good pulse, movement, and sensation in left wrist. Breath sounds are clear and equal bilaterally, and pupils are equal and reactive to light. Although patient denies any neck or back pain, he agrees to full spinal immobilization as a precautionary measure due to the mechanism of injury in the context of a distracting injury to the forearm. Splinted left forearm, immobilizing the elbow and wrist, and reassessed pulse, motor, and sensory functions. Patient was also immobilized on a backboard with cervical collar and head blocks with tape. Patient was then placed on stretcher and loaded into the ambulance. En route monitored vital signs and level of consciousness. Prior to reaching the destination, Medic unit was forced to detour due to a motor vehicle crash, and transport time was extended by 25 minutes. Closely monitored the patient's ABCs for the duration of the transport and provided emotional support as needed. His condition remained unchanged. Arrived at the hospital, gave verbal report to the staff nurse, and transferred patient care.**End of report**

Prep Kit

Ready for Review

- Today's ambulances are designed according to strict government regulations based on national standards.
- The six-pointed Star of Life emblem identifies vehicles that meet federal specifications as licensed or certified ambulances.
- An ambulance call has nine phases:
  - Preparation for the call
  - Dispatch
  - En route
  - Arrival at scene
  - Transfer of the patient to the ambulance
  - En route to the receiving facility (transport)
  - At the receiving facility (delivery)
  - En route to the station
  - Postrun
- Certain items, like sterile gloves, must be available on the ambulance at all times, as dictated by state and jurisdictional requirements.
- Every ambulance must be staffed with at least one EMT in the patient compartment whenever a patient is being transported. However, two EMTs are strongly recommended. Some services may operate with a non-EMT driver and a single EMT in the patient compartment.
- Check all medical equipment and supplies daily, including all the oxygen supplies, the jump kit, splints, dressings and bandages, backboards and other immobilization equipment, and the emergency obstetric kit.
- During the postrun phase, you should complete and file any additional written reports and inform dispatch of your status, location, and availability. Perform a routine inspection to ensure the ambulance is ready to respond to the next call.
- Learning how to properly operate your vehicle is just as important as learning how to care for patients when you arrive on the scene.
  - The first rule of safe driving in an emergency vehicle is that speed does not save lives; good care does.
  - The second rule is that the operator and all passengers must wear seat belts and shoulder restraints at all times.
- Air ambulances are used to evacuate medical and trauma patients.
  - There are two basic types of air medical units: fixed-wing and rotary-wing, otherwise known as helicopters.
  - A medical evacuation is commonly known as a medivac and is generally performed exclusively by helicopters.

Vital Vocabulary

air ambulances Fixed-wing and rotary-wing (known as helicopters) aircrafts that have been modified for medical care; used to evacuate and transport patients with life-threatening injuries to treatment facilities.

ambulance A specialized vehicle for treating and transporting sick and injured patients.

blind spots Areas of the road that are blocked from your view by your vehicle or mirrors.

cleaning The process of removing dirt, dust, blood, or other visible contaminants from a surface.

CPR board A device that provides a firm surface under the patient's torso.

cushion of safety Keeping a safe distance between your vehicle and any vehicles around you.

decontaminate To remove or neutralize radiation, chemical, or other hazardous material from clothing, equipment, vehicles, and personnel.

disinfection The killing of pathogenic agents by direct application of chemicals.

first-responder vehicles Specialized vehicles used to transport EMS equipment and personnel to the scenes of medical emergencies.

high-level disinfection The killing of pathogenic agents by using potent means of disinfection.

hydroplaning Occurs when the tires of a vehicle are lifted off the road surface as a result of water "piling up" underneath them, making the vehicle feel as though it is floating.

jump kit A portable kit containing items that are used in the initial care of the patient.

medivac Medical evacuation of a patient by helicopter.

spotter A person who assists a driver in backing up an ambulance to help adjust for blind spots at the back of the vehicle.

Star of Life The six-pointed star emblem that identifies vehicles that meet federal specifications as licensed or certified ambulances.

sterilization A process, such as heating, that removes microbial contamination.

Assessment *in Action*

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It is time for your annual competency assessment. This test includes knowledge and skills assessments. You refer to your EMT textbook to prepare by answering sample questions provided.

1. The features found in a modern ambulance are defined by which of the following agencies?

   A. Department of Transportation
   B. National Association of EMS Directors
   C. American Ambulance Association
   D. National Research Council of the National Academy of Sciences

2. If you are on an emergency call with your warning lights and siren turned on, you may be allowed to do which of the following?

   A. Proceed through a red traffic light or stop sign without stopping.
   B. Drive faster than the posted speed limit.

C. Drive against the flow of traffic on an interstate in the left lane.
D. Pass a stopped school bus with the stop sign out.

3. Keeping a safe distance between your vehicle and the one in front of you, checking for tailgaters behind your ambulance, and being aware of objects in your mirror's blind spots are considered maintaining a(n):

A. buffer zone.
B. open space.
C. cushion of safety.
D. evasion area.

4. Which of the following is a cause of fatigue?

A. Family interaction
B. Working during the day
C. Sleeping only 6 hours
D. Stress

5. During the _____ phase of an ambulance call, the crew should review dispatch information about the nature of the call and the location of the patient.

A. preparation
B. dispatch
C. en route
D. postrun

6. If you arrive on the scene of a mass-casualty incident, what is the first thing you should do?

A. Declare the area a crime scene.
B. Direct traffic until law enforcement arrives.
C. Ask for additional resources.
D. Begin treating patients.

7. To ensure you have enough reaction time to avoid hitting a motorist who does not move over, you should drive, at minimum, about _____ seconds behind vehicles traveling at an average speed.

A. 2
B. 4
C. 6
D. 8

8. When responding to a scene where smoke or possible hazardous materials are present it is best to park:

A. uphill and upwind.
B. uphill and downwind.
C. downhill and downwind.
D. downhill and upwind.

9. You are treating a 45-year-old woman who is has chest pain. Her blood pressure is 92/40 mm Hg; pulse rate, 132 beats/min and irregular; and respirations, 24 breaths/ min and labored. Should you use lights and siren when transporting this patient? Justify your answer.

10. You respond to a motor vehicle crash with massive damage to the front of the vehicle where it struck a tree head on. The only occupant is a young man, who is unrestrained, unresponsive, and entrapped. Fire rescue is on scene preparing for extrication, and a responding paramedic unit is attending the patient. The supervisor informs you he has requested a helicopter to respond and has asked you and your partner to prepare a landing zone. What should your considerations be when establishing a landing zone?

CHAPTER 38

Vehicle Extrication and Special Rescue

National EMS Education Standard Competencies

EMS Operations

Knowledge of operational roles and responsibilities to ensure patient, public, and personnel safety.

Vehicle Extrication

› Safe vehicle extrication (pp 1389-1398)
› Use of simple hand tools (p 1396)

Knowledge Objectives

1. Explain the responsibilities of an EMT in patient rescue and vehicle extrication. (p 1389)
2. Discuss how to ensure safety at the scene of a rescue incident, including scene size-up and the selection of the proper personal protective equipment and additional necessary gear. (pp 1389, 1391–1395)
3. Describe examples of vehicle safety components that may be hazardous to both EMTs and patients following a collision and how to mitigate their dangers. (pp 1389–1390)
4. Define the terms extrication and entrapment. (p 1390)
5. Describe the ten phases of vehicle extrication and the role of the EMT during each one. (pp 1391–1398)
6. Discuss the various factors related to ensuring situational safety at the site of a vehicle extrication, including controlling traffic flow, performing a 360-degree assessment, stabilizing the vehicle, dealing with unique hazards, and evaluating the need for additional resources. (pp 1391–1395)
7. Describe the special precautions the EMT should follow to protect the patient during a vehicle extrication. (pp 1395–1396)
8. Explain the different factors that must be considered before attempting to gain access to the patient during an incident that requires extrication. (pp 1391–1395)
9. Explain the difference between simple access and complex access in vehicle extrication. (pp 1396–1397)
10. Discuss patient care considerations related to assisting with rapid extrication, providing emergency care to a trapped patient, and removing and transferring a patient. (pp 1397–1398)

11. Describe examples of situations that would require special technical rescue teams and the EMT's role in these situations. (pp 1399–1403)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

As an EMT, you will usually not be responsible for rescue, though you may assist with extrication. Rescue involves many different processes and environments, including vehicle, water, and wilderness rescue. These incidents require training beyond the level of the EMT. You must understand the basic concepts of extrication in order to function effectively as part of a team during a rescue incident. In some cases, you may be the first emergency unit to arrive at the scene, and your initial actions may determine how efficiently the rescue is completed.

The chapter begins with a discussion of safety at the scene of a rescue incident, followed by the 10 phases of extrication. This includes how to gain access to patients and how to keep yourself, your partner, patients, and bystanders safe in the process. In most cases, once you have reached the patient, extrication will occur around you and the patient. Communication between you and the personnel performing the extrication is vital.

Safety

You must always be prepared, mentally and physically, for any incident that requires rescue or extrication. Your priority as an EMT is to provide patient care. However, your personal safety and the safety of your team are paramount and must be addressed before patient care is initiated. Safety begins with the proper mind-set and the proper protective equipment.

The equipment that you use and the gear that you wear will depend on the hazards you expect to encounter, as well as what you observe during your scene size-up **Figure 38-1**. Such protective gear may include turnout gear, a helmet, hearing protection, and a fire extinguisher. However, the importance of wearing blood- and fluid-impermeable gloves at all times during patient contact cannot be over emphasized. If you will be involved with extrication, wear a pair of leather gloves over your disposable gloves to protect you from injury when handling ropes, tools, broken glass, hot or cold objects, or sharp metal.

Figure 38-1 Proper protective equipment varies depending on the anticipated hazards.

Vehicle Safety Systems

A variety of safety systems are used in modern vehicles. Although many of these devices are useful when the vehicle is in motion, they can become hazards after the vehicle has been involved in a crash.

YOU are the Provider — PART 1

It is 1622 hours and your unit is dispatched to a small private airport for a single-engine plane crash involving two passengers. The plane was coming in to refuel and crashed just prior to landing. It is a two-seater aircraft. Upon arrival, a fire rescue team member advises you that a 360-degree assessment of the scene has been performed and it is safe. The pilot has massive head and facial trauma that is incompatible with life. Rescue personnel are attempting to access a woman trapped in the passenger seat located behind the pilot.

1. What information is obtained from a 360-degree assessment of a plane crash?
2. How would your approach change if leaking fuel were present?

Shock-absorbing bumpers provide vehicle protection from low-speed impact. Following a front or rear-end crash, the shock absorbers within these bumpers may be compressed or “loaded.” Avoid standing directly in front of such bumpers, and always approach vehicles from the side, because the shock absorbers can release and injure your knees and legs.

Manufacturers are now mandated to incorporate supplemental restraint systems, or air bags, into their vehicles. These air bags fill with a nonharmful gas on impact and quickly deflate after the crash. Air bags are located in the steering wheel and the dashboard in front of the passenger, and they deploy when the vehicle is struck from the front or rear. Side-impact air bags may be present to protect the driver and passengers from side impacts; these may be located in the doors or seats.

Air bags should normally deploy and deflate before your arrival on the scene. However, air bags that have not deployed may spontaneously inflate while you provide patient care, causing injury to you. Use caution when working in damaged vehicles in which air bags have not inflated. Generally, you should maintain at least a 5-inch (13-cm) clearance around side-impact air bags, a 10-inch (25-cm) clearance around driver-side air bags, and a 20-inch (51-cm) clearance around passenger-side air bags.

Words of Wisdom

A vehicle crash scene can present many hazards to emergency responders and patients, including fuel spills that pose fire and explosion risks, downed power lines that pose electric hazards, broken glass and torn metal, and exposure to potentially infectious body fluids. Your safety at every type of emergency scene begins with, and depends on, your scene size-up. What you see at the scene helps you determine which personal protective equipment to use and whether to call for additional or specialized assistance.

You may notice a haze similar to smoke inside vehicles in which air bags have deployed. This haze is caused by the cornstarch or talcum powder that manufacturers used to place on the air bags to prevent minor skin irritations by reducing the friction between the occupant's skin and the airbag. Appropriate protective gear, including eye protection, will reduce the risk of eye or lung irritation from this substance.

Fundamentals of Extrication

As an EMT, your primary concern during all phases of a rescue is safety, and your primary roles are to provide emergency medical care and prevent further injury to the patient. You will provide care to the patient as extrication goes on around you unless this proves to be too dangerous for you or the patient. **Extrication** is the removal from entrapment or from a dangerous situation or position (also called disentanglement).

Entrapment is a condition in which a person is caught within a closed area with no way out or has a limb or other body part trapped. In the context of this chapter, extrication means removal of a patient from a wrecked vehicle. However, the same principles and concepts apply to other situations, such as a collapsed building.

Words of Wisdom

Extended entrapment of a limb or other body part can lead to crush syndrome in a patient. Crush syndrome requires specific and specialized care that is discussed in greater detail in Chapter 26, *Soft-Tissue Injuries.*

Each emergency responder has a distinct role at a vehicle extrication scene. EMS providers assess patients, provide immediate medical care, triage and package patients, provide additional assessment and care as needed once patients are removed, and provide transport to the emergency department.

The rescue team secures and stabilizes the vehicle, provides safe entrance and **access** to the patients (the ability to reach the patients), safely extricates patients, and provides adequate room so that patients can be removed properly.

Law enforcement officers control traffic, maintain order at the scene, establish and maintain a perimeter so that bystanders are kept at a safe distance, and ultimately investigate the crash or crime scene. Firefighters extinguish fire, prevent additional ignition, ensure that the scene is safe, and remove spilled fuel **Figure 38-2**.

Roles and responsibilities often vary based on jurisdiction and the available agencies. For example, the fire department may take primary responsibility for traffic control in certain situations. An incident commander (discussed later in the chapter) should take command of the scene and coordinate the response, ensuring the agencies work seamlessly together. Good communication among team members and clear leadership are essential to safe, efficient provision of proper emergency care.

Figure 38-2 EMS providers, the rescue team, law enforcement officers, and firefighters have distinct responsibilities at a rescue scene and must cooperate to manage the incident.

There are 10 phases to the extrication process Table 38-1. Many are similar to the phases of an ambulance call (discussed in Chapter 37, *Transport Operations*). Each will be discussed, with emphasis on the phases in which you will participate.

Words of Wisdom

The scene of an extrication is dynamic—it constantly changes. Be alert to new dangers and plan an escape route.

Table 38-1 Ten Phases of Extrication

1. Preparation
2. En route to the scene
3. Arrival and scene size-up
4. Hazard control
5. Support operations
6. Gaining access
7. Emergency care
8. Removal of the patient
9. Transfer of the patient
10. Termination

Safety Tips

Just as in patient care, the first priority in rescue is *personal safety*.

Preparation

Preparing for an incident requiring extrication involves pre-incident training with rescue personnel for the various types of rescue situations to which you might respond. On a daily basis, just as you must check the equipment carried on the ambulance, rescue personnel must also check the extrication tools and their response vehicles to ensure proper operation. Such preparations reduce the possibility of equipment failure at an emergency scene.

En Route to the Scene

The procedures and safety precautions similar to those discussed in the phases of an ambulance call are used when responding to a rescue incident.

Arrival and Scene Size-up

If you are the first unit to arrive on the scene, position the ambulance to block the scene from oncoming traffic. Use only essential warning lights, because too many lights tend to distract or confuse motorists. Many emergency responders have been injured on scenes when they were struck by passing vehicles. (In some locales, policies indicate that emergency lighting can be reduced or turned off after the scene is secured; this may reduce the risk of a secondary crash.) If you are not the first to arrive, choose a location that will allow safe access to the scene while leaving yourself a way out. Do not park in an area where you will be blocked in. If law enforcement or fire units have blocked the roadway, position your unit so that the back of the ambulance is pointing toward the scene to facilitate patient transport.

Avoid adding a hazard to the scene by parking alongside the incident on an active roadway; this could increase the risk of your vehicle or responders being struck. Sometimes the scene at a crash is complicated by the presence of **hazardous materials**. A hazardous material is any substance that is toxic, poisonous, radioactive, flammable, or explosive and can cause injury or death with exposure. Therefore, always park uphill and upwind from the hazard.

Before exiting your vehicle at an emergency scene, put on proper protective gear. Be alert for any vehicles that might cause injury to you. Do not assume that motorists will always heed the warning lights.

Figure 38-3 The scene of a crash should be marked properly, and traffic should be diverted so that responders have enough room to work.

Before proceeding, make sure that the scene is properly marked and protected. Request assistance from law enforcement and/or fire personnel **Figure 38-3**, who should close the road or divert traffic safely around the scene with cones, flares, or barricade tape. Remember, your job is to provide patient care. You may be forced to direct traffic until other units arrive, but ultimately, traffic control is usually handled by other public safety units.

Words of Wisdom

When responding to incidents at night, use your headlights and spotlights to illuminate the scene. Wear a high visibility reflective safety vest so that you will be seen by fellow emergency responders and motorists.

Size-up is the ongoing process of information gathering and scene evaluation to determine appropriate strategies and tactics to manage an emergency, while paying attention to hazards such as downed power lines, leaking fluids, fire, and broken glass. One of the important responsibilities of scene size-up is to determine what, if any, additional resources will be needed. If you are first on the scene, you may need to initiate a rescue response or call for additional EMS units, law enforcement, utility departments, or specialized crews such as Hazardous Materials (HazMat).

Words of Wisdom

Practice situational awareness. Situational awareness is the ability to understand and react to the threats around you. Remember that scenes are dynamic, and be alert for changing situations. Consider weather and environmental conditions, and always be aware of traffic, patients, and bystanders.

A 360-degree walk around the scene will allow you to evaluate the hazards and potential injuries and determine the number of patients. If there is a large group of patients, implement local mass-casualty incident protocols as necessary. During your walk, look for the following:

- The mechanism of injury
- Downed power lines
- Leaking fuels or fluids
- Smoke or fire
- Broken glass
- Trapped or ejected patients
- The number of patients and vehicles involved

On the scene of a motor vehicle crash, it is important to note the physical damage to the structure of the vehicle(s). A bent steering wheel is a mechanism of injury for significant face and/or thoracic trauma. Imprints in the dashboard, which are usually the result of the knees striking it, indicate the potential for serious lower extremity injuries such as hip dislocations and fractures. Always lift deployed air bags to see if there is deformity to the steering wheel or dashboard, which indicates that the patient struck the structure after the airbag deflated. Determine if the patient was restrained or not. An unrestrained patient may have contact injuries as well as secondary injuries. If the unrestrained patient is thrown forward, he or she may strike the windshield with the head, resulting in a spider web pattern of shattered glass and possible head, face, or neck injuries. Include any findings in your documentation and maintain a high index of suspicion, even if the patient does not present with significant obvious injuries. For a detailed discussion on the kinematics of trauma, see Chapter 24, *Trauma Overview*.

Use the information you have gathered to evaluate the need for additional resources such as:

- Extrication equipment
- Fire department
- Law enforcement
- HazMat unit
- Utility company
- Advanced life support unit(s)
- Air transport

Look for spilled fuel and other flammable substances. Motor vehicles carry a variety of fuels and lubricants that pose a fire hazard. Sometimes post-crash fires are started when sparks created during the crash ignite spilled fuel. A short in a vehicle's electric system or a damaged battery may also cause a postcrash fire. These fires may trap the occupants of the vehicle and require fire suppression.

Environmental conditions can lead to unique hazards at a crash scene. Crashes that occur in rain, sleet, or snow, for example, present an added hazard for rescue personnel and patients. Crashes that occur on hills are harder to handle than those that occur on level ground. Uneven terrain increases the potential for the vehicle to roll over, requiring stabilization of the vehicle prior to gaining access. Remember that the conditions responsible for the crash may also cause other motorists to lose control of their vehicles and injure you.

Some crash scenes may present threats of violence if the vehicle's occupants are intoxicated or upset with other motorists. This may pose a threat to you or to others on the scene. Be alert for weapons that are carried in civilian vehicles.

You will need to coordinate your efforts with the rescue teams and with law enforcement officials. If you respect their jobs, they will respect yours. You should communicate with members of the rescue team throughout the extrication process. Report to the incident commander as soon as you arrive at the scene. Under the incident command system (described in Chapter 39, *Incident Management*), rescue operations are integrated as a separate group. You become a member of this group and will enter the vehicle and provide care for the patient(s) when approved by the incident commander.

YOU are the Provider — PART 2

The entire passenger compartment is badly damaged and the aircraft doors cannot be opened manually. There is no window next to the patient; the only window is the windshield in front of the pilot. Next to the passenger's seat are bars rather than a window. A rescue team member is able to cut through the bars with bolt cutters and use a hydraulic cutter to allow better access to the patient. Your partner is able to reach through the bars and manually stabilize the patient's head. You access the patient through the opposite side and perform a primary assessment. The woman is approximately 55 years old and is unresponsive but breathing. Her legs are pinned by the wreckage, and she has large lacerations to her left temple and right arm. The bones at the elbow are exposed.

Recording Time: 0 Minutes	
Appearance	Unresponsive with snoring respirations
Level of consciousness	Unresponsive
Airway	Open with a modified jaw thrust; clear of secretions or foreign bodies
Breathing	Decreased rate; shallow depth
Circulation	Radial pulses, weak and rapid; skin is cool, clammy, and pale; laceration to the forehead from the temple through the left orbit with minimal bleeding; laceration to right arm with the bones of the elbow exposed and bleeding controlled

Because of the mechanism of injury, the patient's clinical condition, and the possibility of a prolonged extrication, you request air transport to respond to the scene and transport her to a trauma center located 35 miles away. You apply high-flow oxygen via nonrebreathing mask, cover the laceration on her forehead, apply a cervical collar, and attempt to shield the patient from debris during the extrication process.

3. How should you initially attempt to gain access to a crash victim?
4. What treatment should you provide to a patient who is entrapped in wreckage?

Hazard Control

A variety of hazards may be present at the extrication scene. Downed power lines are a common example. Never attempt to move downed power lines. If power lines are touching or located in proximity to a vehicle involved in the crash, patients should be instructed to remain in the vehicle until power is shut off by a utility company representative.

If you are not the first on scene, in most incidents, there will be an area designated as the **safe zone**. You and the ambulance should remain in that area, outside of the danger zone **Figure 38-4**. A **danger zone (hot zone)** is an area where people can be exposed to sharp metal edges, broken glass, toxic substances, radiation, or explosion of hazardous materials.

Bystanders and family members can also create hazards. If they are allowed to get too close, they are at risk of injury and may also interfere with the overall management of the incident. For these reasons, the danger zone is off-limits to bystanders **Figure 38-5**. You should help to set up and enforce this zone. If you arrive before the rescue team, coordinate crowd control with law enforcement officials.

The vehicle itself can be a hazard. A vehicle that came to rest on its side or roof is unstable and can be dangerous to you. Rescue personnel can stabilize the vehicle with a variety of jacks or cribbing (wooden blocks). Prior to attempting to gain access to the vehicle, the vehicle should be in "park" with the parking brake set and the ignition turned off. Both battery cables should be disconnected, negative side first, to minimize the possibility of sparks or fire.

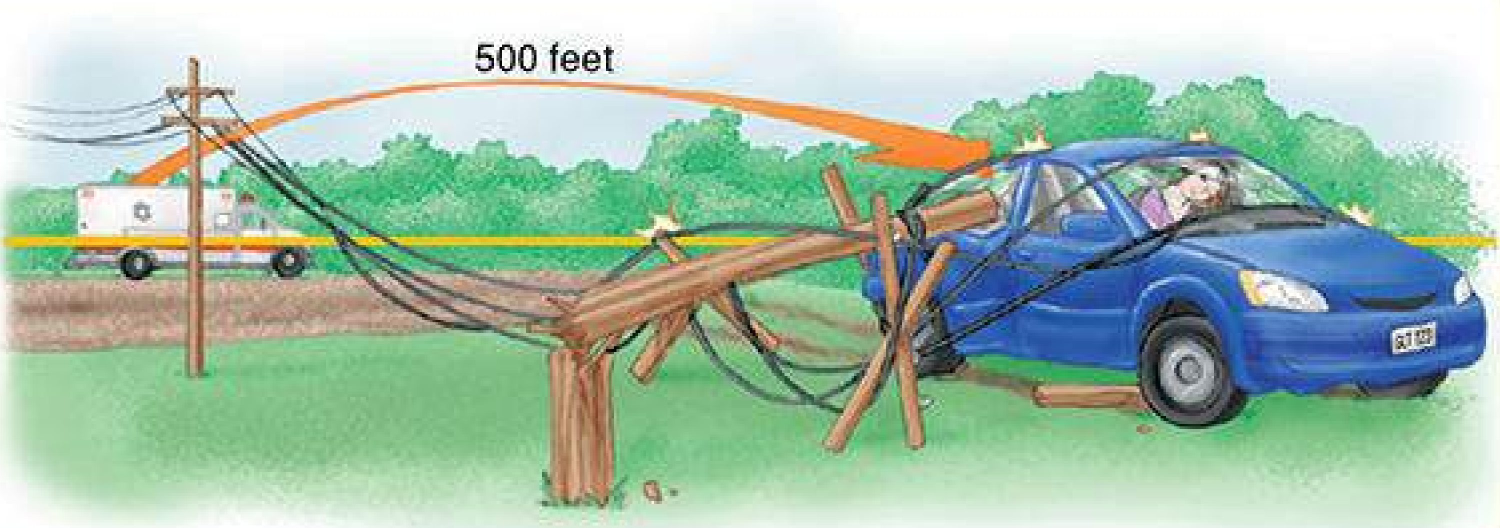


Figure 38-4 Remain outside the danger zone (hot zone).

Figure 38-5 Establish a danger zone to prevent bystanders from entering the incident area.

Safety Tips

Always assume that oncoming traffic cannot see you, and take appropriate steps to keep yourself safe. "Rubberneckers" are gawking at the crash, not looking at you!

Alternative Fuel Vehicles

Today, with advances in automotive technology, some vehicles on the road use alternative fuel. Vehicles may be powered by electricity or electricity/gasoline hybrids, or fuels such as propane, natural gas, methanol, or hydrogen. One feature is common throughout all alternative vehicles—the need for rescue personnel to disconnect the battery to prevent further fire or explosion. In more than 40% of today's alternative fuel vehicles, the batteries are not located in the engine compartment, but in other areas, such as the trunk or under the seats. Furthermore, there may be more than one battery present. You must remain vigilant when presented with alternative vehicles and be aware of their inherent dangers. For example, hybrid batteries have a higher voltage than traditional automotive batteries, and it may take up to 10 minutes for a high voltage system to de-energize after the main battery is turned off. Avoid contact with high-voltage cables (typically orange) and components throughout the rescue. Damaged high-voltage batteries may also give off toxic fumes. Do not approach the vehicle if you detect an unusual odor, and retreat if you experience burning in your eyes or throat until the scene is safe. If not previously notified, call dispatch to request additional assistance from the fire department and/or HazMat team.

Support Operations

Support operations include lighting the scene, establishing tool and equipment staging areas, and marking helicopter landing zones. Fire and rescue personnel will work together on these functions.

Gaining Access

A critical phase of extrication is gaining access to the patient. Remember, do not attempt to gain access to the patient or enter the vehicle until you are sure that the vehicle is stable and that any hazards have been identified and properly controlled or eliminated. When an incident commander is present, you will be authorized to enter the scene or the vehicle only when these conditions have been met.

The safest, most efficient way to reach the patient(s) depends on the situation. It is up to you and the team to identify the best way to gain access. Darkness, uneven terrain, tall grass, shrubbery, and wreckage may make patients hard to find **Figure 38-6**. Multiple vehicles with multiple patients may be involved. If this is the situation, you should locate and rapidly triage each patient to determine who needs urgent care before you proceed with any treatment and patient packaging. Triage is discussed in Chapter 39, *Incident Management.*

Figure 38-6 The exact way to gain access depends on many factors, including the terrain, the way in which the vehicle is situated, and the weather.

Words of Wisdom

Remember that scene size-up is a dynamic and ongoing process, because the situation often changes. As a result, you may need to change your plans for gaining access and providing treatment.

To determine the exact location and position of the patient, consider the following questions:

- Is the patient in a vehicle or in some other structure?
- Is the vehicle or structure severely damaged?
- What hazards exist that pose a risk to the patient and responders?
- In what position is the vehicle? On what type of surface? Is the vehicle stable or is it likely to roll over?

You must also consider the patient's injuries and their severity, and change your course of action as you learn more about the patient's condition. What if you have to quickly remove a patient from a vehicle because the environment is threatening or you need to perform cardiopulmonary resuscitation? Chest compressions and airway management are ineffective when the patient is in a sitting position. Depending on the patient's condition and scene safety, you and your team may have to use the rapid extrication technique (discussed in Chapter 8, *Lifting and Moving Patients*) to move a patient who is not entrapped from a sitting position inside a vehicle to a supine position on a long backboard. A team of experienced EMTs should be able to perform rapid extrication in 1 minute or less.

During the access and extrication phases, make sure that the patient remains safe. For example, cover the patient with a heavy, fire-resistant blanket or place a backboard between the windshield and the patient to protect him or her from breaking glass, flying particles, tools, or other hazards. In addition, maintain good communication with the patient. Reassure the patient that everything possible is being done to remove him or her from the situation. Always describe what you are going to do before you do it and as you are doing it, even if you think the patient is unresponsive **Figure 38-7**.

In many cases, you or your partner may need to provide cervical spine immobilization or other care during extrication.

The rescue team should try to keep heat, noise, and force to a minimum and use only what is necessary to extricate the patient safely.

Figure 38-7 Always explain to the patient why you are there and what you are doing.

Simple Access

The first step is **simple access**, trying to get to the patient as quickly and simply as possible without using any tools or force. Motor vehicles are built for easy entry and exit; however, it may be necessary to use forcible entry methods. The rescue team is responsible for providing the entrance you need to gain access to the patient. In situations where the rescue team has not yet arrived and delayed access to the patient could be life threatening, simple hand tools, such as hammers, center punches (to break side or rear windows), pry bars, and hacksaws, are usually stored on the ambulance for you to use. Whenever possible, you should first try to unlock the doors (or ask the patient to unlock them) or roll down the windows. Try to open every door using the door handles to gain access before breaking any windows or using other methods of forced entry **Figure 38-8**.

> **Safety Tips**
>
> Always try before you pry.

Complex Access

Complex access requires the use of special tools, such as pneumatic and/or hydraulic devices, special training that includes breaking the wind-shield or removing the roof **Figure 38-9**. These advanced skills are typically performed by a specialized team rather than EMS providers and are listed in **Table 38-2**.

Figure 38-8 Get to the patient as quickly and simply as possible by opening the door without using tools or breaking any glass.

Figure 38-9 Complex access requires the use of pneumatic and/or hydraulic devices.

Emergency Care

Providing medical care to a patient who is trapped in a vehicle is essentially the same as for any other patient. Unless there is an immediate threat of fire, explosion, or other danger, once entrance and access to the patient have been provided and the scene is safe, you should perform a primary assessment and provide care before further extrication begins, as follows:

Table 38-2 Vehicle Extrication Techniques (Complex Access)

- Brake and gas pedal displacement
- Dashboard roll-up
- Door removal
- Roof opening and removal
- Seat displacement
- Steering column displacement
- Steering wheel cutting

1. Provide manual stabilization to protect the cervical spine, as needed.
2. Open the airway.
3. Provide high-flow oxygen.
4. Assist or provide for adequate ventilation.
5. Control any significant external bleeding.
6. Treat all critical injuries.

If the patient has obvious, life-threatening external hemorrhage, address it first (even before airway and breathing) and control it quickly.

Removal of the Patient

In the case of a vehicle extrication, work with rescue personnel to determine the best route for removal. Whereas one crash may require removal of the patient through the driver's door, a similar crash may require complete removal of the vehicle's roof. Removal of a patient from a motor vehicle is a multistep process that is intensive in terms of the number of rescue personnel involved, the equipment used, and the effort required to prevent further injury or harm.

As a part of your assessment, participate in the preparation for patient removal. Determine how urgently the patient must be extricated, where you should be positioned to best protect the patient during extrication, and, once the patient has been freed, how you will best move the patient from within the vehicle onto the backboard and onto the stretcher. Carefully examine the exposed area of the limb or other part of the patient that is trapped to determine the extent of injury and whether there is a possibility of hidden bleeding. If possible, evaluate sensation in the trapped area so that you will know whether increased pain indicates that an object is pressing on or impaled in the patient during extrication.

During this time, the rescue team assesses exactly how the patient is trapped and determines the safest, easiest way to extricate him or her. Your input is essential so that the rescue team plans an extrication that protects the patient from further harm. Reevaluate whether the patient needs to be immediately removed by using manual stabilization and the rapid extrication technique, or whether a spinal immobilization device (such as a vest-style extrication device or short backboard) can be applied before he or she is moved further. In most cases, it is impractical and difficult to properly apply extremity splints within the vehicle. Extremity injuries can generally be rapidly supported and stabilized while the patient is being removed by securing an injured arm to the body and, if a leg is injured, securing one leg to the other. This will be adequate until the patient is placed on the immobilization device or until time permits a more detailed assessment and splinting of each injury.

YOU are the Provider — PART 3

As your partner continues to manually stabilize the patient's head, she begins to respond to voice and moans loudly. As the rescue team prepares to remove enough wreckage to allow her to be pulled free, you quickly assess the patient's vital signs.

Recording Time: 7 Minutes	
Respirations	15 breaths/min; shallow
Pulse	138 beats/min; weak at the radial artery
Skin	Cool, clammy, and pale
Blood pressure	98/40 mm Hg
Oxygen saturation (Spo_2)	93% (on oxygen)

A rescue team member informs you that the medical helicopter will arrive in approximately 4 minutes. A landing zone has been established about 500 yards away.

5. Is it appropriate to obtain the vital signs of a patient who is entrapped? Why or why not?
6. What should you do as the patient is being extricated from the wreckage?

Once the extrication plan has been devised and everyone understands what will be done, determine how best to protect the patient. Often, you or your partner will be placed in the vehicle alongside the patient to monitor his or her condition as the vehicle is being forcibly cut, bent, or disassembled. Be sure to wear proper protective clothing.

Remember, your safety and that of the patient are paramount during this process. Extrication is often extremely noisy, and appropriate hearing protection should be worn by you and the patient. Be sure that you can communicate effectively with the patient and the rescue team so that you can instantly let the rescue personnel know if they need to stop.

Transfer of the Patient

Once the patient has been freed, rapidly assess any other patients who were previously inaccessible, and then perform a complete primary assessment. Provide critical interventions, if required. Make sure that the patient's spine is manually stabilized, and apply a cervical collar if this was not previously done Figure 38-10.

To avoid injuring yourself, your team members, or the patient, ensure that each EMT is positioned so that he or she can lift and carry properly at all times. Move the patient in a series of smooth, slow, controlled steps, with designated stops to allow for repositioning and adjustments. Make sure that sufficient team members are available for the move. One EMT should be in charge; he or she will plan and verbalize the exact steps that you will follow to move the patient from a sitting position in the vehicle to lying supine on the backboard or stretcher. Choose a path that requires the least manipulation of the patient and equipment. Once you are sure that everyone understands the steps and is ready, you can transfer the patient safely. Move only on the team leader's command and move the patient as a unit. While transferring the patient, continue to protect the patient from any hazards.

Figure 38-10 Once the patient has been accessed, rapidly assess the patient and make sure that the spine is manually stabilized. Apply a cervical collar if this was not previously done.

Once the patient has been placed on the stretcher, continue with any additional assessment and treatment that was deferred. If it is extremely cold or hot, raining, or snowing, load the stretcher and patient into the climate-controlled ambulance before continuing assessment and treatment. If the patient's condition requires immediate transport, provide only the additional care that is necessary to package the patient. Perform the remaining steps en route to the hospital.

Termination

Termination involves returning the emergency units to service. For rescue units, this process may be time-consuming. All equipment used on the scene, including hydraulic, electric, and hand tools, must be checked before reloading them on the vehicle.

You will also be required to check the ambulance thoroughly, replacing used supplies and decontaminating the unit as required by bloodborne pathogen standards.

Finally, rescue units and medical units will be required to complete all necessary reports.

Specialized Rescue Situations

On most calls, you can drive the ambulance to or within a short distance of the patient's location. However, in some situations, the patient can be reached only by teams trained in special technical rescues. Specialized skills of these teams include the following:

- Cave rescue
- Confined space rescue
- Cross-field and trail rescue (park rangers)
- Dive rescue
- Missing person search and rescue

- Mine rescue
- Mountain-, rock-, and ice-climbing rescue
- Ski slope and cross-country or trail snow rescue (ski patrol)
- Structural collapse rescue
- Special weapons and tactics (SWAT)
- Technical rope rescue (low- and high-angle rescue)
- Trench rescue
- Water and small craft rescue
- White water rescue

Technical Rescue Situations

A **technical rescue situation** requires specialized skills and equipment to safely enter and move around. These situations may contain hidden dangers, and it is unsafe to include personnel who do not have the necessary training and experience. A **technical rescue group** is made up of people from one or more departments in a region who are trained and on call for certain types of technical rescues. Many members of a technical rescue group are also trained as emergency medical responders (EMRs) or EMTs so that they can provide the necessary immediate care when they safely reach the patient. Even when the technical rescue group includes a paramedic or physician, generally only essential care is provided until the group members can bring the patient to the nearest safe and stable setting, known as the staging area.

If a technical rescue group is necessary but is not present when you arrive, immediately check with the **incident commander** to make sure that the group has been summoned and is en route to your location. The incident commander is the individual who has overall command of the scene in the field **Figure 38-11**. Although every team member's input at the scene is important, one person must be clearly in charge. A lack of identifiable leadership at the scene hinders the rescue effort and patient care. The incident commander's assessment of the patient and the scene will dictate how medical care, packaging, and transport will proceed. Usually, the senior medical official is responsible for this role. If no incident commander is present, follow local guidelines. (Chapter 39, *Incident Management*, discusses this in more detail.)

YOU are the Provider — PART 4

The side of the plane has been peeled down, and the patient's seat has been cut to allow access. The patient's legs are freed by moving the back of the seat. You remove the patient from the wreckage using the rapid extrication technique and perform a rapid secondary assessment as your partner reassesses her vital signs.

Recording Time: 18 Minutes	
Level of consciousness	Responsive to voice
Respirations	14 breaths/min; shallow
Pulse	148 beats/min; weak radial pulses
Skin	Cool, clammy, and pale
Blood pressure	80/58 mm Hg
Spo_2	94% (on oxygen)

You note a large, open wound just distal to her right knee with angulation of the tibia. After providing spinal immobilization, you cover the patient with a blanket.

7. How does the rapid extrication technique differ from other methods of patient removal? When is it indicated?

Figure 38-11 The incident commander is the individual who has overall command of the scene.

When you arrive at a scene where a technical rescue is in progress, you will usually be met by a member of the technical rescue group and directed or led to the staging area. If the staging area is some distance from the road, you may need to leave the ambulance on the road. The use of the ambulance stretcher is impractical in these situations; instead take a backboard and/or basket stretcher (or similar rescue stretcher) to carry the patient back to the ambulance. Be sure that you take all of the jump kits and other equipment you may need to treat and immobilize the patient at the staging area.

When you arrive at the rescue site, identify the designated staging area and set up your equipment there. As soon as the technical rescue group brings the patient to the staging area, perform a primary assessment and, after providing the treatment indicated, package the patient without delay. Although you are responsible for the patient's care, it usually requires a cooperative effort by the technical rescue group and the EMTs to carry the patient to the waiting ambulance. Consider using air transport if the patient will need to be carried or transported an extensive distance.

Safety Tips

Treat all downed wires as if they are energized (live) until you receive specific clearance from the electric company. Even if the lights are out along the street where the wires are down, never assume that the wires are de-energized. Be especially alert for downed wires after a storm that has blown down trees or tree limbs.

Search and Rescue

When someone is missing outdoors and a search effort is initiated, an ambulance is usually summoned to the incident **command post** (location of the incident commander) or staging area. Each search team will be organized to include a member who is trained at the EMR or EMT level and who carries the essential equipment to provide essential, immediate care. Your role, and that of the other EMTs who arrive with the ambulance, is to stand by at the command post until the missing person or people have been found.

As soon as you arrive at the scene and have been briefed on the situation, you should isolate and prepare the equipment you will need to carry to the patient's location; this will save time once the patient has been found or if a member of the search team is injured. The carry-in equipment, including a backboard and other devices you will need to immobilize the patient, should be left in the back of the ambulance until it is needed, so that it is protected from the weather. In addition, if the ambulance should need to be relocated, the equipment will not need to be reloaded and will not be left behind. You will usually be given a portable radio that is tuned to the search frequency so that you can monitor the progress of the search and communicate with those in charge of the search operation.

Sometimes, you may be asked to stay with relatives of the missing individual who are at the scene. Find out from relatives whether the missing person has any medical history that may need to be addressed, and pass this information on to those who are in charge of the search. Unless you have been instructed otherwise, only the incident commander should communicate any news or progress of the search to the family. For this reason, be sure that your radio is set at a discreet volume.

Once the missing person has been found, you will be guided by search personnel to that location or to a prearranged meeting point where the patient will be carried, which allows you to begin treatment more quickly. Consider relocating the ambulance or, if one is available, using a four-wheel drive, all-terrain vehicle (ATV), or snowmobile to decrease the time and effort needed to reach and carry out the patient. Be sure that equipment is evenly distributed among personnel and that the pace is such that all can stay together easily. Remember that although EMS will assume the responsibility for patient care once they are at the patient's side, a cooperative effort between the EMS and search teams is necessary to safely carry the patient to the staging area and waiting ambulance.

Trench Rescue

Owing to the physical forces involved, many cave-ins and trench collapses have poor outcomes for victims. Collapses usually involve large areas of falling dirt that weigh approximately 100 pounds per cubic foot (16 kg per cubic meter). Victims with thousands of pounds of dirt resting on their chests cannot fully expand their lungs and may become hypoxic.

The risk of a secondary collapse during the rescue operation is a concern for rescue personnel and EMTs. Safety measures can reduce the potential for injury from this and other hazards. When arriving on the scene of a cave-in or trench collapse, response vehicles should park at least 500 feet from the scene. Because vibration is a primary cause of secondary collapse, all vehicles, including on-scene construction equipment, should be turned off. In addition, all road traffic should be diverted from the 500-foot safety area. Other hazards include exposed or downed electric wires and broken gas or water lines. In addition, construction equipment at the collapse may be unstable and could fall into the cave-in or trench site.

Identify any witnesses to the incident. They may provide valuable information on the number of victims and their location within the collapsed area. Assist any nontrapped people from the area. At no time should medical or rescue personnel enter a trench deeper than 4 feet (1 m) without proper shoring (temporary supports to prevent collapse) in place.

During the extrication of any survivors from a cave-in or trench collapse site, trained medical personnel will provide most medical care. Be prepared to receive patients once they have been extricated from the site.

Tactical Emergency Medical Support

A steady increase in violence throughout the country has resulted in EMTs taking precautions to ensure personal safety. Normally, when the potential for violence exists—as in shootings, stabbings, and attempted suicides—responding units should wait until the scene is secured by law enforcement officers. However, some incidents pose an increased risk to emergency responders. Hostage incidents, barricaded subjects, and snipers require the use of specialized law enforcement tactical units or the **special weapons and tactics team (SWAT)**.

YOU are the Provider — PART 5

A rescue team member drives the ambulance to the landing zone as your partner applies a rigid splint to the patient's right leg and you reassess her vital signs.

Recording Time: 40 Minutes	
Level of consciousness	Responsive to voice
Respirations	16 breaths/min; adequate
Pulse	128 beats/min; weak radial pulse
Skin	Cool, clammy, and pale
Blood pressure	84/60 mm Hg
Spo_2	96% (on oxygen)

The medical helicopter is waiting, and you give a verbal report to the flight paramedic. You assist in the loading of the patient onto the helicopter. You then return to the scene to retrieve any equipment you may have left and to assist with removal of the pilot's body from the wreckage.

8. What are your considerations when calling for air transport?

Words of Wisdom

Physical dangers such as fire, infectious disease, and electricity are not the only risks to your safety during emergency responses. Some calls involve the possibility of deliberate violence against EMTs. Formal tactical situations are obvious examples, but "simple" calls involving assaults, possible alcohol or drug use, and domestic disputes can be just as dangerous. Your training, your attitude when responding to calls, and your routine daily procedures should all help you take these risks into account. Never let your guard down, and continually reassess your surroundings.

Owing to the high potential for injuries at these volatile incidents, many communities have incorporated specially trained EMTs, paramedics, nurses, and even physicians into their SWAT units. These EMS providers provide a special level of care to the sick and injured, and their training goes well beyond the practices seen in standard emergency medical care. Thus, the techniques used may seem inappropriate or inadequate. For example, spinal immobilization is not used within an unsecured area where gunfire is a risk. The time and manpower necessary to completely secure a victim to a backboard may expose EMS providers and SWAT officers to injury or death from gunfire **Figure 38-12**. Such altered standards of care are similar to those used by military EMS providers on the battlefield and are *not* used in the standard situations you will encounter as an EMT.

When called to the scene of a law enforcement **tactical situation**, determine the location of the command post and report to the incident commander for instructions. Lights and siren should be turned off when nearing the scene, and outside radio speakers should not be used. The command post is usually located in an area that cannot be seen by the suspect and is out of range of possible gunfire. Remain in this area and do not roam beyond this site. Nearby areas may be visible to the suspect, and you could be injured.

A number of planning measures will reduce the potential for chaos should a mass-casualty incident occur at the scene. First, have the incident commander identify the specific location of the incident, including the street address and the side of the street on which the house or building is located. The incident commander should determine a safe location (staging area) where you can meet SWAT team members or tactical EMS providers should an injury occur. The incident commander should also determine a safe route to this point. Tactical EMS providers or officers will remove the patient to this area for continued treatment and transport to a medical facility.

Figure 38-12 Tactical EMS providers move a downed officer; only the most basic medical care is provided in an unsecured area.

Words of Wisdom

The topic of active shooter and mass-casualty incidents has received a great deal of attention in recent years. In response, some EMS providers are being trained to enter the area directly around the hazard (the "warm zone") with appropriate law enforcement cover. Their role is to identify patients, provide targeted lifesaving interventions, and perform extraction. Since it is impractical for EMS providers to carry large bags or heavy equipment, they generally provide only essential, specific care including bleeding control, maintaining an open airway, and applying tourniquets.

Such policies should only be implemented in collaboration with local law enforcement and must include appropriate training. Traditional continuing education that focuses on high-quality CPR and other skills that have the greatest potential to save lives should receive the highest emphasis. However, training related to shooting incidents is an excellent resource for you; take advantage of these opportunities.

Words of Wisdom

F-A-I-L-U-R-E:

The reasons for rescue failure can be summarized by the mnemonic FAILURE:

F Failure to understand the environment or underestimating it
A Additional medical problems not considered
I Inadequate rescue skills
L Lack of teamwork or experience
U Underestimating the logistics of the incident
R Rescue versus recovery mode not considered
E Equipment not mastered

To save valuable time in critical situations, designate primary and secondary helicopter landing zones if your region uses aeromedical evacuation. The closest hospital, burn center, and trauma center should be identified. The route of travel to these facilities should also be noted. Many of these measures are incorporated into the operational plan used by tactical EMS providers. If tactical EMS providers are used in your jurisdiction, coordinate with them on your arrival at the command post.

Structure Fires

In most areas, an ambulance is dispatched with the fire department to any **structure fire**, whether or not injuries are reported. A fire in a house or other building is considered a structure fire. When responding to a major fire scene, determine whether any special route will be necessary to reach the scene. Once you arrive at the scene, ask the incident commander where the ambulance should be staged. It is essential that the ambulance be parked far enough from the fire to be safe from the fire itself or a collapsing building. You must also ensure that the ambulance will not block or hinder other arriving units or be blocked in by other equipment or hose lines. However, you must also make sure that the ambulance will be close enough to be visible and that patients can be brought to it easily. The fire officer who is the incident commander will determine this location.

Your next step is to determine whether there are any injured patients at the scene or whether you have been called to stand by. A number of ambulances may be dispatched to a major fire to ensure that one or more units will always remain immediately available at the scene if others leave to transport the injured.

As with other specialized rescue situations, search and rescue in a burning building requires special training and equipment. Search and rescue operations are performed by teams of firefighters wearing full turnout gear and **self-contained breathing apparatus (SCBA)** and carrying tools and fully charged hose lines. These teams will bring patients out of the burning building to the area where the ambulance is staged. Therefore, unless otherwise ordered, you should always stay with the ambulance. Do not leave the scene even after the fire is out because you may need to treat a firefighter who has been injured during salvage and overhaul. The ambulance should leave the scene only if transporting a patient or if the incident commander has released it.

Sometimes the scene at a fire is complicated by the presence of hazardous materials. In addition to posing a threat to you and others at the immediate scene, hazardous materials may pose a threat to a larger population. Whenever there is a possibility that a hazardous material is involved, you will have to follow a number of additional special procedures. Chapter 39, *Incident Management*, covers the specifics of hazardous material procedures.

YOU are the Provider — SUMMARY

1. What information is obtained from a 360-degree assessment of a plane crash?

The 360-degree assessment of a plane crash focuses on hazards unique to this type of incident. Common safety hazards include downed power lines, leaking fuels or other fluids, smoke or fire, broken glass, and aircraft instability. Safety issues must be addressed by the appropriate personnel before anyone attempts to gain access to the patient(s).

Other information obtained during the 360-degree assessment of a plane crash includes the mechanism of injury, the position of the patient(s) in the aircraft, and whether the patient(s) are entrapped or have been ejected.

2. How would your approach change if leaking fuel were present?

A scene with leaking fuel cannot be made 100% safe unless the plane's fuel tank can be emptied. It is imperative that you understand the capabilities of the fire department and rescue team, and coordinate your efforts accordingly. Plan an exit route in the event the scene becomes more unstable. If the fuel spills onto the patient, he or she will have to be decontaminated prior to transport. Fuel spills must also be handled appropriately by qualified personnel.

3. How should you initially attempt to gain access to a crash victim?

Do not attempt to gain access to the patient or enter the wreckage until you are sure that it is stable and that any hazards have been identified and properly controlled or eliminated. The incident commander will inform you when it is safe to gain access to the patient.

Whenever possible, you should use simple access techniques to get to the patient. Try to unlock and open all of the doors, starting with the least damaged door. If the patient's condition requires immediate care and you cannot access the passenger compartment, attempt to provide basic care as the extrication is performed. Be on constant alert for dangers to yourself, your partner, and the patient.

If you must break a window to gain access, try to break one that is farthest away from the patient. If the patient's condition warrants immediate entry (ie, airway compromise, severe bleeding), however, do not hesitate to break the closest window. If you cannot gain access to the patient by opening a door or breaking a window, pneumatic and/or hydraulic rescue tools will be necessary to gain access to the patient.

4. What treatment should you provide to a patient who is entrapped in wreckage?

Unless there is an immediate threat of fire, explosion, or other danger, once entry and access to the patient have been provided, perform a primary assessment and begin immediate emergency care before the process of extrication begins. Focus on identifying and correcting immediate life threats. A lengthy, detailed assessment is inappropriate because this delays the process of patient extrication. Pass on any information that you obtain about the type or degree of entrapment to the extrication team.

In the case of this patient, you can only access her head, torso, and upper extremities. Her legs are pinned by the wreckage. Your partner is manually stabilizing the patient's head and maintaining an open airway with a modified jaw thrust. The airway is clear, and she is breathing, although the rate is a little slow and shallow. There is not enough room to ventilate the patient with a bag-valve mask, but you can apply a nonrebreathing mask to facilitate oxygenation until you have full access to her airway. You have already determined that her pulse is weak and rapid, and her skin is cool, clammy, and pale. You note lacerations to her forehead and right arm.

On the basis of your findings, you should apply high-flow oxygen, control the bleeding from her forehead and arm, and control any other bleeding to the areas of her body that you can access. It would be appropriate to apply a cervical collar—after assessing the back of the neck for any deformities—to help maintain cervical spine immobilization. Cover as much of the patient as you can with a blanket to preserve body heat.

The patient is showing signs of shock; therefore, after correcting problems with airway, breathing, and circulation, she must be extricated so that you can complete your assessment and provide additional treatment.

5. Is it appropriate to obtain the vital signs of a patient who is entrapped? Why or why not?

It is not always appropriate or practical to obtain a complete set of vital signs while a patient is entrapped. Your primary focus should be to provide immediate lifesaving care and then have the patient extricated as quickly and safely as possible.

In some cases, there may be a delay in extricating the patient. If this is the case, obtain a baseline set of vital signs; doing so will provide you with additional information about the patient's condition. However, make sure that you have identified and corrected all immediate life threats *first*.

Do not delay extrication to assess the patient's vital signs. The longer the patient remains trapped in the vehicle, the longer the delay to definitive care.

6. What should you do as the patient is being extricated from the wreckage?

During the coordinated extrication process, your input is essential. Once a plan has been devised and all team members understand what will be done, you have a role in protecting the patient. When possible, position yourself alongside the patient to monitor his or her condition as the wreckage is being cut, bent, or disassembled. In the case of this patient, you and your partner are positioned on opposite sides of the aircraft. Your partner should continue to provide manual stabilization of the cervical spine if it can be managed safely.

Be sure that you are both wearing the appropriate protective clothing (ie, a bunker coat, heavy-duty gloves [over your exam gloves], a rescue helmet, and hearing protection).

Communicate with the patient to let him or her know what is happening. Also communicate with the rescue team. If the patient suddenly screams in pain, instruct the rescue team to stop extrication while you determine where the patient is hurting; it may be necessary for the rescue team to take a different extrication approach.

7. How does the rapid extrication technique differ from other methods of patient removal? When is it indicated?

The main difference between the rapid extrication technique and other methods of patient removal (ie, short backboard, vest-style extrication device) is that it is fast and requires minimal preparation of the patient in the vehicle before he or she is removed. For example, it takes between 6 and 8 minutes—and in some cases, even longer—to properly apply a spinal immobilization device. This is clearly too long when your patient is critically injured and needs immediate treatment and transport. Rapid extrication technique can be performed in 1 minute or less.

8. What are your considerations when calling for air transport?

If your region uses aeromedical evacuation, air transport is an excellent option when a patient is critical and time is a factor. Medical helicopters can quickly access remote locations and provide rapid transport to definitive care. You must locate an area that is large enough and obstacle-free to allow for a landing zone. If the rescue site is not accessible as a landing zone, identify the nearest safe, stable setting (staging area) and transport the patient by ambulance to the alternative location.

To save valuable time in critical situations, designate primary and secondary helicopter landing zones. Identify the closest hospital, burn center, and trauma center, and the most efficient route of travel to these facilities. Many of these measures are incorporated into the operational plan used by tactical EMS providers. If tactical EMS providers are used in your jurisdiction, coordinate with them on your arrival at the command post.

EMS Patient Care Report (PCR)

Date: 10-30-16	**Incident No.:** 013609	**Nature of Call:** Plane crash		**Location:** 100 Airport Drive	
Dispatched: 1622	**En Route:** 1623	**At Scene:** 1628	**Transport:** 1710	**At Landing Zone:** 1711	**In Service:** 1735

Patient Information

Age: Approximately 55 **Sex:** F **Weight (in kg [lb]):** 68 kg (150 lb)	**Allergies:** Unknown **Medications:** Unknown **Past Medical History:** Unknown **Chief Complaint:** Altered mental status and multiple injuries

Vital Signs

Time: 1635	**BP:** 98/40	**Pulse:** 138	**Respirations:** 15	**Spo_2:** 93%
Time: 1640	**BP:** 94/50	**Pulse:** 142	**Respirations:** 15	**Spo_2:** 93%
Time: 1646	**BP:** 80/58	**Pulse:** 148	**Respirations:** 14	**Spo_2:** 94%
Time: 1654	**BP:** 82/60	**Pulse:** 136	**Respirations:** 14	**Spo_2:** 94%
Time: 1708	**BP:** 84/60	**Pulse:** 128	**Respirations:** 16	**Spo_2:** 96%

EMS Treatment (circle all that apply)

Oxygen @ 15 **L/min via (circle one):** **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging** All wounds bandaged	**Splinting** Right lower extremity	**Other:** Spinal immobilization; maintain warmth

Narrative

EMS was dispatched to private airport for a single-engine plane crash involving two passengers. Upon arrival fire rescue on scene advised that the scene was safe. The aircraft was stabilized, and fire personnel were preparing equipment for extrication. A 360-degree assessment of the victims showed that the pilot had massive head and facial trauma incompatible with life. An unresponsive female passenger, approximately 55 years, occupied the second seat. There were no windows in aircraft, only the windshield in front of the pilot. The patient's upper body was accessible through bars along the portion of the plane next to the patient, but lower extremities were not visible under wreckage. Cervical spine immobilization was established, and the patient's airway opened manually. Respirations were shallow, radial pulses were present but weak, and skin was pale, cool, and diaphoretic. Unable to use BVM to ventilate the patient because of space restrictions so she was placed on NRB mask @ 15 L/min. Patient had a large laceration superior to left orbit with bleeding controlled and a large laceration to right arm with muscle and bone exposed at elbow. Both wounds were bandaged, and the patient was covered with a blanket to preserve heat and provide protection. Window bars were removed, and the side flap was created by rescue team to allow access to the patient. Patient responding to voice at this time. Seat was disassembled, and the patient was extricated onto a backboard. The patient's clothing was removed, and she was covered with blankets. Patient fully immobilized and moved to ambulance for transport to helicopter landing zone. Reassessed vital signs and splinted fracture of right lower extremity. Transferred to air transport, and gave verbal report to flight paramedic. Medic 8 returned to service at 1735.**End of report**

Prep Kit

Ready for Review

- You must always be prepared, mentally and physically, for any incident that requires rescue or extrication.
- As an EMT, your first priority in a rescue incident is personal safety.
- EMS personnel are responsible for the assessment, care, triage, packaging, and transport of patients.
- The rescue team secures and stabilizes the vehicle, provides safe access to patients, and safely extricates patients.
- Law enforcement officers control traffic, maintain order at the scene, establish and maintain a perimeter, and ultimately investigate the crash or crime scene.
- Firefighters extinguish fire, prevent additional ignition, ensure scene safety, and remove spilled fuel. Variations in responsibilities are possible, depending on jurisdictional protocols.
- Vehicle safety systems, such as shock-absorbing bumpers and air bags, protect your patients but also have the potential to injure you.
- Simple access is easily achieved without the use of tools or force. Complex access requires heavy-duty tools and special training.
- The 10 phases of extrication are:
  - Preparation
  - En route to the scene
  - Arrival and scene size-up
  - Hazard control
  - Support operations
  - Gaining access
  - Emergency care
  - Removal of the patient
  - Transfer of the patient
  - Termination
- In some situations, the patient can only be reached by teams trained in special technical rescues. Situations requiring specialized teams include:
  - Cave rescue
  - Confined space rescue
  - Cross-field and trail rescue (park rangers)
  - Dive rescue
  - Missing person search and rescue
  - Mine rescue
  - Mountain-, rock-, and ice-climbing rescue
  - Ski slope and cross-country or trail snow rescue (ski patrol)
  - Structural collapse rescue
  - Special weapons and tactics (SWAT)
  - Technical rope rescue (low- and high-angle rescue)
  - Trench rescue
  - Water and small craft rescue
  - White water rescue

Vital Vocabulary

access Gaining entry to an enclosed area and reaching a patient.

command post The location of the incident commander at the scene of an emergency and where command, coordination, control, and communication are centralized.

complex access Entry that requires special tools and training and includes the use of force.

danger zone (hot zone) An area where people can be exposed to hazards such as electric wires, sharp metal edges, broken glass, toxic substances, radiation, or fire.

entrapment To be caught (trapped) within a vehicle, room, or container with no way out or to have a limb or other body part trapped.

extrication Removal of a patient from entrapment or a dangerous situation or position, such as removal from a wrecked vehicle, industrial incident, or collapsed building.

hazardous materials Any substances that are toxic, poisonous, radioactive, flammable, or explosive and cause injury or death with exposure.

incident commander The individual who has overall command of the incident in the field.

safe zone An area of protection providing safety from the danger zone (hot zone).

self-contained breathing apparatus (SCBA) Respirator with independent air supply used by firefighters to enter toxic and otherwise dangerous atmospheres.

simple access Access that is easily achieved without the use of tools or force.

size-up The ongoing process of information gathering and scene evaluation to determine appropriate strategies and tactics to manage an emergency.

special weapons and tactics team (SWAT) A specialized law enforcement tactical unit.

structure fire A fire in a house, apartment building, office, school, plant, warehouse, or other building.

tactical situation A hostage, robbery, or other situation in which armed conflict is threatened or shots have been fired and the threat of violence remains.

technical rescue group A team of emergency responders from one or more departments in a region who are trained and on call for certain types of technical rescue.

technical rescue situation A rescue that requires special technical skills and equipment in one of many specialized rescue areas, such as technical rope rescue, cave rescue, and dive rescue.

Assessment *in Action*

© Jones & Bartlett Learning. Courtesy of MIEMSS.

You are dispatched to the scene of a motor vehicle crash where a gasoline tanker truck has struck a small passenger van. The truck has come to rest in the center of the intersection. The van is situated against a power pole and you note downed power lines. Air bags in the van have not deployed.

1. Where should you park the ambulance?

   A. Uphill and upwind from the hazard
   B. Uphill and downwind from the hazard
   C. Downhill and upwind from the hazard
   D. Downhill and downwind from the hazard

2. As an EMT, what is your role at the scene of this crash?

   A. To provide safe entrance and access to the patients
   B. To extricate the patients
   C. To assess and provide immediate medical care
   D. To provide traffic control and direction

3. Once the scene is deemed safe to approach, you attempt to gain access to the patients inside the van. Which of the following is an example of simple access?

   A. Opening a rear door
   B. Removing the windshield
   C. Breaking a side window
   D. Prying open a door

4. You note three occupants. There are two adults in the front and a small child in a child safety seat in the rear. Patient care should be initiated:

   A. in the order you reach each patient.
   B. in the order of age beginning with the youngest.

C. based on the mechanism of injury.
D. only after all patients have been triaged.

5. There are downed power lines at this scene. How should you handle this situation?

   A. Approach the scene carefully and avoid stepping on power lines.
   B. Use a public address system to instruct all patients with the ability to walk to come to the ambulance.
   C. Wait for the power company to tell you the scene is safe before approaching either vehicle.
   D. Ask the fire department to bring the patients to the ambulance, since the firefighters are wearing turnout gear.

6. While providing care for an entrapped occupant of the van, you note the unstable power pole start to sway. What should you do?

   A. Advise the safety officer or incident commander immediately.
   B. Immediately cease care and leave the scene.
   C. Request that the extrication be halted to address the problem while you continue to provide care.
   D. Nothing; the rescue team is handling the extrication and controlling the scene.

7. What additional resources would you request in this situation?
8. Define hazardous material.
9. Reasons for rescue failure can be summarized by the mnemonic FAILURE. What does FAILURE stand for?
10. Once the scene is safe to approach, what steps should you take to perform a primary assessment and provide care prior to the initiation of extrication?

CHAPTER 39

Incident Management

National EMS Education Standard Competencies

EMS Operations

Knowledge of operational roles and responsibilities to ensure patient, public, and personnel safety.

Incident Management

› Establish and work within the incident management system. (pp 1411–1419)

Multiple-Casualty Incidents*

› Triage principles (pp 1420–1422)
› Resource management (pp 1411–1412, 1415–1418)
› Triage (pp 1420–1425)
- Performing (pp 1420–1424)
- Retriage (p 1421)
- Destination decisions (pp 1424–1425)
- Posttraumatic and cumulative stress (pp 1418, 1425)[1]

Hazardous Materials Awareness

› Risks and responsibilities of operating in a cold zone at a hazardous material or other special incident. (pp 1437–1439)

Knowledge Objectives

1. Describe the purpose of the National Incident Management System (NIMS) and its major components. (pp 1411–1412)
2. Describe the purpose of the incident command system (ICS) and its organizational structure. (pp 1412–1415)
3. Explain the role of EMS response within the ICS. (pp 1415–1417)
4. Describe how the ICS assists EMS in ensuring both personal safety and the safety of bystanders, health care professionals, and patients during an emergency. (pp 1416–1417)

5. Describe the role of the EMT in establishing command under the ICS. (p 1416)
6. Describe the purpose of the medical branch of the ICS and its organizational structure. (pp 1417–1419)
7. Describe the specific conditions that would define a situation as a mass-casualty incident (MCI); include examples. (pp 1419–1420)
8. Describe what occurs during primary and secondary triage, how the four triage categories are assigned to patients on the scene, and how destination decisions regarding triaged patients are made. (pp 1420–1422)
9. Explain how to perform the START and JumpSTART triage methods. (pp 1422–1424)
10. Contrast a disaster with a mass-casualty incident. (p 1425)
11. Describe the role of EMTs during a disaster operation. (p 1425)
12. Recognize the entry-level training or experience requirements identified by the HAZWOPER regulation for EMTs to respond to a HazMat incident. (p 1426)
13. Define hazardous material; include the classification system used by the NFPA. (pp 1426, 1439)
14. Discuss the specific reference materials that EMTs use to recognize a HazMat incident. (pp 1432–1436)
15. Explain the role of EMTs during a HazMat incident both before and after the HazMat team arrives; include the precautions required to ensure the safety of civilians and responders. (pp 1437–1439)
16. Describe how the three control zones are established at a HazMat incident, the characteristics of each zone, and the responders who work within each one. (pp 1437–1439)
17. Describe the four levels of personal protective equipment (PPE) required at a HazMat incident to protect responders from injury by or contamination from a particular substance. (pp 1439–1440)
18. Explain patient care at a HazMat incident; include the special requirements that are necessary for those patients who require immediate treatment and transport prior to full decontamination. (pp 1440–1441)

Skills Objectives

1. Demonstrate how to perform triage based on a fictional scenario that involves a mass-casualty incident. (pp 1420–1422)
2. Using a reference, correctly identify DOT labels, placards, and markings that are used to designate hazardous materials. (pp 1430–1432)
3. Demonstrate the ability to use a variety of reference materials to identify a hazardous material. (pp 1432–1436)

Introduction

Some of the most challenging situations you will encounter are disasters and mass-casualty incidents. In this text, a disaster refers to any situation that overwhelms your resources. A single incident with two critical patients can constitute a disaster if there is only one EMS unit available to respond. A **mass-casualty incident (MCI)** refers to any call that involves three or more patients, any situation that places such a great demand on available equipment or personnel that the system would require a **mutual aid response** (an agreement between neighboring EMS systems to respond when local resources are insufficient to handle the response), or any incident that has the potential to create one of the previously mentioned situations. Bus or train crashes and earthquakes are obvious examples of MCIs. These incidents can be overwhelming because you will find a large number of patients and not enough resources. When you respond to an event with a large number of patients, you must use a systematic approach to manage the incident efficiently. By learning to use the principles of the incident command system (ICS), you will be able to do the greatest good for the greatest number of people. As an EMT, you will typically be assigned to work within the EMS/ medical branch under an ICS, but you may be asked to function in other areas, which will be discussed later in this chapter. The National Incident Management System (NIMS) was developed to promote more efficient coordination between emergency responders at the regional, state, and national levels. To reduce on-scene problems and to increase your efficiency, you need a solid understanding of the basics of the NIMS. Training courses may also be accessed through the Federal Emergency Management System (FEMA) website.

National Incident Management System

The Department of Homeland Security implemented the **National Incident Management System (NIMS)** in 2004. Most incidents are handled at the local level, but major incidents require the involvement of multiple jurisdictions, agencies, and emergency response disciplines. The NIMS provides a framework to enable federal, state, and local governments, as well as private-sector and nongovernmental organizations, to work together effectively. The NIMS is used to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism and hazardous materials (HazMat) incidents.

Two important underlying principles of the NIMS are flexibility and standardization. The organizational structure must be flexible enough to be rapidly adapted for use in any situation. The NIMS provides standardization in terminology, resource classification, personnel training, certification, and more. Another important feature of the NIMS is the concept of interoperability, which refers to the ability of agencies of different types or from different jurisdictions to communicate with each other.

The ICS is one component of the NIMS. The five major NIMS components are as follows:

1. **Preparedness.** The NIMS establishes measures for all responders to incorporate into their systems to prepare for their response to all incidents at any time, including procedures and protocols, licensure, and equipment certification.
2. **Communications and information management.** Effective communications, information management, and sharing are critical aspects of domestic incident management. The NIMS communications and information systems enable the essential functions needed to provide interoperability.

YOU are the Provider — PART 1

Your unit is dispatched to a crash just outside a local amusement park involving an open-air tram transporting guests from the parking lot to the front gate, and a passenger bus that swerved out of control while making a turn. Dispatch advises there have been multiple calls reporting the crash with varying reports of injuries.

1. How will you decide whether to declare this a mass-casualty incident?
2. How will the incident command system facilitate operations at this scene?

3. **Resource management.** The NIMS sets up mechanisms to describe, inventory, track, and dispatch resources before, during, and after an incident. The NIMS also defines standard procedures to recover equipment used during the incident.
4. **Command and management.** The NIMS standardizes incident management for all hazards and across all levels of government. The NIMS standard incident command structures are based on three key constructs: ICS, multiagency coordination systems, and public information systems.
5. **Ongoing management and maintenance.** The multijurisdictional, multidisciplinary NIMS Integration Center (NIC) provides strategic direction for and oversight of the NIMS. It supports routine maintenance and continuous improvement of the system in the long term, including research and development of supporting technologies.

Incident Command System

It is important for you to be familiar with the terminology and concepts of the **incident command system (ICS)**. (Some agencies refer to the incident command system as the incident management system.) The purpose of the ICS is to ensure responder and public safety, achieve incident management goals, and ensure the efficient use of resources.

As you know, communication is the building block of good patient care. Common terminology and the use of "clear text" communications (plain English as opposed to 10-codes) help responders from multiple agencies work efficiently together.

Using the ICS gives you a modular organizational structure that can be applied to all hazards. ICS can be activated for incidents ranging from a single vehicle crash with one patient to a natural gas pipeline explosion involving multiple communities and numerous injuries. The goal of the ICS is to make the best use of your resources to manage the environment around the incident and to treat patients during an emergency. The ICS is designed to avoid duplication of effort and **freelancing**, in which individual units or different organizations make independent and often inefficient decisions about the next appropriate action. Follow your local standard operating procedures for establishing the ICS.

One of the organizing principles of the ICS is to limit the **span of control** of any one individual. This principle refers to keeping the supervisor/worker ratio at one supervisor for three to seven workers. A supervisor who has more than seven people reporting to him or her is exceeding an effective span of control and needs to divide tasks and delegate the supervision of some tasks to another person.

The organizational levels may include sections, branches, divisions, and groups **Figure 39-1**:

- **Sections** are responsible for a major functional area such as finance, logistics, planning, or operations.
- **Branches** are managed by the branch director, and may be functional or geographic in nature. These tend to be established when span of control is a problem; for example, at larger incidents, where more oversight may be needed. Branches are in charge of activity directly related to the section (ie, fire, law enforcement, EMS, operations, etc).
- **Divisions** and **groups** serve to align resources and/or crews under one supervisor. Divisions usually refer to crews

working in the same geographic area. Groups usually refer to crews working in the same functional area, but possibly in different locations.

Generally speaking, the larger the incident, the more divisions there will be. A small incident may require only an IC and support from fire, EMS, and law enforcement. An incident on a much larger scale, such as the Boston Marathon bombing in 2013, will require massive efforts and many agencies working together.

In some regions, emergency operations centers may exist. The centers are usually operated by the city, state, or federal government. These centers will usually be activated only in a catastrophic event that may go on for days. Such events can involve hundreds of patients and tax the entire system.

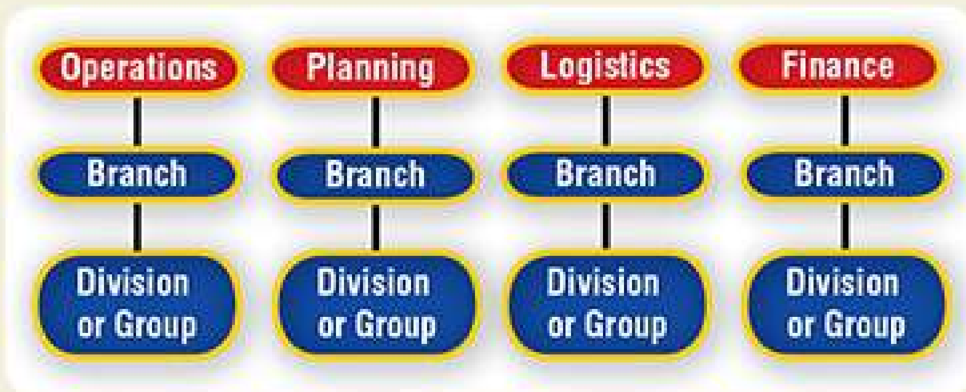


Figure 39-1 The ICS organizational structure may include sections, branches, divisions, and groups.

The responders who will participate in an MCI or a disaster should use the ICS. When an incident occurs, find out from your service who is in charge, how it is activated, and what your expected role will be.

Incident Command System Roles and Responsibilities

There are many roles defined in the ICS. The general staff includes command, finance, logistics, operations, and planning. It is important for you to understand the specific duties of each and how they work to coordinate the response. **Command** staff include the public information officer (PIO), safety officer, and liaison officer.

Command

The **incident commander (IC)** is the person in charge of the overall incident. The IC will assess the incident, establish the strategic objectives and priorities, and develop a plan to manage the incident **Figure 39-2**. The number of command duties the IC takes on often varies by the size of the incident. Small incidents often mean the IC will do it all. In an incident of medium size or complexity, the IC may delegate some functions but retain others. For example, at a motor vehicle crash site with multiple patients, the IC may designate a safety officer or assign a PIO but maintain responsibility for the other command functions. In a complex situation, the IC may appoint team members to all of the command roles.

Figure 39-2 The person in command at a mass-casualty incident oversees the incident and develops a plan for the response.

Courtesy of Captain David Jackson, Saginaw Township Fire Department.

Large MCIs, such as a HazMat incident, require a multiagency or multijurisdiction response and need to use a **unified command system**. In this case, plans are drawn up in advance by all agencies that assume a shared responsibility for decision making. The response plan should designate the lead and support agencies in several kinds of MCIs. (For example, the HazMat team will take the lead in a chemical leak, while the medical team will take the lead in a multivehicle crash.) Agencies that share a border should train often with each other to ensure that a unified command system will function well and that communication among the responders is well established before a real incident occurs.

A **single command system** is one in which one person is in charge, even if multiple agencies respond. It is generally used with incidents in which one agency has the majority of responsibility for incident management. Ideally, it is used for short-duration, limited incidents that require the services of a single agency.

Your IC should be on or near the scene, where he or she can easily communicate with all emergency responders. It is important that you know who the IC is, how to communicate with him or her, and where the **command post** is located. If the incident is very large, you will report to a supervisor working under the IC. (Remember the principle of span of control.) To make the IC easily identifiable, some type of garment is worn, such as a brightly colored vest labeled with the word COMMAND. If the command post is set up in a vehicle, it should be well marked, and you should know its location. Make sure that your supervisor or the IC knows of any plans or operations before they are initiated.

Communication is particularly important if a transfer of command takes place. Because an incident can rapidly change in size and complexity, an IC may turn over command to someone with more experience in a critical area. This change, or transfer of command, must take place in an orderly manner and, if possible, face-to-face. In extreme situations, it could be done by phone, radio, or email, although these methods are not recommended. Your agency should have standard operating procedures that govern the transfer of command. Make certain to follow the standard operating procedures. When an incident draws to a close, there should be a **termination of command**. Your agency should implement **demobilization** procedures as the situation deescalates or comes to an end.

Finance

The **finance** section chief is responsible for documenting all expenditures at an incident for reimbursement. Finance personnel are not usually needed at smaller incidents, but at larger incidents it is necessary to keep track of personnel hours and expenditures for materials and supplies. Ultimately, that information is reported at meetings of the general staff. Responding agencies and organizations may be eligible for reimbursement after the incident, and an efficient finance section chief will help your agency to succeed in the reimbursement process. Finance personnel should be trained in the process of assessing expenditures with an eye to reimbursement long before an actual incident.

The various functions within the finance section include: (1) the time unit, (2) the procurement unit, (3) the compensation and claims unit, and (4) the cost unit. The time unit is responsible for ensuring the daily recording of personnel time and equipment use. The procurement unit deals with all matters concerning vendor contracts. The compensation and claims unit has two major purposes: dealing with claims as a result of the incident, and injury compensation. Finally, the cost unit is responsible for collecting, analyzing, and reporting the costs related to an incident.

Logistics

The **logistics** section is responsible for communications equipment, facilities, food and water, fuel, lighting, and medical equipment and supplies for patients and emergency responders. Local standard operating procedures will list the medical equipment needed for the incident, depending on the type of incident. Logistics personnel are trained to find food, shelter, and health care for you and the other responders at the scene of an MCI. In a large incident, it is often necessary for many people to handle logistics, but only the section chief will report to the IC.

Operations

At a large or complex incident, the IC should appoint an **operations** section chief, who is responsible for managing the tactical operations usually handled by the IC on routine EMS calls. This frees the IC to coordinate with other agencies and the media, engage in strategic planning, and ensure that logistics are functioning effectively. The operations section chief will supervise the people working at the scene of the incident, who will be assigned to branches, divisions, and groups. Operations personnel often have experience in management within EMS.

Planning

The **planning** section solves problems as they arise during the incident. Planners obtain data about the problem, analyze the previous incident plan, and predict what or who is needed to make the new plan work. They need to work closely with the operations, finance, and, especially, logistics sections. Planners can and should call on technical experts to help with the planning process. They should document their decisions and what they learned from the incident and also set out a course for demobilizing the response when necessary.

Another function of the planning section is the development of an **incident action plan**, which is the central tool for planning during a response to a disaster emergency. The incident action plan is prepared by the planning section chief with input from the appropriate sections and units of the incident command team. It should be written at the outset of the response and revised continually throughout the response. In an initial response for an incident that is readily controlled, a written plan may not be necessary. Larger, more complex incidents will require an incident action plan to coordinate activities. The level of detail required in an incident action plan will vary according to the size and complexity of the response.

Command Staff

Three important positions that help the general staff (described previously) and the IC are the safety officer, the public information officer, and the liaison officer. The **safety officer** monitors the scene for conditions or operations that may present a hazard to responders and patients. The safety officer may need to work with environmental health and HazMat specialists. The importance of the safety officer cannot be underestimated—he or she has the authority to stop an emergency operation whenever a rescuer is in danger. A safety officer should remove hazards to EMS personnel and patients before the hazards cause injury.

The **public information officer (PIO)** provides the public and media with clear and understandable information. A wise PIO positions his or her headquarters well away from the incident command post and, most important, away from the incident, to minimize distractions. Also, the PIO must keep the media safe and from becoming part of the incident. The designated PIO may cooperate with PIOs from other agencies in a **joint information center (JIC)**. In some circumstances, the PIO/JIC may be responsible for distributing a message designed to help a situation, prevent panic, and provide evacuation directions.

The **liaison officer** relays information and concerns among command, the general staff, and other agencies. If an agency is not represented in the command structure, questions and input should be given through the liaison officer.

Communications and Information Management

Communications has historically been the weak point at most major incidents. To minimize the effects of communications problems, it is recommended that communications be integrated. This means that all agencies involved should be able to communicate quickly and effortlessly via radios. Communications allow for accountability throughout the incident, as well as instant communication between recipients. As always, and more so during a large incident, you must maintain professionalism on all radio communications, and remember to communicate clearly and concisely using clear text (no 10-codes).

Mobilization and Deployment

When an incident has been declared and the need for additional resources has been identified, a request is made for additional resources. Once a request is made, these resources are mobilized and deployed to the scene. It is important to wait until the request is made before you depart for the scene, to minimize the potential for freelancing.

Check-in at the Incident

On arrival at an incident, first check in with the incident commander at the base, staging area, or other location designated by the IC. If the incident is large in size or complexity, you will be assigned to a supervisor working under the IC. Check-in also allows for personnel tracking throughout the incident, and ensures that costs, wages, and reimbursement can be calculated accurately.

Initial Incident Briefing

After the check-in process is complete, report to your supervisor for an initial briefing that will allow you to get information regarding the incident, as well as your specific job functions and responsibilities.

Incident Record Keeping

Record keeping is important for financial reasons and for documentation purposes. If a large piece of equipment becomes inoperable, it may be possible for the agency to be reimbursed for replacement costs. Record keeping also allows for tracking of time spent on the incident for reimbursement purposes.

Accountability

Because of the large number of responders at a large incident, accountability is important. Accountability means keeping your supervisor advised of your location, actions, and completed tasks. It also includes advising your supervisor of the tasks that you have been unable to complete and what tools you need to complete them.

Incident Demobilization

Once the incident has been stabilized and all of the hazards mitigated, the IC will determine which resources are needed or not needed and when to begin demobilization. This process allows for a prompt return of resources to their parent organizations to be placed back in service.

EMS Response Within the Incident Command System

Preparedness

Preparedness involves the decisions made and basic planning done before an incident occurs. Every state is at risk for natural disasters, such as hurricanes, tornadoes, earthquakes, and wildfires. Therefore, preparedness in a given area involves anticipating the most likely natural disasters for the area, among other disasters.

Your EMS agency should have written disaster plans that you are regularly trained to carry out. A copy of the disaster plan should be kept in each EMS vehicle. EMS facilities should have disaster supplies for at least a 72-hour period of self-sufficiency. Your EMS service should have mutual aid agreements with surrounding organizations; these will facilitate requests for help in an emergency. All groups with mutual aid agreements should practice using the plans frequently. Organizations should share a list of resources with each other so they will know early on what they can access. Also, your local EMS organizations should develop an assistance program for the families of EMS responders. If EMS responders have concerns about their families during a disaster, their effectiveness on the job could be diminished.

Scene Size-up

Remember that scene size-up starts with dispatch. If dispatch information indicates a possible unsafe scene, stay away from the scene or get only close enough to make an assessment without putting yourself in harm's way. When you arrive first on the scene of an incident, you will make an initial assessment and some preliminary decisions. The size-up will be driven by three basic questions that you must ask yourself:

- *What do I have?*
- *What resources do I need?*
- *What do I need to do?*

These questions have a symbiotic relationship. The answer from one helps answer the others, and each answer represents a piece to the puzzle. Work as a team when you answer these questions because overlooking just one safety issue early on can start a chain reaction of problems.

What Do I Have?

Start with scene safety. First, assess the scene for hazards. Warn all other responders about hazardous materials, fuel spills, electrical hazards, or other safety concerns as soon as possible. Confirm the incident location.

Establish whether the incident is open or closed. An **open incident** is one that is not yet contained; there may be patients who have yet to be located and the situation may be ongoing, producing yet more patients. A **closed incident** is one that is contained and in which all casualties are accounted for. However, as with any situation, a closed incident may quickly become an open incident as situations change.

Estimate the number of casualties. Immediately provide a brief incident report to dispatch. An example of such a report would be: "EMT unit number one arriving on scene, multiple vehicles involved, full road blockage, no apparent hazards at this time, EMT unit number one is assuming command."

What Do I Need?

Decide what resources are needed. You may need more EMS responders, ambulances, or other forms of transportation. If extrication is required, a rescue unit and fire department response may be needed. If there are hazardous materials, request a HazMat team immediately (discussed later in the chapter). Many large EMS systems deploy specialized MCI units or mobile emergency room vehicles that are able to treat dozens of patients on the scene **Figure 39-3**.

What Do I Need to Do?

Keep the following priorities in mind:

- Safety
- Incident stabilization
- Preservation of property and the environment

You need to consider these priorities in the order they are given. Safety is paramount. Safety includes your life, your partner's life, and other responders' lives. Then, consider the safety of the patient and any bystanders. This will be difficult for anyone dedicated to saving lives, but it is important to put yourself and your partner first—you have the skills, and bystanders usually do not; the situation can worsen if you become a victim yourself. Often, if a responder is injured, other responders will focus on "their own," removing critical resources from the incident.

Figure 39-3 This mobile emergency room is staffed by EMTs, paramedics, and physicians who are able to provide advanced life support to multiple patients simultaneously on the scene of a mass-casualty incident.

YOU are the Provider — **PART 2**

Upon reaching the scene, you see utter chaos. Your unit is the first to arrive, and the large crowd makes it virtually impossible to determine the number of patients or the extent of injuries. The dispatcher advises that law enforcement, fire department, and additional EMS units are en route.

3. How should you and your partner proceed?

4. Once command has been established, what are your duties?

You may have to initially work to isolate or stabilize the incident before providing care to injured people—this is another difficult concept for all emergency workers. Remember, you cannot help the injured if the scene is unstable. An unstable scene can lead to an injured EMT.

Establishing Command

Once you have performed a good scene size-up and answered the three basic questions, command should be established by the most senior official, notification to other responders should go out, and necessary resources should be requested. Recall that a command system ensures that resources are effectively and efficiently coordinated. Command must be established early, preferably by the first-arriving, most experienced public safety official. These officials may include police, fire, or EMS personnel.

Communications

As discussed earlier, communications is often the key problem at an MCI or a disaster. The infrastructure may be damaged, or communications capabilities may be overwhelmed. If possible, use face-to-face communications to limit radio traffic.

Some organizations responding to a disaster might not know how to use a radio. If you communicate via radio, do not use 10-codes or signals. Most communications problems should be worked out before a disaster happens by designating channels strictly for command during a disaster. Whatever form of communications equipment is used, it must be reliable, durable, and field-tested. Be sure there are backups in place if the primary communications system does not work. Some regions have mobile self-contained communications centers, whereas others use local radio groups such as ham radio operators to assist with communications. Most important, your plan should include a "plan B" in case of communications failure.

The Medical Branch of Incident Command

What has traditionally been referred to as medical incident command is more commonly known as the medical (or EMS) branch of the ICS **Figure 39-4**. At incidents that have a significant medical factor, the IC should appoint someone as the medical branch director. This person will supervise the primary roles of the medical branch—triage, treatment, and transport of injured people. The medical branch director helps to ensure that EMS units responding to the scene are working within the ICS, each medical division or group receives a clear assignment before beginning work at the scene, and personnel remain with their vehicle in the staging area until they are assigned their duties. Depending on the scale of the incident, medical may be a branch or may fall under the logistics section as a unit.

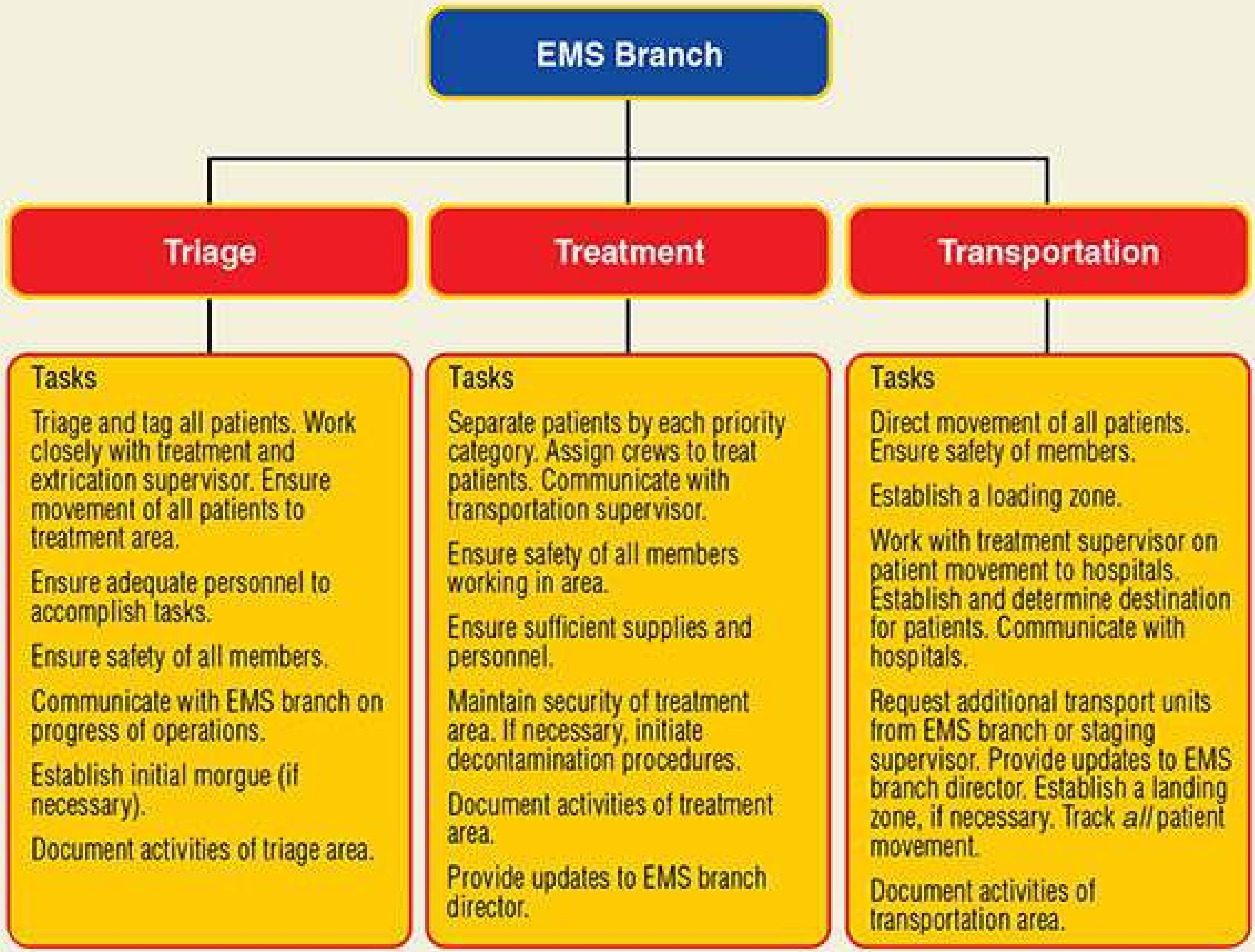


Figure 39-4 Components of the medical branch within the incident command system.

▶ Triage Supervisor

The **triage supervisor** is ultimately in charge of counting and prioritizing patients. During large incidents, a number of triage personnel may be needed. The primary duty of the triage division or group is to ensure that every patient receives initial assessment of his or her condition. One of the most difficult parts of being a triage supervisor is that you must not begin treatment until all patients are triaged, or you will compromise your triage efforts.

▶ Treatment Supervisor

The **treatment supervisor** will locate and set up the **treatment area** with a tier for each priority of patient. The treatment supervisor ensures that secondary triage of patients is performed and that adequate patient care is given as resources allow. The treatment supervisor also assists with moving patients to the **transportation area**. As the treatment supervisor supervises the responders, he or she must communicate with the medical branch director to request sufficient quantities of supplies, including bandages, burn supplies, airway and respiratory supplies, and patient packaging equipment.

Transportation Supervisor

The **transportation supervisor** coordinates the transportation and distribution of patients to appropriate receiving hospitals and helps to ensure that hospitals do not become overwhelmed by a patient surge. The transportation supervisor coordinates with the incident commander to ensure that enough personnel and ambulances are in the staging area or have been requested. Some regions may plan for a designated hospital to coordinate with area hospitals on destination decisions. An MCI typically disrupts the everyday functioning of the region's trauma system, so good coordination is needed. The transportation supervisor documents and tracks the number of transport vehicles, patients transported, and the facility destination of each vehicle and patient.

Staging Supervisor

A **staging supervisor** is assigned when an MCI or disaster requires a multivehicle or multiagency response. Emergency vehicles must have permission from the staging supervisor to enter an MCI scene and should drive only in the directed area. The staging area should be established away from the scene so that the parked vehicles are not in the way. The staging supervisor locates an area to stage equipment and responders, tracks unit arrivals, and releases vehicles and supplies when ordered by command. This position plans for efficient access to and exit from the scene and prevents traffic congestion among responding vehicles.

Physicians on Scene

In an MCI or disaster, some areas have plans in place for physicians to be sent to the scene. Sometimes, even without a plan, the enormity of the situation may require physicians on scene. Emergency physicians, especially, will have the ability to make difficult triage decisions. They also provide secondary triage decisions in the treatment area, deciding which priority patients are to be transported first. Physicians can provide on-scene medical direction for EMTs, and they can provide care as appropriate.

Rehabilitation Supervisor

In disasters or MCIs that will last for extended periods, a rehabilitation section for the responders should be established. The **rehabilitation supervisor** establishes an area that provides protection for responders from the elements and the situation. The **rehabilitation area** should be located away from exhaust fumes and crowds (especially members of the media) and out of view of the scene itself. Rehabilitation is where a responder's needs for rest, fluids, food, and protection from the elements are met. The rehabilitation supervisor must also monitor responders for signs of stress. These signs may include fatigue, altered thinking patterns, and complete collapse. Remember that all EMS personnel must be aware of signs of stress. Your service might consider having a defusing or debriefing team in this area. Responders should be encouraged to take advantage of these services but should never be forced to participate.

Extrication and Special Rescue

Some MCIs or disasters require search and rescue or extrication of patients **Figure 39-5**. An **extrication supervisor** or **rescue supervisor** may need to be appointed. These officers determine the type of equipment and resources needed for the situation. In some incidents, victims may need to be extricated or rescued by specially trained personnel before they can be triaged and treated. Because extrication and rescue are medically complex, the supervisors will usually function under the EMS branch of the ICS. Extrication and rescue can be dangerous, so team member safety is of utmost importance.

Morgue Supervisor

In some MCIs or disasters, there will be many dead patients. The **morgue supervisor** will work with area medical examiners, coroners, disaster mortuary assistance teams, and law enforcement agencies to coordinate removal of the bodies and even, possibly, body parts. The morgue supervisor should attempt to leave the dead victims in the location found, if possible, until a removal and storage plan can be determined. The location of victims may help in the identification of the dead victims in mass-fatality situations, or there may be crime scene considerations. If it is determined that a morgue area is needed, the morgue supervisor should ensure that the morgue is out of view of the living patients and other responders because the psychologic impact could worsen the situation. In addition, the morgue should be secured from the public to prevent theft of any personal effects of the dead victims.

Figure 39-5 Some disasters will involve search and rescue or extrication.

Mass-Casualty Incidents

As discussed earlier, an MCI is an emergency situation that involves three or more patients, places great demand on the EMS system, and/or has the potential to produce multiple casualties **Figure 39-6**. However, other causes of MCIs are far more common than disasters and are usually much smaller in scope. **Figure 39-7** is a diagrammed example of a residential building fire confined to one apartment that may only produce one patient but that has the potential to generate dozens of patients from among the responders and residents. Loss of power to a hospital or nursing home with ventilator-dependent and nonambulatory victims is considered an MCI, although no one is injured. By using the ICS and the NIMS and understanding the various roles and responsibilities of each position, the responders and/or IC can manage the incident in a smooth, organized manner.

Figure 39-6 Mass-casualty incidents can be large, such as the attack on September 11, 2001, or they can be much smaller in scope.

Courtesy of Michael Rieger/FEMA.

All systems have different protocols for when to declare an MCI and initiate the ICS; however, as an EMT, ask yourself the following questions when considering whether the call is an MCI:

- *How many seriously injured or ill patients can I care for effectively and transport in the ambulance? One? Two?*
- *What happens when I have three patients to manage?*
- *How long will it take for additional help to arrive?*
- *What happens if the number of patients exceeds the number of available ambulances?*

Obviously, you and your team cannot treat and transport all injured patients at the same time. At an MCI, you will often experience an increased demand for equipment and personnel. For example, you may realize that you are the only ambulance crew currently at the scene and there is a wait of 15 or more minutes before the next ambulance arrives. Never leave the scene with patients if there are still other patients present who are sick or wounded. This would leave patients at the scene without medical care and can be considered abandonment. If there are multiple patients and not enough resources to handle them without abandoning victims, you should declare an MCI (at least for the present time), request additional resources, and initiate the ICS and triage procedures (discussed next) **Figure 39-8**. Although this may cause some delay in initiating treatment to all patients, it will not adversely affect the patient care. Always follow your local protocol. Many large EMS systems deploy specialized MCI units or mobile emergency room vehicles that are able to treat dozens of patients on the scene.

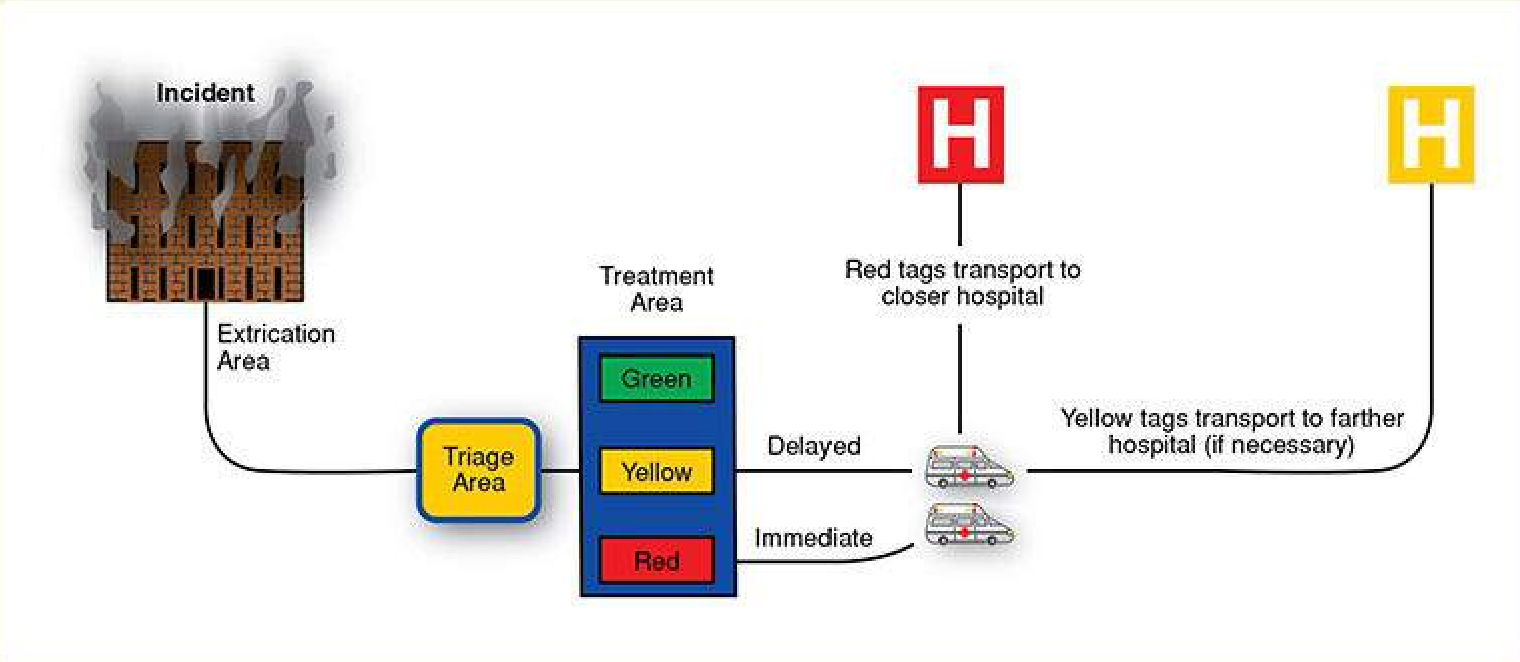


Figure 39-7 Diagram of a mass-casualty incident. The incident command system established at the scene of a building fire may look similar to this diagram.

Words of Wisdom

The terminology used to describe an incident with multiple patients varies in different communities. Many communities use *mass-casualty situation* to describe an emergency that involves more than one patient but use the term *mass-casualty incident* to describe larger scale events, such as those with more than 20 patients. In this text, the term *mass-casualty incident* is used to describe any call that involves three or more patients.

Figure 39-8 Mass-casualty incidents require additional ambulances and EMS providers from the immediate region.

Triage

Triage simply means *to sort* your patients based on the severity of their injuries **Figure 39-9**. The goal of doing the greatest good for the greatest number means that the triage assessment is brief and the patient condition categories are basic. **Primary triage** is the initial triage done in the field, allowing you to quickly and accurately categorize the patient's condition and transport needs, whereas **secondary triage** is done as patients are brought to the treatment area. During primary triage, patients are briefly assessed and then identified in some way, such as by attaching a triage tag or triage tape. The main information needed on the tag is a unique number and a triage category. Rapid and accurate triage will help bring order to the chaos of the MCI scene and allow the most critical patients to be transported first. After the primary triage, the triage supervisor should communicate the following information to the medical branch director:

Figure 39-9 Triage is the process of sorting and prioritizing patients based on severity of conditions.

Courtesy of Journalist 1st Class Mark D. Faram/U.S. Navy.

Words of Wisdom

Recall from Chapter 32, *Environmental Emergencies*, that you should use the reverse triage method with multiple victims of a lightning strike. With traditional triage, an apneic and pulseless patient would typically be triaged as "black" or "expectant." In the case of a lightning strike, however, treat cardiac or respiratory arrest victims first.

- The total number of patients
- The number of patients in each of the triage categories
- Recommendations for extrication and movement of patients to the treatment area
- Resources needed to complete triage and begin movement of patients

When the initial triage has been completed, secondary triage, or retriage, can occur, allowing you to reassess all remaining patients and to upgrade the triage category, if necessary. In smaller MCI events, this step may not be necessary, if enough resources have arrived on the scene.

Triage Categories

There are four common triage categories. You can remember them using the mnemonic IDME, which stands for Immediate (red), Delayed (yellow), Minor or Minimal (green; hold), and Expectant (black; likely to die or dead) Table 39-1. This is the order of priority for treatment and transport of the patients at an MCI.

Table 39-1 Triage Priorities

Triage Category	Typical Injuries
Red tag: first priority (immediate) Patients who need immediate care and transport Treat these patients first, and transport as soon as possible	▪ Airway and breathing compromise ▪ Uncontrolled or severe bleeding ▪ Severe medical problems ▪ Signs of shock (hypoperfusion) ▪ Severe burns ▪ Open chest or abdominal injuries
Yellow tag: second priority (delayed) Patients whose treatment and transport can be temporarily delayed	▪ Burns without airway compromise ▪ Major or multiple bone or joint injuries ▪ Back injuries with or without spinal cord damage
Green tag: third priority, minimal (walking wounded) Patients who require minimal or no treatment and transport can be delayed until last	▪ Minor fractures ▪ Minor soft-tissue injuries
Black tag: fourth priority (expectant) Patients who are already dead or have little chance for survival; treat salvageable patients before treating these patients	▪ Obvious death ▪ Obviously nonsurvivable injury, such as major open brain trauma ▪ Respiratory arrest (if limited resources) ▪ Cardiac arrest

Immediate (red-tag) patients are your first priority. They need immediate care and transport. They usually have problems with the ABCs, head trauma, or signs and symptoms of shock.

Delayed (yellow-tag) patients are the second priority and need treatment and transport, but it can be delayed. Patients usually have multiple injuries to bones or joints, including back injuries with or without spinal cord injury.

Minimal (green-tag) patients are the third priority. Patients may require no field or only minimal treatment. In some parts of the world, this is the hold category. These patients are the "walking wounded" at the scene. If they have any apparent injuries, they are usually soft-tissue injuries such as contusions, abrasions, and lacerations.

The last priority is the expectant (black-tag) patients who are dead or whose injuries are so severe that they have, at best, a minimal chance of survival. This category may include patients who are in cardiac arrest or who have an open head injury, for example. If you have limited resources, this category may also include patients in respiratory arrest. Patients in this category receive treatment and transport only after patients in the other three categories have received care.

Triage Tags

Whatever triage system is used, it is vital that a patient has a tag or some type of label. Tagging patients early assists in tracking them and keeping an accurate record of their condition. Triage tags should be water proof and easily read Figure 39-10. The patient tags or tape should be color-coded and should clearly show the category of the patients. The use of symbols and colors to indicate the triage categories is important in case some responders are color-blind.

The tags will become part of the patient's medical record. Most have a tear-off receipt with a number correlating with the number on the tag. When torn off by the transportation officer, it will assist him or her in tracking the patient. If the patient is unconscious and cannot be identified at the scene, the tag will be an identifier for tracking purposes. Some areas use digital photography to assist in identifying patients later. The photograph is catalogued with the patient's tag number, and the patient's location is tracked with this information. When family members are brought to crisis centers to help locate loved ones, the pictures may be of assistance. This technique has been used effectively in Europe and Israel with Polaroid or digital photos. Another way of tracking and accounting for patients is to issue only 20 to 25 cards or tags at a time with a scorecard to mark how patients are triaged and their priority. When the responder returns for more tags, the scorecard will provide a patient count to help command and the staff to develop a plan to respond and ensure that appropriate resources are either available or summoned. Whatever labeling system is used, it is imperative for the transportation officer to be able to identify which patient was transported by which unit and to which destination, and the priority of the patient's condition.

Figure 39-10 Triage tags (from left to right). **A.** Waterproof triage tape. **B.** Triage tag: back. **C.** Triage tag: front.

▶ START Triage

START triage is one of the easiest methods of triage. START stands for Simple Triage And Rapid Treatment. The staff members at Hoag Memorial Hospital, Newport Beach, CA, developed this method of triage. It is easily mastered with practice and will give you the ability to rapidly categorize patients at an MCI. START triage uses a limited assessment of the patient's ability to walk, respiratory status, hemodynamic status (pulse), and neurologic status.

The first step of the START triage system is performed on arrival at the scene by calling out to patients at the disaster site, "If you can hear my voice and are able to walk..." and then directing patients to an easily identifiable landmark. The injured people in this group are the walking wounded and are considered minimal (green) priority, or third-priority, patients.

The second step in the START process is directed toward nonwalking patients. Move to the first nonambulatory patient and assess the respiratory status. If the patient is not breathing, open the airway by using a simple manual maneuver. A patient who still does not begin to breathe is triaged as expectant (black). If the patient begins to breathe, tag him or her as immediate (red), place in the recovery position, and move on to the next patient **Figure 39-11**.

If the patient is breathing, make a quick estimation of the respiratory rate. A patient who is breathing faster than 30 breaths/min or slower than 10 breaths/ min is triaged as an immediate priority (red). If the patient is breathing from 10 to 29 breaths/min, move to the next step of the assessment.

The next step is to assess the hemodynamic status of the patient by checking for bilateral radial pulses. An absent radial pulse implies the patient is hypotensive; tag him or her as an immediate priority. If the radial pulse is present, go to the next assessment.

The final assessment in START triage is to assess the patient's neurologic status, which simply means to assess the patient's ability to follow simple commands, such as "Show me three fingers." This assessment establishes that the patient can understand and follow commands. A patient who is unconscious or cannot follow simple commands is an immediate priority patient. A patient who complies with a simple command should be triaged in the delayed category (yellow).

Figure 39-11 **A.** A START triage tag is ripped to the level of severity. **B.** A SMART triage tag folds to the level of severity.

A: Nancy G Fire Photography, Nancy Greifenhagen/Alamy; B: Courtesy of Richard Pilbery.

Words of Wisdom

Another triage method is the Sort, Assess, Lifesaving interventions, and Treatment and/or Transport (SALT) triage system. This triage system begins with a global sorting of patients. This step identifies the patients who are able to understand verbal instructions and are therefore likely to have good systemic perfusion. Patients who can walk are asked to move to a designated area and are assigned last priority. This is an attempt to decrease the number of patients leaving the scene and overwhelming local hospital resources before EMS can begin to move highest priority patients. Once those patients have been identified and moved, each remaining patient is assessed individually. The SALT method differs from others in its lifesaving intervention steps, which include bleeding control, opening the airway, two rescue breaths for children, needle decompression for tension pneumothorax, and auto-injector antidotes. These interventions may be all that is needed to upgrade the patient's condition on the SALT triage scale. The final step is treatment and/ or transport.

JumpSTART Triage for Pediatric Patients

Lou Romig, MD, recognized that the START triage system does not take into account the physiologic and developmental differences of pediatric patients. She developed the **JumpSTART triage** system for pediatric patients. JumpSTART is intended for use in children younger than 8 years or who appear to weigh less than 100 pounds (45 kg). As in START, the JumpSTART system begins by identifying the walking wounded. Infants or children not developed enough to walk or follow commands (including children with special needs) should be taken as soon as possible to the treatment area for immediate secondary triage. This action assists in getting children who cannot take care of their own basic needs into a health care provider's hands. There are several differences within the respiratory status assessment compared with that in START. First, if you find that a pediatric patient is not breathing, immediately check the pulse. If there is no pulse, label the patient as expectant (black). If the patient is not breathing but has a pulse, open the airway with a manual maneuver. If the patient does not begin to breathe, give five rescue breaths and check respirations again. A child who does not begin to breathe should be labeled expectant. The primary reason for this difference is that the most common cause of cardiac arrest in children is respiratory arrest.

The next step of the JumpSTART process is to assess the approximate rate of respirations. A child who is breathing fewer than 15 breaths/min or more than 45 breaths/min is tagged as an immediate priority (red), and you move on to the next patient. If the respirations are within the range of 15 to 45 breaths/min, the patient is assessed further.

The next assessment in JumpSTART triage is also the hemodynamic status of the patient. Just like in START, you are simply checking for a distal pulse. This does not need to be the brachial pulse; assess the pulse that you feel the most competent and comfortable checking. If there is an absence of a distal pulse, label the child as an immediate priority and move to the next patient. If the child has a distal pulse, move on to the next assessment.

The final assessment is for neurologic status. Because of the developmental differences in children, their responses will vary. For JumpSTART, a modified AVPU score is used. A child who is unresponsive or responds to pain by posturing or with incomprehensible sounds or is unable to localize pain is tagged as an immediate priority. A child who responds to pain by localizing it or withdrawing from it or is alert is considered a delayed-priority patient (yellow).

Triage Special Considerations

There are a few special situations in triage. Patients who are hysterical and disruptive to rescue efforts may need to be handled as an immediate priority and transported off the site, even if they are not seriously injured. Panic breeds panic, and this type of behavior could have a negative impact on other patients and on the responders.

A responder who becomes sick or injured during the rescue effort should be handled as an immediate priority and be transported off the site as soon as possible to avoid negative impact to the morale of remaining responders.

HazMat and weapons of mass destruction incidents force the HazMat team to identify patients as contaminated or decontaminated before the regular triage process. Contamination by chemicals or biologic weapons in a treatment area, a hospital, or trauma center could obstruct all systems and organizations coping with the MCI or disaster. Bear in mind that some incidents may require multiple triage areas or teams because the victims are located far apart.

Destination Decisions

All patients triaged as immediate (red) or delayed (yellow) should preferably be transported by ground ambulance or air ambulance, if available, to the most appropriate facility (trauma, burn, or pediatric center, etc). In extremely large situations, a bus may transport the walking wounded. If a bus is used for minimal-priority patients, it is strongly suggested that they be transported to a hospital or clinic distant from the MCI or disaster site to avoid overwhelming the local area hospital resources. Refer to the Centers for Disease Control and Prevention 2011 decision scheme for field triage of injured patients presented in Chapter 24, *Trauma Overview*. If a bus is used, plan for at least one EMT or paramedic to ride on board and to have an ambulance follow the bus. If a minimal-priority patient's condition worsens, the patient could be moved to the ambulance and transported to a closer facility. The EMT or paramedic can stay with the minimal-priority patients until their arrival at the designated hospital. Any worsening of a patient's condition must be relayed to the receiving hospital as soon as possible in whatever manner the incident dictates.

YOU are the Provider PART 3

Using the ambulance's public address (PA) system, you ask for anyone who can walk to come to the front gate, where a bus will be positioned to transport them. Next, you approach a supine middle-aged woman who is unresponsive with slow respirations. She has weak radial pulses. The next patient you encounter is a teenage boy who is apneic with a weak carotid pulse and no radial pulses. You note exposed brain matter. The third patient is an older woman with a severe laceration through the neck and chest; the neck injury has caused near decapitation. She is apneic and pulseless.

5. What are your considerations in determining whether you should stop and provide treatment for the first patient?
6. What triage categories should you assign to the second and third patients?

Immediate-priority patients should be transported two at a time until all are transported from the site. Then patients in the delayed category can be transported two or three at a time until all are at a hospital. Finally, the walking wounded are transported. Expectant patients who are still alive would receive treatment and transport at this time. Dead victims are handled or transported according to the standing operating procedure for the area.

It is important to remember that during an MCI, local hospitals may have their resources overwhelmed. Early notification to receiving facilities will allow for the hospitals to increase staffing and move patients within their facility as required. Typically, EMS agencies will know a hospital's surge capacity, which will tell the agency how many patients of each category the hospital is able to safely handle and care for.

Disaster Management

A **disaster** is a widespread event that disrupts functions and resources of a community and threatens lives and property. Many disasters do not necessarily result in personal injuries; for example, droughts causing widespread crop damage. On the other hand, many disasters such as floods, fires, and hurricanes will result in widespread injuries. Unlike an MCI, which generally lasts no longer than a few hours, emergency responders will generally be on the scene of a disaster for days to weeks and sometimes months (as in the events following Hurricane Katrina in 2005). Although you can "declare" an MCI as an EMT, only an elected official can declare a disaster.

Your role in a disaster is to respond when requested and to report to the IC for assigned tasks. In a disaster with an overwhelming number of casualties, area hospitals may decide that they cannot treat all patients at their facility. In this case, they may mobilize medical and nursing teams with equipment and set up a **casualty collection area** at a facility near the disaster scene, such as a warehouse. Once at the casualty collection area, the teams can perform triage, provide medical care, and transport patients to the hospital on a priority basis.

If a casualty collection area is established, it will be coordinated through the ICS in the same way as all other branches and areas of the operation. This is usually done only in a major disaster such as an earthquake when transportation to a hospital facility is impossible or involves prolonged delays. It may take several hours to establish a casualty collection area.

Words of Wisdom

Mass-casualty incidents and disasters take a physical and emotional toll on emergency responders. Make certain that you are medically evaluated if you have been injured, come into contact with any hazardous substance, or inhale any dust, fumes, or smoke. Often the health effects of such exposures do not manifest for years and are difficult to link back to a particular event. Also be aware of the signs of stress in yourself and in your coworkers. Consider taking advantage of critical incident stress debriefing (CISD)/critical incident stress management (CISM) opportunities after an incident if you feel they may be valuable. Chapter 2, *Workplace Safety and Wellness*, covers stress and CISD/CISM in detail.

Words of Wisdom

Urban Search and Rescue teams (USARs) and Disaster Medical Assistance Teams (DMATs) may be mobilized in the event of a natural disaster or mass-casualty incident. USARs typically provide rescue and initial medical stabilization to patients entrapped in confined spaces, such as from a structural collapse. DMATs provide medical care during an incident; they include providers such as physicians, paramedics, nurses, and EMTs who work at a federal level. DMATs arrive with sufficient supplies and equipment to provide care for at least 72 hours or until further aid arrives or the situation is resolved.

Introduction to Hazardous Materials

Your training has taught you that rapid response to the scene of a crash can save lives. However, when you arrive at the scene of a possible HazMat incident, you must first step back and assess the situation. This can be very stressful for you, particularly if you can see a patient. However, rushing into an unsafe scene can have catastrophic results. If you are overcome by a hazardous substance, not only will patients suffer because you will be unable to assist them, but you will also place a strain on the system because you will require emergency care.

Words of Wisdom

Methamphetamine (meth) is an illegal substance that has gained in popularity due to its increased accessibility and relatively low cost. Meth is manufactured in illegal labs with highly volatile chemicals in a process known as "cooking." The toxic fumes from meth labs not only create respiratory hazards, but may also ignite, causing fires or explosions. Exposure to the toxic fumes may cause irritation to the nose and throat, headaches, confusion, altered mental status, dizziness, nausea and/or vomiting, and respiratory problems.

You may find meth labs anywhere in the country, including homes, garages, abandoned trailers, or the trunk of a vehicle. People who cook meth are often exposed to the toxins or have burn injuries because the risk of explosion is high. Therefore, your potential for contact with a meth lab is high.

When responding to a general medical call, you may not realize that you are responding to a hazardous area. A house with all of the windows covered, glass cookware with a powdery residue, or a strong smell of an unusual odor like ammonia, cat urine, or nail polish remover is a sign of a potential meth lab. When responding to a motor vehicle crash, be aware of any vehicle with paint peeling off the back, especially around the seams where the trunk closes. If you have any suspicions that you may be in the presence of a meth lab, leave the area immediately and notify law enforcement to secure the scene and arrange for decontamination and cleanup.

Because of the unique aspects of responding to and working at a **hazardous materials (HazMat) incident**, the Occupational Safety and Health Administration, or OSHA, has published a set of guidelines known as the Hazardous Waste Operations and Emergency Response (HAZWOPER). All providers, including EMTs, must meet specific additional training requirements before becoming involved in HazMat incidents. As an EMT, you need training at the First Responder Awareness Level. This text does not include the skills and information necessary to meet those requirements. You need to check with your agency for information about specific awareness level training.

On the basis of the HAZWOPER regulation, first responders at the awareness level should have sufficient training or experience to demonstrate competency in the following areas:

- An understanding of what hazardous substances are and the risks associated with them
- An understanding of the potential outcomes of an incident
- The ability to recognize the presence of hazardous substances
- The ability to identify the hazardous substances, if possible
- An understanding of the role of the first responder awareness individual in the emergency response plan
- The ability to determine the need for additional resources and to notify the communication center

Recognizing a Hazardous Material

A **hazardous material** is any material that poses an unreasonable risk of damage or injury to people, property, or the environment if it is not properly controlled during handling, storage, manufacture, processing, packaging, use and disposal, and transportation. Recognizing a HazMat incident, determining the identity of the material(s), and understanding the hazards involved often require some detective work. You must train yourself to take the time to look at the whole scene so that you can identify the critical visual indicators and fit them into what you know about the problem.

Hazardous materials may be involved in any of the following situations **Figure 39-12**:

- A truck or train crash in which a substance is leaking from a tank truck or railroad tank car
- A leak, fire, or other emergency at an industrial plant, refinery, or other complex where chemicals or explosives are produced, used, or stored
- A leak or rupture of an underground natural gas pipe
- Deterioration of underground fuel tanks and seepage of oil or gasoline into the surrounding ground
- Buildup of methane or other by-products of waste decomposition in sewers or sewage-processing plants
- A motor vehicle crash in which a gas tank has ruptured

Initially, it is important to approach the scene from a safe location and direction. The traditional rules of staying uphill and upwind are a good place to start. In addition, it may be wise to use binoculars and view the scene from a safe distance. Be sure to question anyone involved in the incident—a wealth of information may be available to you if you simply ask the right person. Take enough time to assess the scene and interpret other clues such as dead animals near the point of release, discolored pavement, dead grass, visible vapors or puddles, or labels that may help identify the presence of a hazardous material. Once you have a basic idea of what happened or determine that danger may be present, you can begin to formulate a plan for addressing the incident.

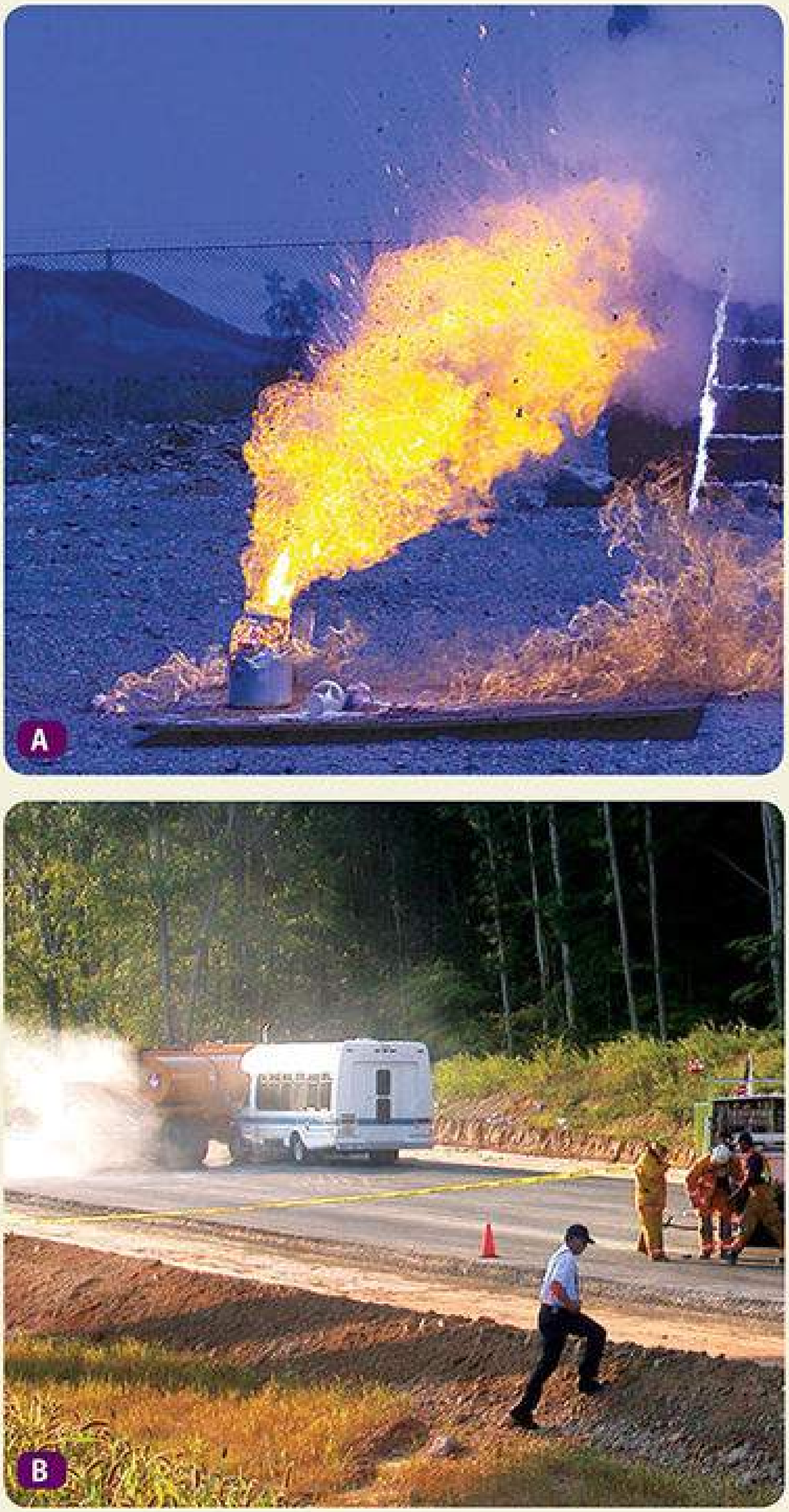


Figure 39-12 Two examples of hazardous materials incidents.

A: Courtesy of Rob L. Jackson/U.S. Marines; B: Courtesy of George Roarty/Virginia Department of Emergency Management.

Occupancy and Location

A wide variety of chemicals are stored in warehouses, hospitals, laboratories, industrial complexes, residential garages, bowling alleys, home improvement centers, garden supply stores, restaurants, and scores of other facilities or businesses in your response area. So many different chemicals exist in so many different locations that you could encounter almost anything during any type of emergency situation. The location and type of building are two good indicators of the possible presence of a hazardous material. For example, a biomedical laboratory is more likely than a preschool to have chemicals that could be hazardous on site.

Senses

Another way to detect the presence of hazardous materials is to use your senses, although this technique must be used carefully to avoid exposure. The senses you can safely use are sight and sound. Initially, the farther you are from the incident, the safer you will be. When it comes to HazMat incidents, "leading with your nose" is not a good tactic—but using binoculars from a distance is.

Clues that are seen or heard from a distance may enable you to take precautionary steps. Vapor clouds at the scene, for example, are a signal to move yourself and others away to a place of safety; the sound of an alarm from a toxic gas sensor in a chemical storage room or laboratory may also serve as a warning to retreat. Some highly vaporous and odorous chemicals—chlorine and ammonia, for example—may be detected by smell a long way from the actual point of release.

Containers

In basic terms, a **container** is any vessel or receptacle that holds a material. Often the container's type, size, and material of construction provide important clues about the nature of the substance inside. Nevertheless, do not rely solely on the type of container when making a determination about hazardous materials.

Red phosphorus from a drug laboratory, for example, might be found in an unmarked plastic container. In this case, there may not be legitimate markings to alert you to the possible contents. Gasoline or waste solvents may be stored in 55-gallon (208-L) steel drums. Sulfuric acid, at 97% concentration, could be found in a polyethylene drum that might be colored black, red, white, or blue. In most cases, there is no correlation between the color of the drum and the possible contents. The same sulfuric acid might also be found in a 1-gallon (3.8-L) amber glass container. Steel or polyethylene drums, bags, high-pressure gas cylinders, railroad tank cars, plastic buckets, aboveground and underground storage tanks, cargo tanks, and pipelines are all examples of how hazardous materials are packaged, stored, and shipped **Figure 39-13**.

Figure 39-13

Drums may be constructed of many different types of materials, including cardboard, polyethylene, and stainless steel. The drum shown here is made of polyethylene.

Courtesy of EMD Chemicals, Inc.

Some recognizable chemical containers, such as 55-gallon (208-L) drums and compressed gas cylinders, can be found in almost every type of manufacturing facility. Materials stored in a cardboard drum are usually in solid form. Stainless steel containers hold particularly dangerous chemicals, and cold liquids are kept in containers designed to maintain the appropriate temperature **Figure 39-14**.

Figure 39-14 A series of chemical storage containers.

One way to distinguish containers is to divide them into two categories based on their capacity: bulk and non-bulk storage containers.

Safety Tips

When you consider locations for possible hazardous materials incidents, do not limit your thinking. You may be surprised at how many different kinds of containers you may find in your area.

Container Volume

Bulk storage containers include fixed tanks, highway cargo tanks, rail tank cars, totes, and intermodal tanks. In general, bulk storage containers are found in buildings that rely on and need to store large quantities of a particular chemical. Most manufacturing facilities have at least one type of bulk storage container. Often these bulk storage containers are surrounded by a secondary containment system to help control an accidental release. **Secondary containment** is an engineered method to control spilled or released product if the main containment vessel fails. A 5,000-gallon (18,927-L) vertical storage tank, for example, may be surrounded by a series of short walls that form a catch basin around the tank.

Large-volume horizontal tanks are also common. When stored above ground, these tanks are referred to as aboveground storage tanks; if they are placed underground, they are known as underground storage tanks. These tanks can hold a few hundred gallons to several million gallons of product and are usually made of aluminum, steel, or plastic.

Another commonly encountered bulk storage vessel is the tote, also referred to as an intermediate bulk container. Totes have capacities ranging from 119 gallons to 703 gallons (450 to 2,661 L); the most common sizes are 350 and 550 gallons (1,325 and 2,082 L). These portable plastic tanks are surrounded by a stainless steel web that adds both structural stability and protection to the container. They can contain any type of chemical, including flammable liquids, corrosives, food-grade liquids, or oxidizers **Figure 39-15**.

Shipping and storing totes can be hazardous. These containers often are stacked atop one another and moved with a forklift, and a mishap with the loading or moving process can damage the tote. Because totes have no secondary containment system, any leak has the potential to create a large puddle. In addition, the steel webbing around the tote makes it difficult to access and patch leaks.

Intermodal tanks are both shipping and storage vessels. They hold between 5,000 and 6,000 gallons (18,927 and 22,712 L) of product and can be pressurized or nonpressurized. Intermodal tanks can also be used to ship and store gaseous substances that have been chilled until they liquefy, such as liquid nitrogen. In most cases, an intermodal tank is shipped to a facility, where it is stored and used and then returned to the shipper for refilling. Intermodal tanks can be shipped by all methods of transportation—air, sea, and land **Figure 39-16**.

Figure 39-15 A tote is a commonly encountered bulk storage vessel.

Courtesy of Tank Service, Inc.

Figure 39-16 An intermodal tank.

Courtesy of UBH International Ltd.

Nonbulk Storage Vessels

Essentially, **nonbulk storage vessels** are all types of containers other than bulk containers. Nonbulk storage vessels can hold a few ounces to 119 gallons (450 L) of product and include vessels such as drums, bags, compressed gas cylinders, cryogenic containers, and more. Nonbulk storage vessels hold commonly used commercial and industrial chemicals such as solvents, industrial cleaners, and compounds. This section describes the most commonly encountered types of nonbulk storage vessels.

Drums. **Drums** are easily recognizable, barrel-like containers. They are used to store a wide variety of substances, including food-grade materials, corrosives, flammable liquids, and grease. Drums may be constructed of low-carbon steel, polyethylene, cardboard, stainless steel, nickel, or other materials. Generally, the nature of the chemical dictates the construction of the storage drum. Steel utility drums, for example, hold flammable liquids, cleaning fluids, oil, and other noncorrosive chemicals. Polyethylene drums are used for corrosives such as acids, bases, oxidizers, and other materials that cannot be stored in steel containers. Cardboard drums hold solid materials such as soap flakes, sodium hydroxide pellets, and food-grade materials. Stainless steel or other heavy-duty drums generally hold materials too aggressive (ie, too reactive) for either plain steel or polyethylene.

Bags. Bags are commonly used to store solids and powders such as cement powder, sand, pesticides, soda ash, and slaked lime. Storage bags may be constructed of plastic, paper, or plastic-lined paper. Bags come in different sizes and weights, depending on their contents.

Pesticide bags must be labeled with specific information **Figure 39-17**. You can learn a great deal from the label, including the following details:

- Name of the product
- Active ingredients
- Hazard statement
- The total amount of product in the container
- The manufacturer's name and address
- The Environmental Protection Agency (EPA) registration number, which provides proof that the product was registered with the EPA

- The EPA establishment number, which shows where the product was manufactured
- Signal words to indicate the relative toxicity of the material:
  – Danger—Poison: Highly toxic by all routes of entry
  – Danger: Severe eye damage or skin irritation
  – Warning: Moderately toxic
  – Caution: Minor toxicity and minor eye damage or skin irritation
- Practical first-aid treatment description
- Directions for use
- Agricultural use requirements
- Precautionary statements such as mixing directions or potential environmental hazards
- Storage and disposal information
- Classification statement on who may use the product

In addition, every pesticide label must carry the statement, "Keep out of reach of children."

Carboys. Some corrosives and other types of chemicals are transported and stored in carboys **Figure 39-18**. A carboy is a glass, plastic, or steel container that holds 5 to 15 gallons (19 to 57 L) of product. Glass carboys are often placed in a protective wood, foam, fiberglass, or steel box to help prevent breakage. For example, nitric acid, sulfuric acid, and other strong acids are often transported and stored in thick glass carboys protected by a wooden or polystyrene (Styrofoam) crate to shield the glass container from damage during normal shipping.

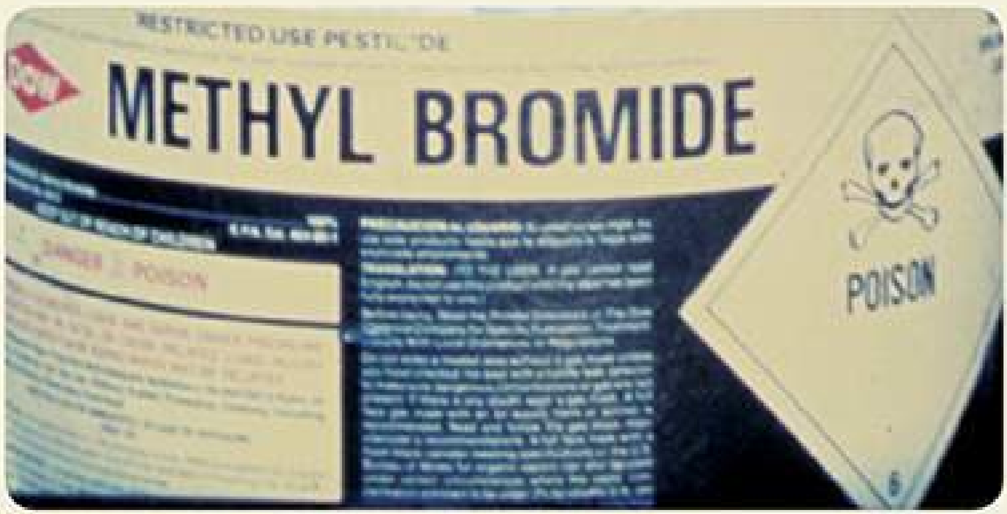


Figure 39-17 A pesticide bag must be labeled with the appropriate information.

Courtesy of the USDA.

Figure 39-18 A carboy is used to transport and store corrosive chemicals.

Courtesy of EMD Chemicals, Inc.

Cylinders. Several types of cylinders are used to hold liquids and gases. Uninsulated compressed gas cylinders are used to store substances such as nitrogen, argon, helium, and oxygen. They come in a range of sizes. As an EMT, you are very familiar with the shape of a cylinder; it holds the oxygen for your patients.

The Department of Transportation Marking System

The presence of labels, placards, and other markings on buildings, packages, boxes, and containers can often enable you to identify a released chemical. When used correctly, marking systems indicate the presence of a hazardous material from a safe distance and provide clues about the substance.

The US Department of Transportation (DOT) marking system is an identification system characterized by labels, placards, and markings Figure 39-19.

This marking system is used in the United States when materials are being transported from one location to another. The same marking system is also used in Canada by Transport Canada.

Placards are diamond-shaped indicators (10.75 inches [27 cm] per side) that are placed on all four sides of highway transport vehicles, railroad tank cars, and other forms of transportation carrying hazardous materials Figure 39-20. Labels are smaller versions (4 inches [10 cm] per side) of placards; they are placed on the four sides of individual boxes and smaller packages being transported.

Placards, labels, and markings are intended to give a general idea of the hazard inside a particular container or cargo tank. A placard identifies the broad hazard class (flammable, poison, corrosive) to which the material inside belongs. A label on a box inside a delivery truck, for example, relates only to the potential hazard inside that particular package Figure 39-21.

Other Considerations

The DOT system does not require that all chemical shipments be marked with placards or labels. In most cases, the package or cargo tank must contain a certain amount of hazardous material before a placard is required. For example, the “1,000-pound rule” applies to blasting agents, flammable and nonflammable gases, flammable/combustible liquids, flammable solids, air-reactive solids, oxidizers and organic peroxides, poison solids, corrosives, and miscellaneous (class 9) materials. Placards are required for these materials only when the shipment weighs more than 1,000 pounds (454 kg). Commercial package delivery services often carry small amounts of hazardous materials that fall below that weight limit. The vehicle exterior will not display placards to warn you of the danger.

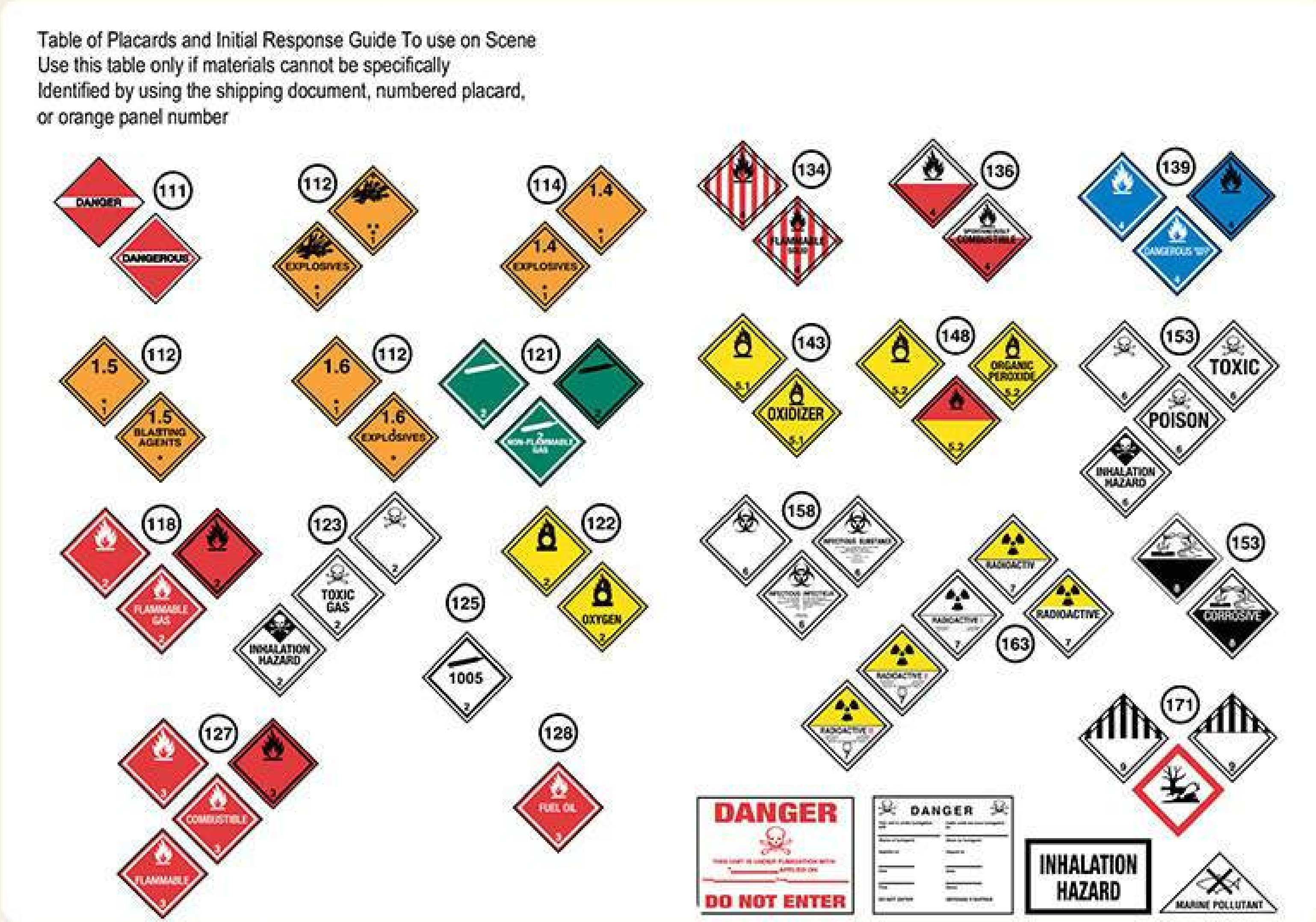


Figure 39-19 The Department of Transportation uses labels, placards, and markings (such as these found in the *Emergency Response Guidebook*) to give a general idea of the hazard inside a particular container or cargo tank.

Courtesy of the U.S. Department of Transportation.

Figure 39-20 A placard is a large diamond-shaped indicator that is placed on all sides of transport vehicles that carry hazardous materials.

© Mark Winfrey/ShutterStock.

Conversely, some chemicals are so hazardous that shipping any amount of them requires the use of labels or placards. These materials include explosives, poisonous gases, water-reactive solids, and high-level radioactive substances. A four-digit United Nations number may be required on some placards. This number identifies the specific material being shipped; a list of United Nations numbers is included in the *Emergency Response Guidebook*.

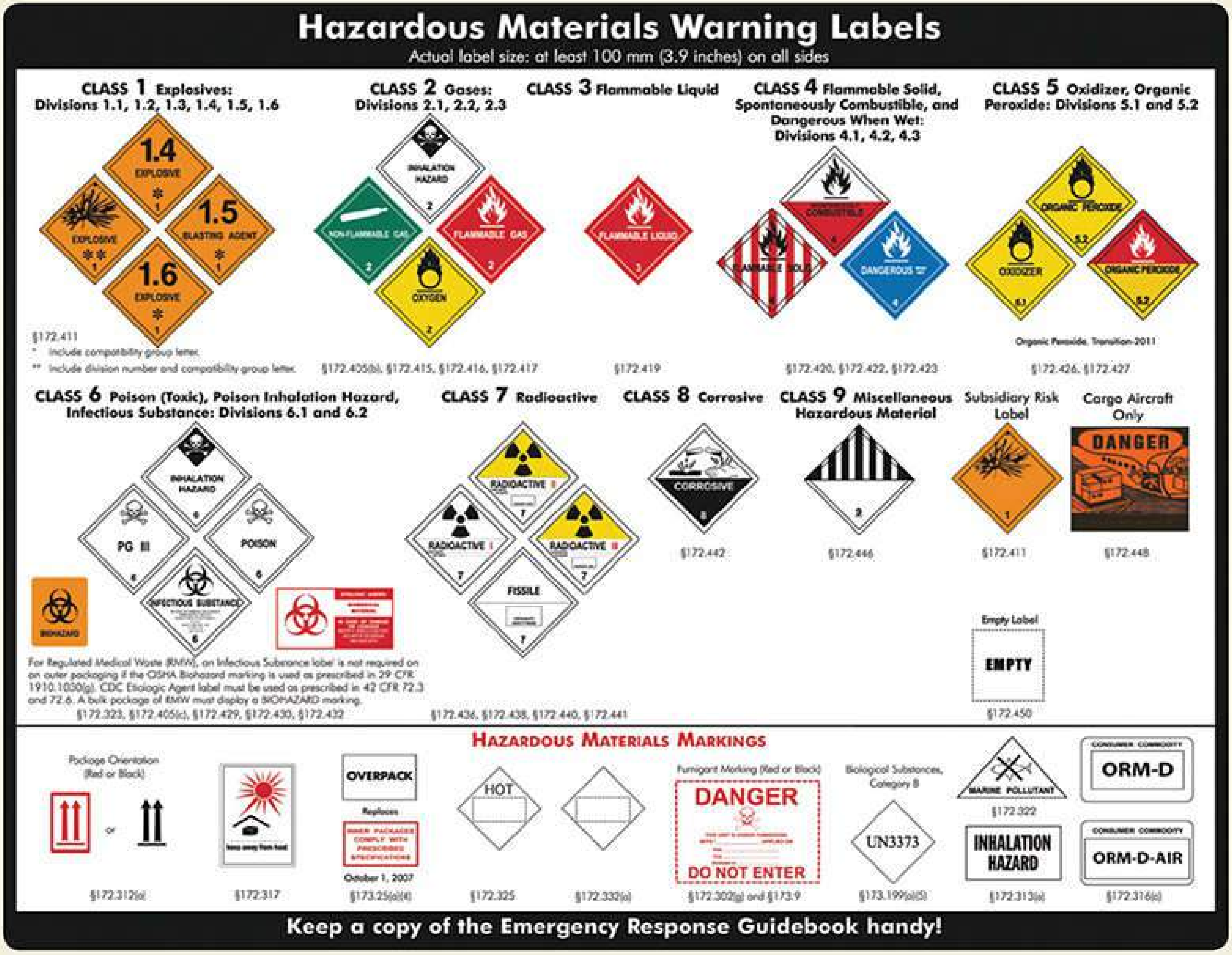


Figure 39-21 A label is a smaller version of the placard and is placed on boxes or smaller packages that contain hazardous materials.

Courtesy of the U.S. Department of Transportation.

References

Numerous reference materials are available to you, including the DOT's *Emergency Response Guidebook* and Jones & Bartlett Learning's *Fire Fighter's Handbook of Hazardous Materials*. The following sections describe these resources.

The *Emergency Response Guidebook*

The DOT's ***Emergency Response Guidebook (ERG)*** offers a certain amount of guidance for responders operating at a HazMat incident **Figure 39-22**. This guide is updated every 3 to 4 years and provides information on approximately 4,000 chemicals. The US DOT and the Secretariat of Communications and Transportation of Mexico, along with Transport Canada, jointly developed the *Emergency Response Guidebook*. You can download a free copy of the ERG via the Pipeline and Hazardous Materials Safety Administration (PHMSA) website.

Material Safety Data Sheets

A common source of information about a particular chemical is the **material safety data sheet (MSDS)** (or safety data sheet [SDS]) specific to that substance **Figure 39-23**. Essentially, the MSDS provides basic information about the chemical makeup of a substance, the potential hazards it presents, appropriate first aid in the event of an exposure, and other pertinent data for safe handling of the material. The MSDS will typically include the following details:

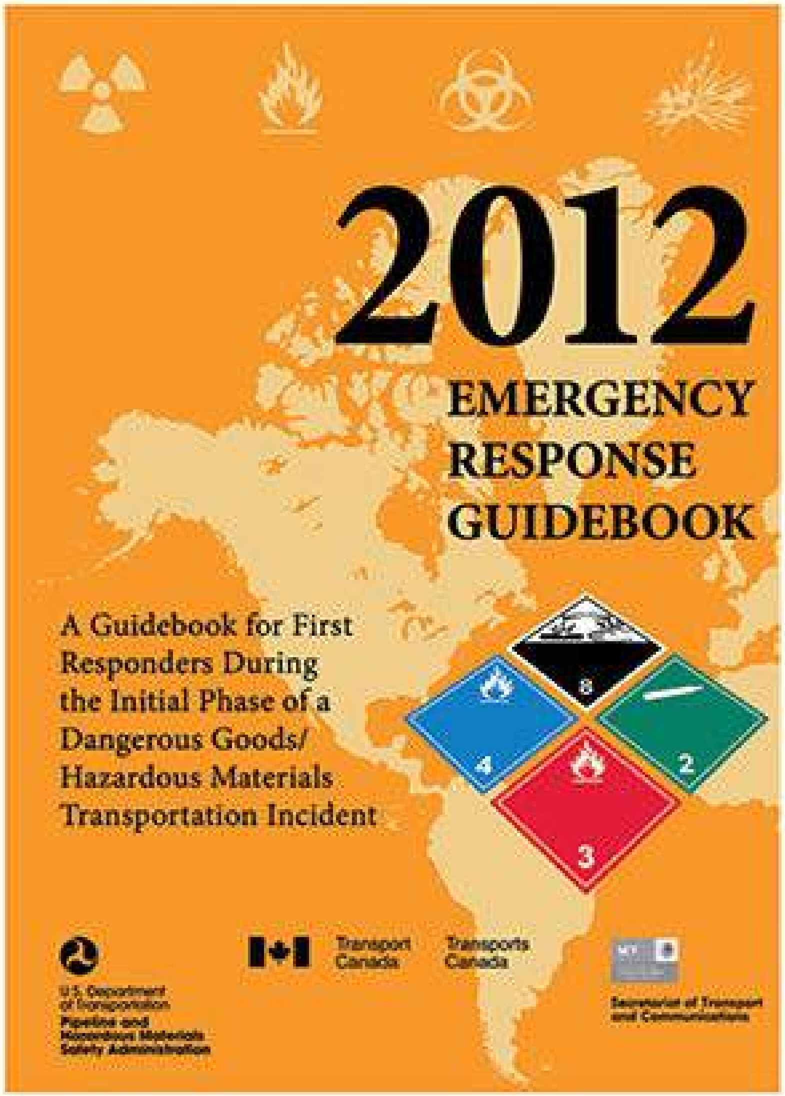


Figure 39-22 *The Emergency Response Guidebook* is a reference used as a base for your initial actions at a hazardous materials incident.

Courtesy of the U.S. Department of Transportation.

- The name of the chemical, including any synonyms for it
- Physical and chemical characteristics of the material
- Physical hazards of the material
- Health hazards of the material
- Signs and symptoms of exposure
- Routes of entry
- Permissible exposure limits
- Responsible-party contact
- Precautions for safe handling (including hygiene practices, protective measures, and procedures for cleaning up spills or leaks)

- Applicable control measures, including personal protective equipment
- Emergency and first-aid procedures
- Appropriate waste disposal

All facilities that use or store chemicals are required by law to have an MSDS on file for each chemical used or stored in the facility. Many sites, especially those that stock many different chemicals, may keep this information archived on a computer database. Although the MSDS is not a definitive response tool, it is a key piece of the puzzle. The MSDS can also be obtained from the transporting vehicle.

Shipping Papers

Shipping papers are required whenever materials are transported from one place to another. They include the names and addresses of the shipper and the receiver, identify the material being shipped, and specify the quantity and weight of each part of the shipment. Shipping papers for road and highway transportation are called **bills of lading** or **freight bills** and are located in the cab of the vehicle **Figure 39-24**. Drivers transporting chemicals are required by law to have a set of shipping papers on their person or within easy reach inside the cab at all times.

YOU are the Provider PART 4

While triaging the patients, several other ambulances and other pieces of fire department equipment arrive on the scene, as well as a battalion chief who assumes command. You update him on your findings and the status of your EMS personnel and ambulances. There are 37 walking wounded (green) who will need to be loaded onto a bus for transport. Of the 3 remaining patients, 2 have been tagged expectant (black) and one is immediate (red).

7. What changes, if any, should you make in your initial triage assignments with the arrival of additional responders?
8. What should you consider in deciding whether to set up a treatment area at this incident?

MATERIAL SAFETY DATA SHEET
ANHYDROUS AMMONIA

T I

DISTRIBUTORS:

TANNER INDUSTRIES, INC.

DIVISIONS:

NATIONAL AMMONIA	NORTHEASTERN AMMONIA
HAMLER INDUSTRIES	BOWER AMMONIA & CHEMICAL

735 Davisville Road, Third Floor, Southampton, PA 18966; 215-322-1238

CORPORATE EMERGENCY TELEPHONE NUMBER: 800-643-6226 CHEMTREC: 800-424-9300

DESCRIPTION

CHEMICAL NAME: Ammonia, Anhydrous — **CAS REGISTRY NO**: 7664-41-7

SYNONYMS: Ammonia — **CHEMICAL FAMILY**: Inorganic Nitrogen Compound

FORMULA: NH_3 — **MOL. WT**: 17.03 (NH_3) — **COMPOSITION**: 99+% Ammonia

STATEMENT OF HEALTH HAZARD

HAZARD DESCRIPTION:

Ammonia is an irritant and corrosive to the skin, eyes, respiratory tract and mucous membranes. Exposure to liquid or rapidly expanding gases may cause severe chemical burns and frostbite to the eyes, lungs and skin. Skin and respiratory related diseases could be aggravated by exposure.

Not recognized by OSHA as a carcinogen.
Not listed in the National Toxicology Program.
Not listed as a carcinogen by the International Agency for Research on Cancer.

EXPOSURE LIMITS FOR AMMONIA: Vapor

OSHA	50 ppm,	35 mg / m^3 PEL	8 hour TWA
NIOSH	35 ppm,	27 mg / m^3 STEL 15 minutes	
	25 ppm,	18 mg / m^3 REL	10 hour TWA
	300 ppm,	IDLH	
ACGIH	25 ppm,	18 mg / m^3 TLV	8 hour TWA
	35 ppm,	27 mg / m^3 STEL 15 minutes	

TOXICITY: LD 50 (Oral / Rat) 350 mg / kg

PHYSICAL DATA

BOILING POINT: -28°F at 1 Atm.
PH: N/A
SPECIFIC GRAVITY OF GAS (air = 1): 0.596 at 32°F
SPECIFIC GRAVITY OF LIQUID (water = 1): 0.682 at 28°F (Compared to water at 39°F).
PERCENT VOLATILE: 100% at 212°F
APPEARANCE AND ODOR: Colorless liquid or gas with pungent odor.
CRITICAL TEMPERATURE: 271.4°F
GAS SPECIFIC VOLUME: 20.78 Ft^3/Lb at 32°F and 1 Atm.

VAPOR DENSITY: 0.0481 Lb/Ft^3 at 32°F
LIQUID DENSITY: 38.00 Lb/Ft^3 at 70°F
APPROXIMATE FREEZING POINT: -108°F
WEIGHT (per gallon): 5.15 pounds at 60°F
VAPOR PRESSURE: 114 psig at 70°F
SOLUBILITY IN WATER (per 100 pounds of water): 86.9 pounds at 32°F, 51 pounds at 68°F
SURFACE TENSION: 23.4 Dynes / cm at 52°F
CRITICAL PRESSURE: 111.5 atm

Revision: September 2005 Page 1 of 4 Prepared By: JRP

Figure 39-23 An example of a material safety data sheet for anhydrous ammonia.

STRAIGHT BILL OF LADING
ORIGINAL - NOT NEGOTIABLE

BOL/Reference No.
RSI82715

CARRIER: NORFOLK SOUTHERN

Date: 12/23/2008

Shipper: RSI LOGISTICS, INC (OKEMOS, MI US)

The property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on itsroute, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classificatio n in effect on the date hereof, if this isa rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment

Shipper hereby certifies that he is familiar with all the terms and conditions or the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consignee Information: CONSIGNEE DEER PARK, TX Address: City: DEER PARK, TX US	
Route: NS-ESTL-BNSF	
Origin Switch Route:	
Destination Switch Route: HUSTN-PTRA	Rail Car No: GATX290861

For assistance in any transportation emergency involving chemicals, phone CHEMTREC, day or night, Toll Free 1-800-424-9300

DESCRIPTION		*WEIGHT
ONE TANK CAR	Contains: Methyl Esters STCC#2899415 BIODIESEL-15, Biodiesel Sales Order Contract No: RSI82715 Sales Order Contract No: AAT122308-4 Purchase Order Contract No: AAT122308-4	(Sub. To Correction) 204400 Lbs.

SEAL NUMBERS:

Gross

Tare

Net

Weighed By: ____________________

If charges are to be prepaid, write or stamp here, "To be Prepaid"
Prepaid

Subject to Section 7 of the conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:: *The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.*

Not In Effect

* This is to certify that the above named materials are properly classified, described, packaged marked, and labeled, and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation.

Figure 39-24 A bill of lading or freight bill.

Courtesy of RSI Logistics.

CHEMTREC

Located in Falls Church, VA, the Chemical Transportation Emergency Center (CHEMTREC), now operated by the American Chemistry Council, is an agency that provides invaluable technical information for first responders of all disciplines who are called upon to respond to chemical incidents. The toll-free number for CHEMTREC is 1-800-262-8200. CHEMTREC can provide you with technical chemical information via telephone, fax, or other electronic media. It also offers a phone conferencing service to connect you with thousands of shippers, subject matter experts, and chemical manufacturers.

When you call CHEMTREC, be sure to have the following basic information ready:

- The name of the chemical(s) involved in the incident (if known)
- Name of the caller and callback telephone number
- Location of the incident or problem
- Shipper or manufacturer of the chemical (if known)
- Container type
- Railcar or vehicle markings or numbers
- The shipping carrier's name
- Recipient of material
- Local conditions and exact description of the situation

When you are speaking with CHEMTREC personnel, spell out all chemical names; if using a third party, such as a dispatcher, it is vital that you confirm all spellings to avoid misunderstandings. One number or letter out of place could throw off all subsequent research. When in doubt, be sure to obtain clarification.

Identification

Unfortunately, even with all of these resources, identifying materials can still be difficult. Little consistency is used on labels and placards, and sometimes dishonest transporters will not label containers or vessels appropriately. The laws and regulations that cover labeling of packages and transport vehicles can also be misleading. As discussed previously, in most cases, the package or tank must contain a certain amount of a hazardous material before a placard is required. For example, because of the small quantities of hazardous materials that are involved, a truck carrying 99 pounds (45 kg) of HazMat No. 1 and 99 pounds (45 kg) of both HazMat No. 2 and HazMat No. 3 may not be required by law to display any labels or placards. The truck may show only a "Please drive carefully" placard, implying that it does not carry hazardous materials. Therefore, a crash involving this truck is a serious situation, but you would not necessarily know this if you relied on labels and placards. Always maintain a high index of suspicion when approaching the scene of a truck or train tanker crash.

Some substances are not hazardous; however, when mixed with another substance, they may become highly toxic. There may not be regulations against carrying such substances together on one truck or railroad car (or adjacent tank cars). The driver of a commercial truck and the conductor of a train, however, must carry shipping papers that identify what is being transported in their care. These shipping papers may be your first clue that there is a possible HazMat problem, although, depending on the nature of the incident, the papers may not be available to you.

In the event of a leak or spill, a HazMat incident is often indicated by the presence of the following:

- A visible cloud or strange-looking smoke resulting from the escaping substance
- A leak or spill from a tank, container, truck, or railroad car with or without HazMat placards or labels
- An unusual, strong, noxious (harmful), harsh odor in the area

To indicate the presence of normally odorless toxic gases or fluids during a leak or spill, manufacturers may add a substance that produces a strong noxious odor. However, a large number of hazardous gases and fluids are essentially odorless (or do not have a distinctive unpleasant smell) even when a substantial leak or spill has occurred. In some incidents, a large number of people are exposed and may be injured or killed before the presence of a HazMat incident is identified. If you approach a scene where more than one person has collapsed or is unconscious or in respiratory distress, you should assume that there has been a HazMat leak or spill and that it is unsafe to enter the area.

It is important for you to understand the potential danger of hazardous materials and know how to operate safely at a HazMat incident. If you do not follow the proper safety measures, you and many others could end up needlessly injured or dead. The safety of you and your team, the other responders, and the public must be your most important concern.

Words of Wisdom

Safety considerations at HazMat scenes differ considerably from those involved in emergency response in general. A HazMat scene requires you to have an even higher degree of alertness than usual to avoid entering a dangerous environment and to help others avoid it. There is also a need to prevent the spread of contamination to yourself and your ambulance. Understanding these two concepts is a good start toward safe operations in the presence of hazardous materials.

There will be times when the ambulance is the first to arrive at the scene. If, as you approach, any signs suggest that a HazMat incident has occurred, stop at a safe distance and park upwind or uphill from the incident. After rapidly sizing up the scene, call for a HazMat team. If you do not recognize the danger until you are too close, immediately leave the area. Once you have reached a safe place, try to rapidly assess the situation and provide as much information as possible when calling for the HazMat team, including your specific location, the size and shape of the containers of the hazardous material, and what you have observed and have been told has occurred. Do not reenter the scene, and do not leave the area until you have been cleared by the HazMat team, or you may contribute to the situation by spreading hazardous materials. Finally, do not allow civilians to enter the scene, if possible. No one should enter the area without the proper protective equipment, respiratory protection, or training.

Above all, avoid all contact with the material!

HazMat Scene Operations

Once you have recognized the incident as one involving hazardous materials and have called for the HazMat team, focus your efforts on activities that will ensure the safety and survival of the greatest number of people. Use the ambulance's public address system to alert people who are near the scene and direct them to move to a location where they will be sufficiently far from danger. With the aid of others on your team, try to set up a perimeter to stop traffic and people from entering the area.

Establishing Control Zones

Setting control zones and limiting access to the incident site helps reduce the number of civilians and responders who may be exposed to the released substance. **Control zones** are established at a HazMat incident based on the chemical and physical properties of the released material, the environmental factors at the time of the release, and the general layout of the scene. Of course, isolating a city block in the busy downtown area of a large city presents far different challenges than isolating the area around a rolled-over cargo tank on an interstate highway. Each situation is different, requiring flexibility and thoughtfulness. Securing access to the incident helps ensure that no one will accidentally enter a contaminated area.

If the incident takes place inside a structure, the best place to control access is at the normal points of ingress and egress (entry and exit)—doors. Once the doors are secured so that no unauthorized personnel can enter, appropriately trained emergency response crews can begin to isolate other areas as appropriate.

The same concept applies to outdoor incidents. The goal is to secure logical access points around the hazard. Begin by controlling intersections, on and off ramps, service roads, and other access routes to the scene. Law enforcement officers should assist by diverting traffic at a safe distance outside the hazard area. They should block off streets, close intersections, and redirect traffic as needed.

During a long-term incident, highway department or public works department employees may be called upon to set up traffic barriers. Whatever methods or devices are used to restrict access, they should not limit or prevent a rapid withdrawal of responders from the area.

It is not uncommon to set large control zones at the onset of an incident, only to discover that the zones may have been established too liberally. At the same time, control zones should not be defined too narrowly **Figure 39-25**. As the IC gets more information about the specifics of the chemical or material involved, the control zones may be expanded or reduced. Ideally, the control zones will be established in the right place the first time. Wind shifts are a common reason why control zones are modified during the incident. If there is a prevailing wind pattern in your area, factor that consideration into your decision making when it comes to control zones.

Typically, control zones at HazMat incidents are labeled as *hot, warm,* or *cold.* You may also discover that other terms are used, such as *exclusionary zone* (hot zone), *contamination reduction zone* (warm zone), and *outer perimeter* (cold zone). In any case, make sure you understand the terminology used in your jurisdiction. Be aware that different jurisdictions may use terminology and setup procedures unlike the ones used in your agency. As long as you understand the concepts behind the actions and remember that safety is the main focus, the act of setting up and naming zones can remain flexible.

The **hot zone** is the area immediately surrounding the release, which is also the most contaminated area. Its boundaries should be set large enough that adverse effects from the released substance will not affect people outside of the hot zone. An incident involving a gaseous substance or a vapor, for example, may require a larger hot zone than one involving a solid or nonvolatile liquid leak. In some cases, atmospheric monitoring, plume modeling, or reference sources such as the *Emergency Response Guidebook* may prove useful in helping to establish the perimeters of a hot zone. Specially trained responders, in accordance with their level of training, should be tasked with using these tools. Keep in mind that the physical characteristics of the released substance will significantly affect the size and layout of the hot zone. In addition, all specially trained responders entering the hot zone should avoid contact with the product to the greatest extent possible. Adhering to this important policy makes the job of decontamination easier and reduces the risk of cross-contamination.

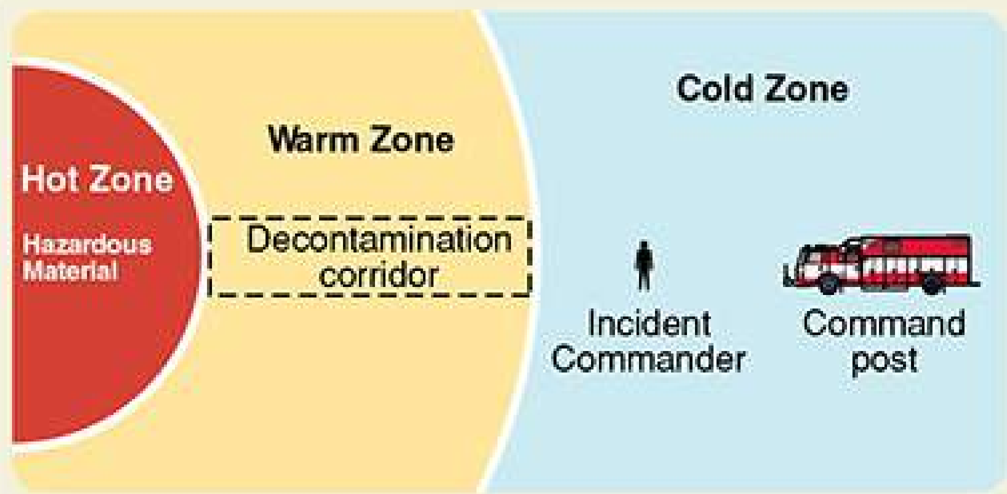


Figure 39-25 Control zones spread outward from the center of a hazardous materials incident.

Personnel accountability is important, so access into the hot zone must be limited to only the responders necessary to control the incident. All personnel and equipment must be decontaminated when they leave the hot zone. This practice ensures that contamination is not inadvertently spread to “clean” areas of the scene.

The **warm zone** is where personnel and equipment transition into and out of the hot zone. It contains control points for access to the hot zone as well as the decontamination area. Only the minimal number of personnel and the equipment necessary to perform decontamination, or support those operating in the hot zone, should be permitted in the warm zone.

A patient’s skin and clothing may contain hazardous material, so the **decontamination area** is set up in the warm zone. The decontamination area is the designated area where contaminants are removed before an individual can go to another area. **Decontamination** is the process of removing or neutralizing and properly disposing of hazardous materials from equipment, patients, and rescue personnel. The decontamination area must include special containers for contaminated clothing and special bags to isolate each patient’s personal effects safely until they can be decontaminated **Figure 39-26**. The area will also contain a number of special facilities to thoroughly wash and rinse patients and backboards. The water that is used must be captured and delivered into special sealable containers.

Anyone who leaves the hot zone must pass through the decontamination area. Firefighters’ and HazMat team members’ outer protective gear is rinsed and washed in the decontamination area before it is removed **Figure 39-27**. To prevent needless contact and transmission of splash or residues, different personnel are used in the decontamination and treatment areas. Do not move into the decontamination area unless you are properly trained and equipped. Wait for the patients to be brought to you.

Beyond the warm zone is the **cold zone**. The cold zone is a safe area where personnel do not need to wear any special protective clothing for safe operation. Personnel staging, the command post, EMS providers, and the area for medical monitoring, support, and/or treatment after decontamination are all located in the cold zone.

Figure 39-26 Patients should be decontaminated before they are taken to treatment areas.

Figure 39-27 The decontamination zone is where firefighters' and HazMat team members' outer protective gear is rinsed and washed before removal.

Courtesy of Airman 1st Class Scherrie Gates/U.S. Air Force.

Role of the EMT

As an EMT, your job is to report to a designated area outside of the hot and warm zones and provide triage, treatment, transport, or rehabilitation when HazMat team members bring patients to you.

Classification of Hazardous Materials

The National Fire Protection Association (NFPA) 704 Hazardous Materials Classification standard classifies hazardous materials according to health hazard or toxicity levels, fire hazard, chemical reactive hazard, and special hazards (such as radiation and acids) for fixed facilities that store hazardous materials. Toxicity protection levels are also classified according to the level of personal protection required. For your safety, you must know the type and degree of health, fire, and reactive hazard protection you need to operate safely near these substances before you enter the scene.

Toxicity Level

Toxicity levels are measures of the health risk that a substance poses to someone who comes into contact with it. There are five toxicity levels: 0, 1, 2, 3, and 4. The higher the number, the greater the toxicity, as follows:

- **Level 0** includes materials that would cause little, if any, health hazard if you came into contact with them.
- **Level 1** includes materials that would cause irritation on contact but only mild residual injury, even without treatment.
- **Level 2** includes materials that could cause temporary damage or residual injury unless prompt medical treatment is provided. Both levels 1 and 2 are considered slightly hazardous but require use of self-contained breathing apparatus (SCBA) if you are going to come into contact with them.
- **Level 3** includes materials that are extremely hazardous to health. Contact with these materials requires full protective gear so that none of your skin surface is exposed.
- **Level 4** includes materials that are so hazardous that minimal contact will cause death. For level 4 substances, you need specialized gear that is designed for protection against that particular hazard.

You must note that all health hazard levels, with the exception of 0, require respiratory and chemical protective gear that is not standard on most ambulances and specialized training. Table 39-2 further describes the four hazard classes.

Personal Protective Equipment Level

Personal protective equipment (PPE) levels indicate the amount and type of protective gear that you need to prevent injury from a particular substance. The four recognized protection levels, A, B, C, and D, are as follows Figure 39-28:

- **Level A**, the most hazardous, requires fully encapsulated, chemical-resistant protective clothing that provides full body protection, as well as SCBA and special, sealed equipment.
- **Level B** requires nonencapsulated protective clothing or clothing that is designed to protect against a particular hazard Figure 39-29. Usually, this clothing is made of material that will let only limited amounts of moisture and vapor pass through (nonpermeable). Level B also requires eye protection and breathing devices that contain their own air supply, such as SCBA.

Table 39-2 Toxicity Levels of Hazardous Materials

Level	Health Hazard	Protection Needed
0	Little or no hazard	None
1	Slightly hazardous	SCBA (level C suit) only
2	Slightly hazardous	SCBA (level C suit) only
3	Extremely hazardous	Full protection, with no exposed skin (level A or B suit)
4	Minimal exposure causes death	Special HazMat gear (level A suit)

Figure 39-28 Four levels of protection. **A.** Level A protection. **B.** Level B protection. **C.** Level C protection. **D.** Level D protection.

A, B: © Jones & Bartlett Learning. Photographed by Glen E. Ellman. C: Courtesy of The DuPont Company; D: © Jones & Bartlett Learning. Courtesy of MIEMSS.

- **Level C**, like Level B, requires the use of nonpermeable clothing and eye protection. In addition, face masks that filter all inhaled outside air must be used.
- **Level D** requires a work uniform, such as coveralls, that affords minimal protection.
- All levels of protection require the use of gloves. Two pairs of rubber gloves are needed for protection in case one pair must be removed because of heavy contamination.

Figure 39-29 Workers in Level B protection.

Caring for Patients at a HazMat Incident

Generally, HazMat team members who are trained in prehospital emergency care will initiate emergency care for patients who have been exposed to a hazardous material. However, because of the dangers, time constraints, and bulky protective gear that team members wear, it is practical only to provide the simplest assessment and essential care in the hazard zone and the decontamination area. In addition, to avoid entrapment and spread of contaminants, no bandages or splints are applied—except pressure dressings that are needed to control bleeding—until the “clean” (decontaminated) patient has been moved to the treatment area. Therefore, when you are providing care in the treatment area, assess and treat the patient in the same way as you would a patient who has not been previously assessed or treated.

Your care of patients at a HazMat incident must address the following two issues:

- Any trauma that has resulted from other related mechanisms, such as vehicle crash, fire, or explosion
- The injury and harm that have resulted from exposure to the hazardous substance

Most serious injuries and deaths from hazardous materials result from airway and breathing problems. Therefore, be sure to maintain the airway, and, if the patient appears to be in distress, give oxygen at 12 to 15 L/min with a nonrebreathing mask. Monitor the patient’s breathing at all times. If you see signs that indicate that respiratory distress is increasing, you may need to provide assisted ventilation with a bag-valve mask (BVM) and high-flow oxygen.

Treat the patient's injuries in the same way that you would treat any injury. There are few specific antidotes or treatments for exposure to most hazardous materials. Different people may respond differently to contact with the same hazardous material. Therefore, your treatment for the patient's exposure to the toxic substance should focus mainly on supportive care and initiating prompt transport to the hospital.

If antidotes or other special treatments need to be initiated in the field, they will be ordered by medical control and relayed to the officer in charge of EMS operations at the scene. If special treatment includes medications, intravenous fluids, or other advanced care, paramedics or other advanced personnel will be sent to work with you at the treatment area.

Special Care

In some cases, before the decontamination area has been completely set up, the HazMat team will find one or two patients who need immediate treatment and transport without delay if they are to survive. Even if the decontamination area is set up and functioning, some patients may have such respiratory distress or otherwise urgent critical condition that the time necessary for full decontamination may prove fatal. If additional delay for proper decontamination seems life threatening in nontoxic exposure situations, it may be necessary to simply cut away all of the patient's clothing and do a rapid rinse to remove the majority of the contaminating matter before transport.

If you must treat and transport a patient who has not been properly decontaminated, you will need to increase the amount of protective clothing you wear, including the use of SCBA. At the least, this should include two pairs of gloves, goggles or a face shield, a protective coat, respiratory protection, and a disposable fluid-impervious apron or similar outfit. Many HazMat teams carry lightweight, easy-to-use, disposable, fluid-impervious protective suits for such a purpose. Remember, however, that transporting a contaminated patient merely increases the scope of the event. The decision to transport even one patient with critical injuries rests with the IC, who bases his or her decision on recommendations made by the HazMat team.

Prior to your arrival on scene, there are steps you can take to make decontaminating the ambulance easier. First, tape the cabinet doors shut. Any equipment kits, monitors, and other items that will not be used en route should be removed from the patient compartment and placed in the front of the ambulance or in outside compartments. Before loading the patient, turn on the power vent ceiling fan and patient compartment air-conditioning unit fan. Unless the weather is too severe, the windows in the driver's area and sliding side windows in the patient compartment should also be partially opened to prevent creating a "closed box" inside the ambulance and to ensure that it is properly ventilated for the safety of the patient, you, and your team members.

When you leave the scene, inform the hospital that you are transporting a critically injured patient who has not been fully decontaminated at the scene. This will allow the hospital to prepare to receive the patient. Many emergency departments (EDs) have decontamination facilities and trained personnel for such an event. You may be diverted to a facility with these capabilities if the receiving hospital is not so equipped. On arrival, one EMT enters the ED and, after giving hospital staff the report and advising them again of the incomplete decontamination, obtains directions before the patient is unloaded and brought inside. If there are enough ambulances at a HazMat scene, one may be isolated and used only to transport such patients. Remember, the ambulance needs to be decontaminated before transporting another patient.

YOU are the Provider — PART 5

As the patients are being retriaged and treated, the IC contacts the local trauma center to advise staff of the situation and to determine how many of the walking wounded they can handle in addition to the one critically injured patient. Hospital staff advises him that they can handle 10 of the patients. You reassess a boy whom you originally triaged as expectant. He is now apneic and pulseless. Your partner begins cardiopulmonary resuscitation (CPR) as you contact medical control. Based on the patient's injuries, medical control determines that resuscitation is not indicated.

9. What factors should be considered when determining the appropriate transport destination?
10. Why did medical control advise termination of resuscitation?

YOU are the Provider — SUMMARY

1. How will you decide whether to declare this a mass-casualty incident?

In this case, you are responding to an incident involving *at least* three patients, and the severity of their injuries is unknown. One ambulance and two EMTs can effectively treat and transport only two stable patients *or* one critical patient at a time. In addition, there will likely be a crowd at the scene, which may hinder responder access and pose a possible danger to them.

On the basis of the information provided by dispatch, you should request additional EMS units. It is arguably better to call for help earlier, rather than wait until you arrive at the scene and find yourself overwhelmed by patients—some of whom may be critically injured. The longer it takes to call for help, the longer it will take for help to arrive.

2. How will the incident command system facilitate operations at this scene?

You have requested the assistance of other EMS units because you have determined that there are more patients than you can effectively care for. When the other units arrive, the ICS will facilitate the processes of triage, treatment, and transport; it will also help control the duplication of efforts and freelancing, in which individual units or different organizations make independent and often inefficient decisions that could compromise the effectiveness of the entire operation.

3. How should you and your partner proceed?

Once you have conducted a good scene size-up and answered the three basic questions—*What do I have? What resources do I need? What do I need to do?* —command should be established by the highest ranking public safety provider present, notification to other responders should go out, and necessary resources should be requested. In this instance, you and your partner will need to establish command until more senior personnel arrive.

4. Once command has been established, what are your duties?

Once an IC and safety officer have been identified, you and your partner should begin the process of locating the patients and triaging them.

Because you and your partner are the only EMTs at the scene, you will initially need to function as the triage and treatment officer, and the primary and secondary triage will likely occur in the same area. If you have triaged all patients and additional help has still not arrived, begin treating the most critically injured patients first. As additional EMTs and ambulances arrive, they should be assigned accordingly—again, with priority given to the most critically injured patients.

5. What are your considerations in determining whether you should stop and provide treatment for the first patient?

Major treatment is not allowed during the triage process; however, because this patient is breathing—although slowly—and has a pulse, it is acceptable to stop and roll her to the recovery position. This may facilitate her breathing and possibly improve her condition. Due to her altered mental status, respiratory status, and weak pulses, she should be categorized as immediate (red). You should return to treat her as soon as you have completed triage.

6. What triage categories should be assigned to the second and third patients?

Both patients should be categorized as expectant (black tag). The boy is unresponsive; is not breathing; has a slow, weak carotid pulse; and has no radial pulses. He also has exposed brain matter indicating injury that is highly likely to be incompatible with life. If adequate help was available at the scene, this patient would be categorized as immediate. The near decapitation injury in the older woman is also likely to be incompatible with life. Compared with others encountered during your triage, these two patients have the least likely chance of survival. If you and your partner were to focus on treating these two patients, the condition of the patient you categorized as red could deteriorate further, potentially resulting in the death of multiple patients.

7. What changes, if any, should you make in your initial triage assignments with the arrival of additional responders?

One patient was initially triaged as immediate (red tag); her triage category should stay the same. Remember, do not downgrade a patient's initial triage category; only upgrade it if the patient's condition deteriorates.

When you and your partner were the only EMTs at the scene, you had to decide which patients were the most critical, yet the most likely to survive with immediate treatment and prompt transport. The nonbreathing teenage boy and the older woman with near decapitation were initially triaged as expectant (black tag) because they were the least likely to survive and your available resources were limited. However, now that you have a sufficient number of EMTs and ambulances at the scene, reconsider their triage categories. Patients triaged as red and yellow should still receive the most immediate treatment and transport.

If you leave the teenager in the expectant category, he will die. However, if you provide immediate treatment and prompt transport, there is a chance that he will survive. Because he is pulseless and apneic, begin CPR and contact medical control; treatment and transport may still be indicated.

8. What should you consider in deciding whether to set up a treatment area at this incident?

Initially, there were only two EMTs at the scene and three critically injured patients. It would be more practical and time-saving to triage and treat the patients in the same area. Taking the time to set up a treatment area would delay patient care and would require more personnel. Once more EMS resources arrive at the scene, there may be a need for a designated treatment area if transport will be delayed for any of the patients.

9. What factors should be considered when determining the appropriate transport destination?

As soon as you declare an MCI, notify area hospitals as early as possible, inform them of the situation, and determine their surge capacity; this will tell you how many patients of each category they are able to safely and effectively care for. It will also allow the hospitals to increase their staffing and, if needed, move patients within the facility.

Do *not* begin transport until the intended destination facility has been notified and has accepted the patient(s). There must be a plan of action in place *before* any patients are transported from the scene.

The basic principles of transport that apply to any other patient also apply to MCIs; the most critically injured (red-tagged) patients should be transported to a designated trauma center, whereas yellow-tagged patients can be transported to hospitals that are located a farther away. In cases where the closest trauma center is located a great distance away, air medical transport should be considered.

10. Why did medical control advise termination of resuscitation?

He is a poor candidate because he is apneic with a weak carotid pulse and exposed brain matter. A patient who is critically injured will require more resources than are available and will pull valuable resources from others who may benefit from less time-consuming care. Multiple other patients may be saved in the amount of time required to treat this one individual. Even though it would be ideal to save everyone, the purpose of triage is to do the most good for the greatest number.

However, once all other patients are treated, or if there is enough manpower, even those patients who are considered poor candidates may receive treatment. This patient's age is a consideration for attempting resuscitation. While an older person is more likely to have concomitant issues and a more extensive medical history, a younger person may respond well to minimal treatment. If unsure, initiate treatment and contact medical control for further direction.

Patient No. 1

Triage Tag
No. 239351

Move the Walking Wounded — MINIMAL

NO respirations after head tilt — EXPECTANT

☐ Respirations–under 10 — IMMEDIATE

☐ Perfusion–capillary refill over 2 seconds — IMMEDIATE

☐ Mental status–unresponsive — IMMEDIATE

Otherwise — DELAYED

MAJOR INJURIES: None

HOSPITAL DESTINATION : Trauma Center

ORIENTED × 4 DISORIENTED ☐ UNCONSCIOUS ☒

TIME	PULSE	B/P	RESPIRATION
1425	132	N/A	6
N/A	N/A	N/A	N/A

PERSONAL INFORMATION:

NAME : Unknown

MALE ☐ FEMALE ☒ AGE: N/A WEIGHT : N/A

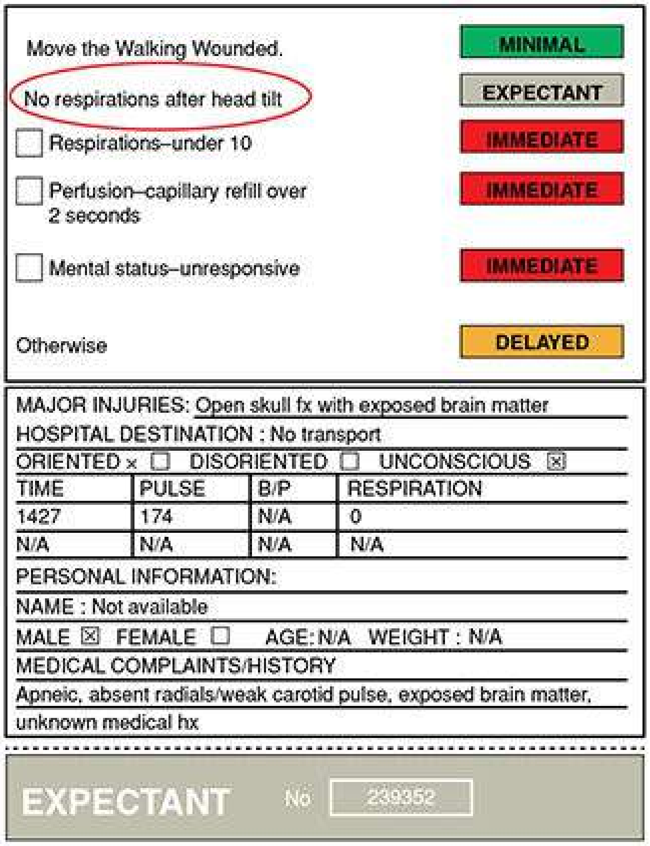
MEDICAL COMPLAINTS/HISTORY

Unknown medical history

EXPECTANT No 239351

IMMEDIATE No 239351

Patient No. 2
Triage Tag
No. 239352



Move the Walking Wounded. MINIMAL

No respirations after head tilt EXPECTANT

☐ Respirations–under 10 IMMEDIATE

☐ Perfusion–capillary refill over 2 seconds IMMEDIATE

☐ Mental status–unresponsive IMMEDIATE

Otherwise DELAYED

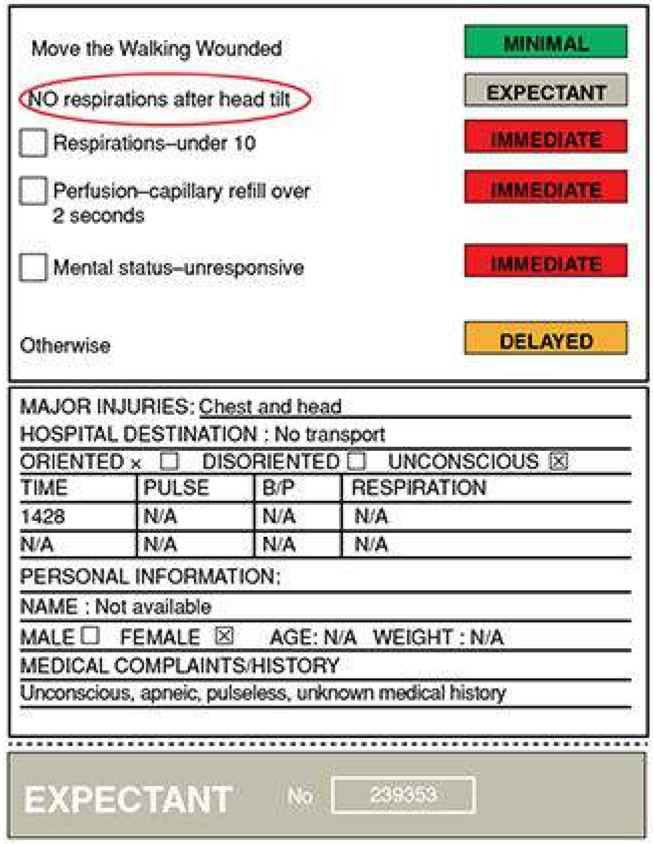
MAJOR INJURIES: Open skull fx with exposed brain matter
HOSPITAL DESTINATION : No transport
ORIENTED x ☐ DISORIENTED ☐ UNCONSCIOUS ☒

TIME	PULSE	B/P	RESPIRATION
1427	174	N/A	0
N/A	N/A	N/A	N/A

PERSONAL INFORMATION:
NAME : Not available
MALE ☒ FEMALE ☐ AGE: N/A WEIGHT : N/A
MEDICAL COMPLAINTS/HISTORY
Apneic, absent radials/weak carotid pulse, exposed brain matter, unknown medical hx

EXPECTANT No 239352

Patient No. 3
Triage Tag
No. 239353



Move the Walking Wounded MINIMAL

NO respirations after head tilt EXPECTANT

☐ Respirations–under 10 IMMEDIATE

☐ Perfusion–capillary refill over 2 seconds IMMEDIATE

☐ Mental status–unresponsive IMMEDIATE

Otherwise DELAYED

MAJOR INJURIES: Chest and head
HOSPITAL DESTINATION : No transport
ORIENTED x ☐ DISORIENTED ☐ UNCONSCIOUS ☒

TIME	PULSE	B/P	RESPIRATION
1428	N/A	N/A	N/A
N/A	N/A	N/A	N/A

PERSONAL INFORMATION:
NAME : Not available
MALE ☐ FEMALE ☒ AGE: N/A WEIGHT : N/A
MEDICAL COMPLAINTS/HISTORY
Unconscious, apneic, pulseless, unknown medical history

EXPECTANT No 239353

Prep Kit

Ready for Review

- The National Incident Management System (NIMS) provides a framework to enable federal, state, and local governments, as well as private-sector and nongovernmental organizations, to work together effectively and efficiently. The NIMS is used to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism and hazardous materials (HazMat) incidents.
- The five major NIMS components are preparedness, communications and information management, resource management, command management, and ongoing management and maintenance.
- The purpose of the incident command system is to ensure responder and public safety; achieve incident management goals; and ensure the efficient use of resources.
- Preparedness involves the decisions made and basic planning done before an incident occurs.
- Your agency should have written disaster plans that you are regularly trained to carry out.
- At incidents that have a significant medical factor, the incident commander should appoint someone as the medical group or branch leader. This person will supervise the primary roles of the medical group: triage, treatment, and transport of the injured.
- A mass-casualty incident (MCI) refers to any call that involves three or more patients, any situation that places such a great demand on available equipment or personnel that the system would require a mutual aid response, or any incident that has a potential to create one of the previously mentioned situations.
- The goal of triage is to do the greatest good for the greatest number of people. This means that the triage assessment is brief and the patient condition categories are basic.

- There are four basic triage categories that can be recalled using the mnemonic IDME:
  - Immediate (red)
  - Delayed (yellow)
  - Minimal (green; hold)
  - Expectant (black; likely to die or dead)
- A disaster is a widespread event that disrupts functions and resources of a community and threatens lives and property.
- Many disasters, such as a drought, may not involve personal injuries.
- When you arrive at the scene of a HazMat incident, you must first step back and assess the situation. This can be very stressful, particularly if you see a patient.
- A valuable resource for determining what the hazardous material is and what you should do is CHEMTREC.

Vital Vocabulary

bills of lading The shipping papers used for transport of chemicals over roads and highways; also referred to as freight bills.

bulk storage containers Any container other than nonbulky storage containers such as fixed tanks, highway cargo tanks, rail tank cars, totes, and intermodal tanks. These are typically found in manufacturing facilities and are often surrounded by a secondary containment system to help control an accidental release.

carboys Glass, plastic, or steel containers, ranging in volume from 5 to 15 gallons (19 to 57 L).

casualty collection area An area set up by physicians, nurses, and other hospital staff near a major disaster scene where patients can receive further triage and medical care.

Chemical Transportation Emergency Center (CHEMTREC) An agency that assists emergency responders in identifying and handling hazardous materials transport incidents.

closed incident An incident that is contained; all casualties are accounted for.

cold zone A safe area at a hazardous materials incident for the agencies involved in the operations. The incident commander, the command post, EMS providers, and other support functions necessary to control the incident should be located in this zone. Also referred to as the clean zone or the support zone.

command In incident command, the position that oversees the incident, establishes the objectives and priorities, and develops a response plan.

command post The designated field command center where the incident commander and support staff are located.

container Any vessel or receptacle that holds material, including storage vessels, pipelines, and packaging.

control zones Areas at a hazardous materials incident that are designated as hot, warm, or cold, based on safety issues and the degree of hazard found there.

cylinders Portable, compressed gas containers used to hold liquids and gases such as nitrogen, argon, helium, and oxygen. They have a range of sizes and internal pressures.

decontamination The process of removing or neutralizing and properly disposing of hazardous materials from equipment, patients, and responders.

decontamination area The designated area in a hazardous materials incident where all patients and responders must be decontaminated before going to another area.

demobilization The process of directing responders to return to their facilities when work at a disaster or mass-casualty incident has finished, at least for those particular responders.

disaster A widespread event that disrupts community resources and functions, in turn threatening public safety, citizens' lives, and property.

drums Barrel-like containers used to store a wide variety of substances, including food-grade materials, corrosives, flammable liquids, and grease. May be constructed of low-carbon steel, polyethylene, cardboard, stainless steel, nickel, or other materials.

Emergency Response Guidebook (ERG) A preliminary action guide for first responders operating at a hazardous materials incident in coordination with the US Department of Transportation's labels and placards marking system. Jointly developed by the DOT, the Secretariat of Communications and Transportation of Mexico, and Transport Canada.

extrication supervisor In incident command, the person appointed to determine the type of equipment and resources needed for a situation involving extrication or special rescue; also called the rescue officer.

finance In incident command, the position in an incident responsible for accounting of all expenditures.

freelancing When individual units or different organizations make independent and often inefficient decisions about the next appropriate action.

freight bills The shipping papers used for transport of chemicals along roads and highways; also referred to as bills of lading.

hazardous material Any substance that is toxic, poisonous, radioactive, flammable, or explosive and causes injury or death with exposure.

hazardous materials (HazMat) incident An incident in which a hazardous material is no longer properly contained and isolated.

hot zone The area immediately surrounding a hazardous materials spill or incident site that endangers life and health. All responders working in this zone must wear appropriate protective clothing and equipment. Entry requires approval by the incident commander or other designated officer.

incident action plan An oral or written plan stating general objectives reflecting the overall strategy for managing an incident.

incident command system (ICS) A system implemented to manage disasters and mass-casualty incidents in which section chiefs, including finance, logistics, operations, and planning, report to the incident commander.

incident commander (IC) The overall leader of the incident command system to whom commanders or leaders of incident command system divisions report.

intermodal tanks Shipping and storage vessels that can be either pressurized or nonpressurized.

joint information center (JIC) An area designated by the incident commander, or a designee, in which public information officers from multiple agencies distribute information about the incident.

JumpSTART triage A sorting system for pediatric patients younger than 8 years or weighing less than 100 pounds (45 kg). There is a minor adaptation for infants because they cannot ambulate on their own.

liaison officer In incident command, the person who relays information, concerns, and requests among responding agencies.

logistics In incident command, the position that helps procure and stockpile equipment and supplies during an incident.

material safety data sheet (MSDS) A form, provided by manufacturers and compounders (blenders) of chemicals, containing information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal of a specific material; also known as safety data sheet (SDS).

mass-casualty incident (MCI) An emergency situation involving three or more patients or that can place great demand on the equipment or personnel of the EMS system or has the potential to produce multiple casualties.

morgue supervisor In incident command, the person who works with area medical examiners, coroners, and law enforcement agencies to coordinate the disposition of dead victims.

mutual aid response An agreement between neighboring EMS systems to respond to mass-casualty incidents or disasters in each other’s region when local resources are insufficient to handle the response.

National Incident Management System (NIMS) A Department of Homeland Security system designed to enable federal, state, and local governments and private-sector and nongovernmental organizations to effectively and efficiently prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism.

nonbulk storage vessels Any container other than bulk storage containers such as drums, bags, compressed gas cylinders, and cryogenic containers. These hold commonly used commercial and industrial chemicals such as solvents, industrial cleaners, and compounds.

open incident An incident that is not yet contained; there may be patients to be located and the situation may be ongoing, producing more patients.

operations In incident command, the position that carries out the orders of the commander to help resolve the incident.

personal protective equipment (PPE) levels Indicates the amount and type of protective equipment that an individual needs to avoid injury during contact with a hazardous material.

placards Signage required to be placed on all four sides of highway transport vehicles, railroad tank cars, and other forms of hazardous materials transportation; the sign identifies the hazardous contents of the vehicle, using a standardization system with 10¾-inch (27-cm) diamond-shaped indicators.

planning In incident command, the position that ultimately produces a plan to resolve any incident.

primary triage A type of patient sorting used to rapidly categorize patients; the focus is on speed in locating all patients and determining an initial priority as their conditions warrant.

public information officer (PIO) In incident command, the person who keeps the public informed and relates any information to the media.

rehabilitation area The area that provides protection and treatment to firefighters and other responders working at an emergency. Here, workers are medically monitored and receive any needed care as they enter and leave the scene.

rehabilitation supervisor In incident command, the person who establishes an area that provides protection for responders from the elements and the situation.

rescue supervisor In incident command, the person appointed to determine the type of equipment and resources needed for a situation involving extrication or special rescue; also called the extrication officer.

safety officer In incident command, the person who monitors the scene for conditions or operations that may present a hazard to responders and patients; he or she may stop an operation when responder safety is an issue.

secondary containment An engineered method to control spilled or released product if the main containment vessel fails.

secondary triage A type of patient sorting used in the treatment area that involves retriage of patients.

single command system A command system in which one person is in charge, generally used with small incidents that involve only one responding agency or one jurisdiction.

span of control In incident command, the subordinate positions under the commander's direction to which the workload is distributed; the ideal supervisor/worker ratio is one supervisor for three to seven workers.

staging supervisor In incident command, the person who locates an area to stage equipment and personnel and tracks unit arrival and deployment from the staging area.

START triage A patient sorting process that stands for Simple Triage And Rapid Treatment and uses a limited assessment of the patient's ability to walk, respiratory status, hemodynamic status, and neurologic status.

termination of command The end of the incident command structure when an incident draws to a close.

toxicity levels Indicates the risk that a hazardous material poses to the health of an individual who comes into contact with it.

transportation area The area in a mass-casualty incident where ambulances and crews are organized to transport patients from the treatment area to receiving hospitals.

transportation supervisor In incident command, the person in charge of the transportation sector in a mass-casualty incident who assigns patients from the treatment area to awaiting ambulances in the transportation area.

treatment area The location in a mass-casualty incident where patients are brought after being triaged and assigned a priority, where they are reassessed, treated, and monitored until transport to the hospital.

treatment supervisor In incident command, the person, usually a physician, who is in charge of and directs EMS providers at the treatment area in a mass-casualty incident.

triage The process of sorting patients based on the severity of injury and medical need to establish treatment and transportation priorities.

triage supervisor In incident command, the person in charge of the incident command triage sector who directs the sorting of patients into triage categories in a mass-casualty incident.

unified command system A command system used in larger incidents in which there is a multiagency response or multiple jurisdictions are involved.

warm zone The area located between the hot zone and the cold zone at a hazardous materials incident. The decontamination corridor is located in this zone.

Assessment *in Action*

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You and your partner are dispatched to the scene of an industrial incident where an explosion has taken place. En route you receive a call on the radio from the local fire chief advising that oxygen and multiple other chemicals are stored at this facility, including pesticides and acids, and HazMat precautions should be followed. After arriving near the scene, you are directed to the staging area where patients will be brought to you once they have been decontaminated by the HazMat team. The HazMat team is made up of properly trained firefighters who are dressed appropriately to enter the scene and are responsible for initiating care of any ill or injured patients.

1. The HazMat team members enter the hot zone to approach the patients. They visually examine the containers to determine what chemicals may be in the hot zone. Which type of drum is used for the storage of corrosives such as acids, bases, or oxidizers?

   A. Steel
   B. Polyethylene
   C. Cardboard
   D. Nickel

2. The HazMat team members continue their visual examination of the containers. Oxygen is stored in which type of container?

   A. Cylinder
   B. Drum

C. Intermodal tank
D. Carboy

3. Once patients have been decontaminated and brought to the staging area, how should you continue care?

   A. Treat the airway only.
   B. Apply splints and bandages.
   C. Take vital signs and provide transport.
   D. Begin as if they have not received any treatment.

4. The HazMat team finds a small pesticide bag underneath a patient after lifting him. Which of the following is a requirement when labeling pesticide bags?

   A. Permissible exposure limits
   B. Routes of entry
   C. The EPA establishment number
   D. Contact information for the responsible party

5. The incident commander arrives with a notebook containing basic information about the chemical makeup of a substance, the potential hazard it presents, appropriate first aid in the event of an exposure, and other pertinent data for safe handling of the material. This information is contained in which of the following resources?

   A. Placards
   B. Labels
   C. Material Safety Data Sheet (MSDS)
   D. *Emergency Response Guidebook (ERG)*

6. Which control zone at a HazMat incident includes the area immediately surrounding the release, which is also the most contaminated area and the area that the HazMat team works in?

   A. Hot zone
   B. Contamination zone
   C. Warm zone
   D. Outer perimeter

7. In which control zone would you find the staging area for EMS?

   A. Hot zone
   B. Contamination zone
   C. Outer perimeter
   D. Cold zone

8. Which toxicity level includes materials that are extremely hazardous to health? Contact with these materials requires full protective gear so that none of your skin surface is exposed.

   A. Level 1
   B. Level 2
   C. Level 3
   D. Level 4

9. You may be required to call CHEMTREC to gain further information on potential exposures. List the basic information needed when calling CHEMTREC.

10. As an EMT, what is your role at a HazMat incident?

*This text uses the term mass-casualty incident.

CHAPTER 40

Terrorism Response and Disaster Management

Courtesy of Journalist 1st Class Mark D. Faram/U.S. Navy.

National EMS Education Standard Competencies

EMS Operations

Knowledge of operational roles and responsibilities to ensure patient, public, and personnel safety.

Mass-Casualty Incidents Due to Terrorism and Disaster

› Risks and responsibilities of operating on the scene of a natural or man-made disaster. (pp 1451–1474)

Knowledge Objectives

1. Define international terrorism and domestic terrorism; include examples of incidents that have been caused by each one. (p 1451)
2. Name four different types of goals that commonly motivate terrorist groups to carry out terrorist attacks. (p 1452)
3. Define weapon of mass destruction (WMD) and weapon of mass casualty (WMC); include examples of weapons considered WMDs. (p 1453)
4. Explain how the Department of Homeland Security (DHS) National Terrorism Advisory System (NTAS) relates to the actions and precautions EMTs must take while performing their daily activities. (p 1454)
5. Name the key observations EMTs must make on every call to determine the potential of a terrorist attack. (p 1454)
6. Explain the critical response actions related to establishing and reassessing scene safety, personnel protection, notification procedures, and establishing command EMTs must perform at a suspected terrorist event. (pp 1454–1457)
7. Discuss the history of chemical agents, their four main classifications, routes of exposure, and the effects on patient care. (pp 1457–1463)
8. List three categories of biologic agents, their routes of exposure, effects on the patient, and patient care. (pp 1463–1471)
9. Explain the role of EMS in relation to syndromic surveillance and points of distribution (PODS) during a biologic event. (pp 1470–1471)
10. Discuss the history of nuclear/radiologic devices, sources of radiologic materials and dispersal devices, medical management of patients, and protective measures EMTs must take during a nuclear/radiologic incident. (pp 1471–1473)

11. Describe the mechanisms of injury caused by incendiary and explosive devices; include the types and severity of wounds. (pp 1473–1474)

Skills Objectives

1. Demonstrate the steps EMTs can take to establish and reassess scene safety based on a scenario of a terrorist event. (pp 1454–1457)
2. Demonstrate the steps EMTs can take for the management of a patient exposed to a chemical agent. (pp 1457–1463)
3. Demonstrate the use of the DuoDote Auto-Injector and/or the Antidote Treatment Nerve Agent Auto-Injector. (pp 1461–1462)

Introduction

The increase in terrorist activity makes it possible that you may be called on to respond to a terrorist event during your career. International terrorists and domestic groups have increased their targeting of civilian populations with acts of terror. The question is not will terrorists strike again, but rather when and where they will strike. You must be mentally and physically prepared for the possibility of a terrorist event.

The use of weapons of mass destruction (WMDs), or weapons of mass casualty (WMCs), further complicates the management of the terrorist incident and places you in greater danger. Although it is difficult to plan and anticipate a response to many terrorist events, there are several key principles that apply to every response. This chapter discusses the types of terrorist events, personnel safety, and patient management and gives you tools to prepare to respond to these events. You will learn the signs, symptoms, and treatment of patients who have been exposed to nuclear, chemical, or biologic agents or an explosive attack. At the end of this chapter, you will be able to answer the following key questions:

- What are my initial actions?
- Whom should I notify, and what should I tell them?
- What type of additional resources do I require?
- How should I proceed to address the needs of the victims?
- How do I ensure my and my partner's safety, as well as the safety of the victims?
- What is the clinical presentation of a victim exposed to a WMD?
- How do I assess and treat patients of WMD?
- How should I avoid becoming contaminated or cross-contaminated with a WMD agent?

What Is Terrorism?

No one is quite sure who was the first terrorist, but terrorist forces have been at work since early civilizations. Today, terrorists pose a threat to nations and cultures everywhere. International terrorism has brought a new fear into the lives of many American citizens.

The US Department of Justice defines both **international terrorism** and **domestic terrorism** with these points:

- Involves violent acts or acts dangerous to human life that violate federal or state law
- Appears to be intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping

One difference between the two is location. International terrorism occurs primarily outside the territorial jurisdiction of the United States, and domestic terrorism occurs primarily within the territorial jurisdiction of the United States.

Modern-day terrorism is common in the Middle East, where terrorist groups frequently attack civilian populations. In Central and South America, political terrorist groups target oil resources as a means to instill fear.

In the United States, domestic terrorists have carried out multiple attacks in previous years. The Centennial Park bombing during the 1996 Summer Olympics, the destruction of the Alfred P. Murrah Federal Building in Oklahoma City in 1995, and, most recently, the Boston Marathon bombing in 2013 are examples **Figure 40-1**.

Figure 40-1 The bombing at the Boston Marathon in 2013 is a recent example of domestic terrorism.

Terrorist organizations are often categorized based on their beliefs and goals. Only a small percentage of groups actually turn toward terrorism as a means to achieve their goals, such as the following:

1. **Religious extremist groups/doomsday cults.** These include groups such as Aum Shinrikyo, who carried out chemical attacks in Tokyo in 1994 and 1995. Some of these groups may participate in apocalyptic violence.
2. **Extremist political groups.** They may include violent separatist groups and those who seek political, religious, economic, and social freedom Figure 40-2.
3. **Cyber terrorists.** They attack a population's technological infrastructure as a means to draw attention to their cause.
4. **Single-issue groups.** These include antiabortion groups, animal rights groups, anarchists, racists, and even ecoterrorists who threaten or use violence as a means to protect the environment Figure 40-3.

Most terrorist attacks require the coordination of multiple terrorists or "actors" working together. Nineteen hijackers worked together to commit the worst act of terrorism in US history on September 11, 2001 Figure 40-4. At least four terrorists worked together to commit the London Subway bombings on July 7, 2005. However, in a few instances there has been a single terrorist responsible for causing devastating results. Terrorists who acted alone carried out each of the Atlanta abortion clinic attacks in 1996 and the 1996 Summer Olympics attack.

Figure 40-2 Militant groups in Afghanistan, Iraq, Syria, and Nigeria have been associated with terrorism.

Figure 40-3 Demonstrators being held back by police near the World Bank in Washington, DC.

YOU are the Provider — PART 1

At 1005 hours, you are dispatched to an abortion clinic where a car crashed into the building and then exploded. According to dispatch, the frantic caller could not tell her how many victims were involved; he could tell her only that the building was on fire. Law enforcement and the fire department's hazardous materials (HazMat) team are en route to the scene as well. The weather is clear, and a light breeze is blowing from the northwest.

1. On the basis of the dispatch information, how should you approach this incident?
2. What indicators suggest that an incident is the result of terrorism?

Figure 40-4 The September 11, 2001, attack on the World Trade Center in New York City accounted for the majority of the deaths caused by terrorists in 2001.

Weapons of Mass Destruction

A **weapon of mass destruction (WMD)**, or **weapon of mass casualty (WMC)**, is any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports). To help remember the different kinds of weapons of mass destruction, use the mnemonic **B-NICE**: **b**iologic, **n**uclear, **i**ncendiary, **c**hemical, and **e**xplosive weapons; or CBRNE for chemical, biologic, radiologic, nuclear, and explosive weapons.

To date, the preferred WMD for terrorists has been explosive devices. Terrorist groups have favored tactics that use truck bombs or car or pedestrian suicide bombers. Many previous terrorist attempts to use either chemical or biologic weapons to their full capacity have been unsuccessful. Nonetheless, as an EMT, ensure you understand the destructive potential of these weapons.

The motives and tactics of the new-age terrorist groups have begun to change. As with the doomsday cults, many terrorist groups participate in indiscriminate killing. This doctrine of total carnage would make the use of WMDs highly desirable. WMDs are relatively easy to obtain or create and are specifically geared toward killing a large number of people. Had the proper techniques been used during the 1995 Aum Shinrikyo attack on the Tokyo subway, there may have been tens of thousands of casualties. Since the fall of the former Soviet Union, the technology and expertise to produce WMDs may be available to terrorist groups with sufficient funding. Moreover, the technical recipes for making B-NICE weapons can be readily found on the Internet; in fact, they have even been published on terrorist group websites.

Words of Wisdom

Chemical warfare may consist of agents in the form of a liquid, powder, or vapor.

Chemical Terrorism/Warfare

Chemical agents are manufactured substances that can have devastating effects on living organisms. They can be produced in liquid, powder, or vapor form depending on the desired route of exposure and dissemination technique. Developed during World War I (WWI), these agents have been implicated in thousands of deaths since being introduced on the battlefield and since then have been used to terrorize civilian populations. These agents consist of the following types:

- Vesicants (blister agents)
- Respiratory agents (choking agents)
- Nerve agents
- Metabolic agents (cyanides)

Biologic Terrorism/Warfare

Biologic agents are organisms that cause disease. They are generally found in nature; however, for terrorist use, they are cultivated, synthesized, and mutated in a laboratory. The **weaponization** of biologic agents is performed to artificially maximize the target population's exposure to the germ, thereby exposing the greatest number of people and achieving the desired result.

The primary types of biologic agents that you may come into contact with during a biologic event include the following:

- Viruses
- Bacteria
- Toxins

Nuclear/Radiologic Terrorism

There have been only two publicly known incidents involving the use of a nuclear device. During World War II (WWII), Hiroshima and Nagasaki were devastated when they were targeted with nuclear bombs. The awesome destructive power demonstrated by the attack ended WWII and has served as a deterrent to nuclear war.

There are nations that hold close ties with terrorist groups (known as **state-sponsored terrorism**) and have obtained some degree of nuclear capability.

It is also possible for a terrorist to secure radioactive materials or waste to perpetrate an act of terror. These materials are far easier for a terrorist to acquire than are nuclear weapons, and require less expertise to use. The difficulties in developing a nuclear weapon are well documented. Radioactive materials, however, such as those in radiologic dispersal devices (RDDs), also known as "dirty bombs," can cause widespread panic and civil disturbances. These devices are covered later in this chapter.

EMT Response to Terrorism

When you respond to a terrorist event, the basic foundations of patient care remain the same; however, the treatment can and will vary. Terrorist events can produce a single casualty, hundreds of casualties, or even thousands of casualties. In all cases, you must remember situational awareness. Your response in one situation may not be appropriate for another situation. In large-scale terrorist events, it is important to use triage and base patient care on available resources.

Recognizing a Terrorist Event (Indicators)

The planning of most acts of terror is **covert**, which means that the public safety community generally has no prior knowledge of the time, location, or nature of the attack. This element of surprise makes responding to an event more complex. You must constantly be aware of your surroundings and understand the possible risks for terrorism associated with certain locations, at certain times. Therefore, it is important that you know the current threat level issued by the federal government through the Department of Homeland Security (DHS).

In April 2011, the color-coded Homeland Security Advisory System was replaced by the National Terrorism Advisory System (NTAS). Alerts from the NTAS contain a summary of the threat and the actions that first responders, government agencies, and the public can take to maintain safety. On the basis of threat information, make sure you take the appropriate actions and precautions while you continue to perform your daily duties and response to calls.

The DHS has not issued specific recommendations for EMS personnel to follow in response to specific threats. Follow your local protocols, policies, and procedures.

It is your responsibility to make sure you are aware of information sent out by the advisory system at the start of your workday. Daily newspapers, television news programs, and multiple websites (including the DHS website) all give up-to-date information. Many EMS organizations are starting to display the advisory system on boards where it can be seen by staff when they arrive for a shift.

Understanding and being aware of the current threat is only the beginning of responding safely to calls. To determine the potential for a terrorist attack, make the following observations on every call:

- **Type of location.** Is the location a monument, infrastructure, government building, or a specific type of location such as a temple? Is there a large gathering? Is there a special event taking place?
- **Type of call.** Is there a report of an explosion or suspicious device nearby? Are there reports of people fleeing the scene?
- **Number of patients.** Are there multiple victims with similar signs and symptoms? This is probably the single most important clue that a terrorist attack or an incident involving a WMD has occurred.
- **Victims' statements.** This is probably the second best indication of a terrorist or WMD event. Are the victims fleeing the scene giving statements such as, "Everyone is passing out," "There was a loud explosion," or "There are a lot of people shaking on the ground." If so, something is occurring that you do not want to rush in to, even if it is questionable as to whether or not it is a terrorist event.
- **Preincident indicators.** Has there been a recent increase in violent political activism? Are you aware of any credible threats made against the location, gathering, or occasion?

Response Actions

Once you suspect that a terrorist event has occurred or a WMD has been used, there are certain actions you must take to ensure you will be safe and properly prepared to help the community.

Scene Safety

Remember to stage your vehicle a safe distance (usually 1 to 2 blocks) from the incident, and wait for law enforcement personnel to advise you that the scene has been made secure. If you have any doubt that it may not be safe, do not enter. When dealing with a WMD scene, assume you will not be able to enter the scene where the event has occurred—nor do you want to. The best location for staging is upwind and uphill from the incident. Wait for assistance from those who are trained in assessing and managing WMD scenes **Figure 40-5**. Expect that a perimeter will be created, usually by law enforcement personnel, in an effort to isolate the scene, prevent further contamination of evidence, and protect rescuers and the public from further danger. Also remember the following rules:

- Failure to park your vehicle at a safe location can place you and your partner in danger **Figure 40-6**. Always have an escape plan determined beforehand, in case the scene becomes unsafe.
- If your vehicle is blocked in by other emergency vehicles or damaged by a secondary device (or event), you will be unable to provide transportation for victims **Figure 40-7** or escape yourself.

Terrorists have been known to plant additional explosives that are set to explode after the initial bomb. This type of **secondary device** is intended primarily to injure responders and to secure media coverage because the media generally arrive on scene just after the initial response. Secondary devices may include various types of electronic equipment such as cell phones or pagers that are designed to detonate when they are activated.

Responder Safety (Personnel Protection)

The best form of protection from a WMD agent is preventing yourself from coming into contact with the agent. The greatest threats facing you in a WMD attack are contamination and **cross-contamination**. Contamination with an agent occurs when you have direct contact with the WMD or are exposed to it. Cross-contamination occurs when you come into contact with a contaminated person who has not yet been decontaminated.

Notification Procedures

When you suspect a terrorist or WMD event has taken place, notify the dispatcher. Vital information needs to be communicated effectively if you are to receive the appropriate assistance (see Chapter 4, *Communications and Documentation*, for information on effective communication). Inform dispatch of the nature of the event, any additional resources that may be required, the estimated number of patients, and the upwind route of approach or optimal route of approach.

Figure 40-5 Improper staging of a mass-casualty scene can lead to injury or even death of EMS personnel. Wait for trained personnel to assist in assessing and managing such scenes.

Figure 40-6 Park your vehicle at a safe location.

Figure 40-7 Make sure your vehicle is not blocked in by other emergency vehicles.

Words of Wisdom

One way to distinguish between an antiterrorist and a terrorist mass-casualty event is whether the intentional use of a WMD affects multiple people. These patients will generally exhibit the same signs and symptoms. It is highly unlikely for more than one person to experience a seizure at any given time. It is not uncommon to find multiple patients complaining of difficulty breathing at the scene of a fire. However, the same report in the subway at rush hour, when no smell of smoke has been reported, is certainly cause for suspicion. In these situations, use your good judgment and resist the urge to "rush in and help."

It is extremely important to establish a staging area, where other units will converge. Be mindful of access and exit routes when you direct units to respond to a location. It is unwise to have units respond to the front entrance of a hotel or apartment building that has had an explosion (see Chapter 37, *Transport Operations*, on vehicle positioning). Last, trained responders in the proper protective equipment are the only people equipped to handle the WMD incident. These specialized units, traditionally HazMat teams, must be requested as early as possible because of the time required to assemble and dispatch the team and their equipment. Many jurisdictions share HazMat teams, so the team may have to travel a long distance to reach the location of the event. It is always better to be safe than sorry; call the team early, and the outcome of the call will be more favorable.

Keep in mind that there may be more than one type of device or agent present.

Words of Wisdom

Weapons of Mass Destruction

On September 11, 2001, communications were severely affected by the collapse of the World Trade Center. The primary communications repeater was located on top of one of the towers. In addition, excess radio traffic made transmitting and receiving messages extremely difficult. Not only were radio communications affected, but most cell phones and the majority of radio and television stations were disabled. The lesson learned from this event is to have multiple backups to your ability to communicate with your dispatcher. In the event of a terrorist or WMD event, refrain from using the radio unless you have something important to transmit. If you do transmit, gather your thoughts and speak in as calm a tone as possible, avoiding unnecessary chatter. Remember, while you are transmitting, others may be unable to call for help.

Establishing Command

The first provider on the scene must begin to sort out the chaos and define his or her responsibilities under the incident command system (ICS). As the first person on scene, you may need to establish command until additional personnel arrive. Depending on the circumstances and stage of the operation, you and other EMTs may function as medical branch directors, triage supervisors, treatment supervisors, transportation supervisors, logistic officers, or command and general staff. If the initial ICS is already in place, then immediately find the medical staging officer to receive your assignment. Chapter 39, *Incident Management*, discusses in detail how to work within the ICS and the National Incident Management System (NIMS).

Reassessing Scene Safety

Do not rely on others to secure your safety. It is your responsibility to constantly assess and reassess the scene for safety. This is an important component of situational awareness. It is easy to overlook a suspicious package while you are treating casualties. Stay alert. Something as subtle as a change in the wind direction during a gas attack or an increase in the number of contaminated patients can place you in danger. Never become so involved with the tasks you are performing that you do not look around and make sure the scene remains safe.

YOU are the Provider — PART 2

The HazMat team has assessed the scene. On the basis of its assessment and observations, the team has determined that radiation is present in the area of the incident. The driver of the vehicle is obviously deceased, and there are four patients who require emergency care. The severity of their injuries, however, is unknown.

3. On the basis of the HazMat team's findings, what has most likely occurred?
4. What should be done first to ensure the scene is safe for you and other EMS personnel to enter?

Words of Wisdom

While it may be difficult for you because of ethical or moral reasons to treat a suspected criminal or suspected terrorist, it is important that this patient receive the same care as any other patient. You are not the judge or jury. It is up to the legal system to prove in a court of law that someone is guilty.

Chemical Agents

Chemical agents are liquids or gases that are dispersed to kill or injure. Modern-day chemicals were first developed during WWI and WWII. During the Cold War, many of these agents were perfected and stockpiled. Whereas the United States has long renounced the use of chemical weapons, many nations still develop and stockpile them. These agents are deadly and pose a threat if they are acquired by terrorists.

Chemical weapons have several classifications. The properties or characteristics of an agent can be described as liquid, gas, or solid material. **Persistency** and **volatility** describe how long the agent will stay on a surface before it evaporates. Persistent or nonvolatile agents can remain on a surface for long periods, usually longer than 24 hours. Nonpersistent or volatile agents evaporate relatively fast when left on a surface in the optimal temperature range. An agent that is described as highly persistent (such as VX, a nerve agent) can remain in the environment for weeks to months, whereas an agent that is highly volatile (such as sarin, also a nerve agent) will turn from liquid to gas (evaporate) within minutes to seconds.

Route of exposure is how the agent most effectively enters the body. Chemical agents can have either a vapor or contact hazard. Agents with a **vapor hazard** enter the body through the respiratory tract in the form of vapors. Agents with a **contact hazard** (or skin hazard) give off very little vapor or no vapors and enter the body through the skin.

Vesicants (Blister Agents)

The primary route of exposure of blister agents, or **vesicants**, is the skin (contact); however, if vesicants are left on the skin or clothing long enough, they produce vapors that can enter the respiratory tract. Vesicants cause burn-like blisters to form on the victim's skin and in the respiratory tract. The vesicant agents consist of sulfur mustard (H), lewisite (L), and phosgene oxime (CX) (the symbols H, L, and CX are military designations for these chemicals). The vesicants usually cause the most damage to damp or moist areas of the body, such as the armpits, groin, and respiratory tract. Signs of vesicant exposure on the skin include the following:

- Skin irritation, burning, and reddening
- Immediate, intense skin pain (with L and CX)
- Formation of large blisters
- Gray discoloration of skin (a sign of permanent damage seen with L and CX)
- Swollen and closed or irritated eyes
- Permanent eye injury (including blindness)

If vapors were inhaled, the patient may experience the following signs and symptoms:

- Hoarseness and stridor
- Severe cough
- Hemoptysis (coughing up blood)
- Severe dyspnea

Sulfur mustard (H), commonly known as mustard gas, is a brownish, yellowish oily substance that is generally considered very persistent. When released, mustard gas has the distinct smell of garlic or mustard and is quickly absorbed into the skin and/or mucous membranes. As the agent is absorbed into the skin, it begins an irreversible process of damage to the cells. Absorption through the skin or mucous membranes usually occurs within seconds, and damage to the underlying cells takes place within 1 to 2 minutes.

Mustard gas is considered a **mutagen**, which means that it mutates, damages, and changes the structures of cells. Eventually, cellular death will occur. On the surface, the patient will generally not produce any signs or symptoms until 4 to 6 hours after exposure (depending on concentration and amount of exposure) **Figure 40-8**.

The patient will experience a progressive reddening of the affected area, which will gradually develop into large blisters. These blisters are very similar in shape and appearance to those associated with thermal second-degree burns. The fluid within the blisters does not contain any of the agent; however, the skin covering the area is considered contaminated until trained personnel have decontaminated the patient.

Figure 40-8 Skin damage resulting from exposure to sulfur mustard (H).

Courtesy of Dr. Saeed Keshavarz/RCCI, Research Center of Chemical Injuries/IRAN.

Mustard gas also attacks vulnerable cells within the bone marrow and depletes the body's ability to reproduce white blood cells. Like other burns, the primary complication associated with vesicant blisters is secondary infection. If the patient survives the initial direct injury from the agent, the depletion of the white blood cells leaves the patient with a decreased resistance to infections. Although sulfur mustard is regarded as persistent, the vapors it releases when dispersed can be inhaled. This creates upper and lower airway compromise. The result is damage and swelling of the airways. The airway compromise makes the patient's condition far more serious.

Lewisite (L) and **phosgene oxime (CX)** produce blister wounds very similar to those caused by mustard gas. They are highly volatile and have a rapid onset of symptoms, compared with the delayed onset seen with mustard gas. These agents produce immediate intense pain and discomfort when contact is made. The patient's skin may have a grayish discoloration at the contaminated site. While tissue damage also occurs with exposure to these agents, they do not cause the secondary cellular injury that is associated with mustard gas.

Vesicant Agent Treatment

There are no antidotes for mustard gas or CX exposure. British anti-lewisite is the antidote for agent L; however, it is not carried by civilian EMS. Ensure the patient has been decontaminated before you initiate any treatment. If any agent has been inhaled, the patient may require prompt airway support as soon as decontamination is completed. Initiate transport as soon as possible. Generally, burn centers are best equipped to handle the wounds and subsequent infections produced by vesicants. Follow your local protocols when deciding the transport destination.

Pulmonary Agents (Choking Agents)

The pulmonary agents are gases that cause immediate harm to people exposed to them and include chlorine (Cl) and phosgene. These agents produce respiratory-related symptoms such as dyspnea and tachypnea. The primary route of exposure for these agents is through the respiratory tract, which makes them an inhalation or vapor hazard. Once inside the lungs, they damage the lung tissue and fluid leaks into the lungs. Pulmonary edema develops in the patient, resulting in difficulty breathing because of severely impaired gas exchange.

Chlorine (Cl) was the first chemical agent ever used in warfare. It has a distinct odor of bleach and creates a green haze when released as a gas. Initially, it produces upper airway irritation and a choking sensation. The patient may later experience the following signs and symptoms:

- Shortness of breath
- Tightness in chest
- Hoarseness and stridor as the result of upper airway constriction
- Gasping and coughing

With serious exposures, patients may experience pulmonary edema, complete airway constriction, and death. The fumes from a mixture of household bleach and ammonia create an acid gas that produces similar effects. According to the American Association of Poison Control Centers' 2013 data report, human exposure involving household cleaning substances was the third most frequently reported exposure.

Do not confuse **phosgene** with phosgene oxime, a blistering agent, or vesicant. Not only has phosgene been produced for chemical warfare, but it is a product of combustion that might be produced as a result of a fire involving other chemicals, such as at a textile factory or house or from metalwork or burning Freon (a liquid chemical used in refrigeration). Therefore, you may encounter a victim of exposure to this gas during the course of a normal call or at a fire scene. Phosgene is a very potent agent that has a delayed onset of symptoms, usually hours. Unlike Cl, when phosgene enters the body, it generally does not produce severe irritation that would possibly cause the victim to leave the area or hold his or her breath. In fact, the odor produced by the chemical is similar to that of freshly mowed grass or hay. The result is that much more of the gas may enter the body unnoticed. Initially, a mild exposure may include the following signs and symptoms:

- Nausea
- Tightness in chest
- Severe cough
- Dyspnea on exertion

The victim of a severe exposure may present with dyspnea at rest and excessive pulmonary edema. The pulmonary edema may be so severe that the patient continually coughs up white or pink-tinged fluid. A severe exposure produces such large amounts of fluid in the lungs that the patient may actually become hypovolemic and subsequently hypotensive.

Pulmonary Agent Treatment

The best initial treatment of any patient who has been exposed to a pulmonary agent is to remove the patient from the contaminated atmosphere. This should be done by trained personnel in the proper personal protective equipment (PPE).

Aggressively manage the ABCs, paying particular attention to oxygenation, ventilation, and suctioning if required. Do not allow the patient to be active because this will worsen the condition. There are not any antidotes to counteract the pulmonary agents. The primary goals for basic life support prehospital emergency care are to perform the ABCs, allow the patient to rest in a position of comfort with his or her head elevated, and initiate rapid transport. If the patient's condition does not improve with basic airway support, consider requesting an advance life support (ALS) intercept. Continuous positive airway pressure (CPAP) may benefit some of these patients, but others will require more advanced airway management.

Nerve Agents

The **nerve agents** are among the most deadly chemicals developed. They are classified as WMDs. Nerve agents are not readily available to the general public and are extremely toxic and rapidly fatal with any route of exposure. Designed to kill a large number of people with small quantities, nerve agents can cause cardiac arrest within seconds to minutes of exposure. Nerve agents, discovered while in search of a superior pesticide, are a class of chemical called organophosphates, which are found in household bug sprays, agricultural pesticides, and some industrial chemicals at much lower strengths then in the weaponized form. Organophosphates block an essential enzyme in the nervous system, causing the body's organs to become overstimulated and burn out.

G agents came from the early nerve agents, the G-series, which were developed by German scientists (hence the G) in the period after WWI and during WWII. There are three G-series agents, which are all designed with the same basic chemical structure with slight variations to produce different properties. The two variations of these agents are lethality and volatility. The following G agents are listed from high volatility to low volatility:

- **Sarin (GB)**. Highly volatile colorless and odorless liquid. Turns from liquid to gas within seconds to minutes at room temperature. Highly lethal, with an **LD_{50}** of about 1 drop, depending on the purity. The LD_{50} is the standard measurement that represents the amount that will kill 50% of a population exposed to this level. Sarin is primarily a vapor hazard, with the respiratory tract as the main route of entry. This agent is especially dangerous in enclosed environments such as office buildings, shopping malls, and subway cars. When this agent comes into contact with the skin, it is quickly absorbed and evaporates. When sarin is on clothing, it has the effect of **off-gassing**, which means that the vapors are continuously released over a period of time (like perfume). This renders the victim and the victim's clothing contaminated.
- **Soman (GD)**. Twice as persistent as sarin and five times as lethal. It has a fruity odor as a result of the type of alcohol used in the agent and generally has no color. This agent is a contact and inhalation hazard that can enter the body through skin absorption and through the respiratory tract. A unique additive in GD causes it to bind to the cells that it attacks faster than any other agent. This irreversible binding is called **aging**, which makes it more difficult to treat patients who have been exposed.
- **Tabun (GA)**. Approximately half as lethal as sarin and 36 times more persistent. Under the proper conditions it will remain present for several days. It has a fruity smell and an appearance similar to sarin. The components used to manufacture GA are easy to acquire, and the agent is easy to manufacture, which makes it unique. GA is a contact and inhalation hazard that can enter the body through skin absorption and through the respiratory tract.
- **V agent (VX)**. Clear oily agent that has no odor and looks like baby oil. V agent was developed by the British after WWII and has chemical properties similar to the G-series agents. The difference is that VX is more than 100 times more lethal than sarin and is extremely persistent **Figure 40-9**. In fact, VX is so persistent that given the proper conditions, it will remain relatively unchanged for weeks to months. These properties make VX primarily a contact hazard because it lets off very little vapor. It is easily absorbed into the skin, and the oily residue that remains on the skin's surface is extremely difficult to decontaminate.

Nerve agents all produce similar symptoms but have varying routes of entry. Nerve agents differ slightly in lethal concentration or dose and also differ in their volatility. Some agents are designed to quickly become a gas (nonpersistent or highly volatile), whereas others remain a liquid for a period of time (persistent or nonvolatile). These agents have been used successfully in warfare and, until recently, were the only type of chemical agent that had been used successfully in a terrorist act. Once the agent has entered the body through skin contact or through the respiratory system, the patient will begin to exhibit a pattern of predictable symptoms. Like all chemical agents, the severity of the patient's symptoms will depend on the route of exposure of the agent and the amount of exposure.

The symptoms are described in **Table 40-1** using the military mnemonic SLUDGEM and the medical mnemonic DUMBELS. The medical mnemonic is more useful to you because it lists the more dangerous symptoms associated with exposure to nerve agents.

Figure 40-9 VX is the most toxic chemical ever created. The dot on the penny demonstrates the amount needed to achieve the lethal dose.

Table 40-1 Symptoms of Exposure to Nerve Agents

Military Mnemonic: SLUDGEM	Medical Mnemonic: DUMBELS (all age groups)
Salivation, **S**weating	**D**iarrhea
Lacrimation (excessive tearing) (also Rhinorrhea)	**U**rination
Urination	**M**iosis (pinpoint pupils) **M**uscle weakness
Defecation, **D**rooling, **D**iarrhea	**B**radycardia, **B**ronchospasm, **B**ronchorrhea
Gastric upset and cramps	**E**mesis (vomiting)
Emesis (vomiting)	**L**acrimation (excessive tearing) (also Rhinorrhea)
Muscle twitching/**M**iosis (pinpoint pupils)	**S**eizures, **S**alivation, **S**weating

YOU are the Provider — PART 3

You have been informed that the patients have been properly decontaminated and have been moved to an area that has been designated as being safe for you to enter. After donning the appropriate personal protective equipment, you and the other responders report to the incident scene.

5. Given the situation, what are some unique concerns about this incident?
6. What types of injuries should you expect to encounter?

Safety Tips

Industrial Chemicals/Insecticides

The basic chemical ingredient in nerve agents is organophosphate. This is a common chemical that is used in lesser concentrations for insecticides. Whereas industrial chemicals do not possess sufficient lethality to be effective WMDs, they are easy to acquire and inexpensive and have similar effects to the nerve agents. Crop-duster planes could be used to disseminate these chemicals. Be cautious when responding to calls where insecticide equipment is stored and used, such as a farm or supply stores that sells these products. The symptoms and medical management of victims of organophosphate insecticide poisoning are identical to those of the nerve agents.

There are only a handful of medical conditions that are associated with the bilateral pinpoint constricted pupils (**miosis**) seen with nerve agent exposure. Conditions such as a cerebrovascular accident, direct light to both eyes, and a drug overdose all can cause bilaterally constricted pupils. Therefore, assess the patient for all of the SLUDGEM/DUMBELS signs and symptoms to determine whether the patient has been exposed to a nerve agent.

Miosis is the most common symptom of nerve agent exposure and can remain for days to weeks. This symptom, along with the others listed in Table 40-1, will help you recognize exposure to a nerve agent early. Miosis will be seen quickly in a vapor exposure but may occur later after an isolated skin exposure. In some cases the patient may have been exposed to both.

The seizures that are associated with nerve agent exposure are unlike those found in patients with a history of seizure. The seizure will continue until the patient dies or until treatment is given with a nerve agent antidote kit (DuoDote Auto-Injector or Antidote Treatment Nerve Agent Auto-Injector [ATNAA]).

Nerve Agent Treatment

Fatalities from severe exposure to a nerve agent occur as a result of respiratory complications, which lead to respiratory arrest. Once the patient has been decontaminated, be prepared to treat aggressively, if the patient is to be saved. You can greatly increase the patient's chances of survival simply by providing airway and ventilatory support. As with all emergencies, securing the ABCs is the best and most important treatment that you can provide. Often in patients exposed to these agents, seizures will begin and will not stop. These patients will require administration of nerve agent antidote kits in addition to support of the ABCs.

Words of Wisdom

On March 20, 1995, members of Aum Shinrikyo, a Japanese cult, released sarin (GB) in the Tokyo subway. The first arriving medical responders were met with chaos as hundreds and then thousands of people fled the subway system **Figure 40-10**. Many were contaminated and showed signs and symptoms of nerve agent exposure. In the end, more than 5,000 people sought medical care for exposure to sarin, and 12 people died. None of the EMS personnel wore protective clothing, so most became cross-contaminated. Remember, you can avoid becoming exposed. Do not become a victim. Medical professionals responding to an attack in 1995, where cult members released sarin in the Tokyo subway.

Figure 40-10 Medical professionals responding to an attack in 1995, where cult members released sarin in the Tokyo subway.

Medical treatment for nerve agent exposure may include the **DuoDote Auto-Injector**. The DuoDote Auto-Injector contains 2.1 mg of atropine and 600 mg of pralidoxime chloride (2-PAM) and is delivered as a single dose through one needle. Atropine is used to block the nerve agent. However, because the nerve agent may remain in the body for long periods, 2-PAM is used to eliminate the agent from the body. Many of the symptoms described in the DUMBELS mnemonic will be reversed with the use of atropine; however, you may need to administer many doses to see these results. The military form of this combination injector is the **Antidote Treatment Nerve Agent Auto-Injector (ATNAA)**.

In some regions, EMTs may carry DuoDote kits on the unit and will be called on to administer the antidotes to themselves or their patients. If your service carries a nerve agent antidote, refer to your local protocols for dosage and usage information. These medications are delivered using the same technique as the EpiPen auto-injector; however, multiple doses may need to be administered. Activated antidote kits need to be properly disposed into a sharps container.

Table 40-2 has been provided for quick reference and comparison of the nerve agents.

Metabolic Agents (Cyanides)

Hydrogen cyanide (AC) and cyanogen chloride (CK) are both agents that affect the body's ability to use oxygen. **Cyanide** is a colorless gas that has an odor similar to almonds. The effects of the cyanides begin on the cellular level and are very rapidly seen at the organ and system levels. Unlike nerve agents, however, these deadly gases are commonly found in many industrial settings. Cyanides are produced every year in massive quantities throughout the United States for industrial uses such as gold and silver mining, photography, and plastics processing. They are often present in fires associated with textile and plastic factories. In fact, cyanide is naturally found in the pits of many fruits in very low doses.

There is very little difference in the symptoms found between AC and CK. In low doses, these chemicals are associated with dizziness, light-headedness, headache, and vomiting. Higher doses will produce symptoms that include the following:

- Shortness of breath and gasping respirations
- Respiratory distress or arrest
- Tachypnea
- Flushed skin
- Tachycardia
- Altered mental status
- Seizures
- Coma
- Apnea
- Cardiac arrest

The symptoms associated with the inhalation of a large amount of cyanide will all appear within several minutes. Death is likely unless the patient is treated promptly.

Table 40-2 The Nerve Agents

Name	Military Designation	Odor	Special Features	Onset of Symptoms	Volatility	Route of Exposure
Tabun	GA	Fruity	Easy to manufacture	Immediate	Low	Skin contact and vapor hazard
Sarin	GB	None (if pure) or strong	Will off-gas while on victim's clothing	Immediate	High	Primarily respiratory vapor hazard; skin exposure is extremely lethal
Soman	GD	Fruity	Ages rapidly; difficult to treat	Immediate	Moderate	Skin contact; minimal vapor hazard
V agent	VX	None	Most lethal chemical agent; difficult to decontaminate	Immediate	Very low	Skin contact; no vapor hazard (unless aerosolized)

Words of Wisdom

Patients exposed to cyanide and who have shortness of breath will have a normal pulse oximetry reading.

Cyanide Agent Treatment

Cyanide binds with the body's cells, preventing oxygen from being used. Several medications act as antidotes, but most services do not carry them. Once trained personnel wearing the proper PPE have removed the patient from the source of exposure, even if there is no liquid contamination, all of the patient's clothes must be removed to prevent off-gassing in the ambulance. Trained and protected personnel must decontaminate any patients who may have been exposed to liquid contamination before you can initiate treatment. Then support the patient's ABCs. Mild effects of cyanide exposure will generally resolve by simply removing the victim from the source of contamination and administering supplemental oxygen. Severe exposure, however, will require aggressive oxygenation and perhaps ventilation with supplemental oxygen. Always use a bag-valve mask (BVM) or oxygen-powered ventilator device to ventilate a victim of a metabolic agent. The agent can easily be passed on from the patient to you through mouth-to-mouth or mouth-to-mask ventilations. Initiate transport immediately if antidote by ALS is not available.

Words of Wisdom

Always make sure your patients have been thoroughly decontaminated by trained personnel before you come into contact with them. Chemical agents are primarily a vapor hazard, and all of the patient's clothing must be removed prior to treatment to prevent off-gassing to you. Finally, never perform mouth-to-mouth or mouth-to-mask ventilation on a victim of a chemical agent exposure. Many of the vapors may linger in the patient's airway, and cross-contamination may occur.

Table 40-3 summarizes the chemical agents. The odors of the particular chemicals are provided for informational purposes only. The sense of smell is a poor tool to use to determine whether there is a chemical agent present. Many people are unable to smell the agents, and the odor could be derived from another source. This information is useful to you if you receive reports from victims who claimed to smell bleach or garlic, for example. Never enter a potentially hazardous area and "smell" to determine whether a chemical agent is present.

Biologic Agents

Biologic agents pose many difficult issues when used as a WMD. Biologic agents can be almost completely undetectable. Also, most of the diseases caused by these agents will be similar to other minor illnesses commonly seen by EMS providers.

Biologic agents are grouped as viruses, bacteria, and neurotoxins and may be spread in various ways. **Dissemination** is the means by which a terrorist will spread the agent—for example, poisoning the water supply or aerosolizing the agent into the air or ventilation system of a building. A **disease vector** is an animal that spreads disease, once infected, to another animal. For example, bubonic plague can be spread by infected rats; smallpox by infected humans; and West Nile virus by infected mosquitoes. How easily the disease is able to spread from one human to another human is called *communicability*. Some diseases, such as those caused by the human immunodeficiency virus (HIV), are difficult to spread by routine contact. Therefore, communicability is considered low. In other instances when communicability is high, such as with smallpox, the person is considered **contagious**. Typically, routine standard precautions are enough to prevent contamination from contagious biologic organisms.

Incubation is the period of time between the person becoming exposed to the agent and the appearance of the first symptoms. The incubation period is especially important for you to understand. Although your patient may not exhibit signs or symptoms, he or she may be contagious.

Be aware of when you should suspect the use of biologic agents. If the agent is in the form of a powder, such as in the October 2001 Amerithrax attacks involving letters laced with anthrax powder appearing in the US mail, the incident must be handled by HazMat specialists. Patients who come into direct contact with the agent need to be decontaminated before you make any contact with them or initiate treatment.

Viruses

Viruses are germs that require a living host to multiply and survive. A virus is a simple organism and cannot thrive outside of a host (living body). Once in the body, the virus invades healthy cells and replicates itself to spread through the host. As the virus spreads, so does the disease that it carries. Viruses spread from host to host by direct methods, such as through respiratory droplets, or through vectors. A *vector* is any agent that acts as a carrier or transporter.

Table 40-3 Chemical Agents						
Name	**Military Designations**	**Odor**	**Lethality**	**Onset of Symptoms**	**Volatility**	**Primary Route of Exposure**
Nerve agents	Tabun (GA) Sarin (GB) Soman (GD) VX	Fruity or none	Highly lethal chemical agents; kill within minutes; effects are reversible with antidotes	Immediate	Moderate (GA, GD) Very high (GB) Low (VX)	GA—both GB—vapor hazard GD—both VX—contact hazard
Vesicants	Mustard (H) Lewisite (L) Phosgene oxime (CX)	Garlic (H) Geranium (L)	Cause large blisters to form; inhalation severely damages upper airway; severe, intense pain and grayish skin discoloration (L and CX)	Delayed (H) Immediate (L, CX)	Very low (H, L) Moderate (CX)	Primarily contact, with some vapor hazard
Pulmonary agents	Chlorine (Cl) Phosgene (CG)	Bleach Cut grass (CG)	Cause irritation choking (Cl); severe pulmonary edema (CG)	Immediate (Cl) Delayed (CG)	Very high	Vapor hazard
Cyanide agents	Hydrogen cyanide (AC) Cyanogen chloride (CK)	Almonds (AC) Irritating (CK)	Highly lethal chemical gases; kill within minutes; effects are reversible with antidotes	Immediate	Very high	Vapor hazard

Viral agents that may be used during a biologic terrorist release pose an extraordinary problem for health care providers, especially those in EMS. Although some viral agents do have vaccines, there is no treatment of a viral infection other than antiviral medications for some agents. Because of this characteristic, the following viruses have the potential to be used as terrorism agents.

Smallpox

Smallpox is a highly contagious disease. Use all forms of standard precautions to prevent cross-contamination. Simply by wearing examination gloves, a HEPA-filtered respirator, and eye protection, you will greatly reduce your risk of contamination. The last natural case of smallpox in the world was seen in 1977. Before the rash and blisters show, the illness will start with a high fever and body aches and headaches. The patient's temperature is usually in the range of 101°F to 104°F (38.3°C to 40°C).

An easy, quick way to differentiate the smallpox rash from other skin disorders is to observe the size, shape, and location of the lesions. In smallpox, all the lesions are identical in their development. In other skin disorders, the lesions will be in various stages of healing and development. Smallpox blisters begin on the face and extremities and eventually move toward the chest and abdomen. The disease is in its most contagious phase when the blisters begin to form Figure 40-11. Unprotected contact with these blisters will promote transmission of the disease Table 40-4. There is a vaccine to prevent smallpox; however, it has been linked to medical complications and, in rare cases, death. Should an outbreak occur, the US government has enough vaccine to vaccinate every person in the United States.

Figure 40-11 In smallpox, all the lesions are identical in their development. In other skin disorders, the lesions will be in various stages of healing and development.

Courtesy of CDC.

Viral Hemorrhagic Fevers

Viral hemorrhagic fevers (VHF) consist of a group of diseases caused by viruses that include the Ebola, Rift Valley, Marburg, and yellow fever viruses, among others. This group of viruses causes the blood in the body to seep out from the tissues and blood vessels **Figure 40-12**. Initially, the patient will have flulike symptoms, progressing to more serious symptoms such as internal and external hemorrhaging. Outbreaks are not uncommon in Africa and South America; however, outbreaks in the United States are extremely rare. Use all standard precautions when treating these illnesses. Mortality rates can range from 5% to 90%, depending on the strain of virus, the victim's age and health condition, and the availability of a modern health care system **Table 40-5**.

Figure 40-12 Viral hemorrhagic fevers cause the blood vessels and tissues to seep blood. The end result is ecchymosis, bloody sputum, and blood In the patient's stool. Notice the severe discoloration in this patient with Crimean Congo hemorrhagic fever, indicating internal bleeding.

Courtesy of Professor Robert Swanepoel/National Institute for Communicable Disease, South Africa.

Table 40-4 Characteristics of Smallpox

Dissemination	Aerosolized for warfare or terrorist uses
Communicability	High from infected patients or contaminated items (such as blankets); person-to-person transmission possible
Route of entry	Inhalation of coughed droplets or direct skin contact with blisters
Signs and symptoms	Severe fever, malaise, body aches, headaches, small blisters on the skin, bleeding of the skin and mucous membranes; incubation period 10 to 12 days; duration of the illness, approximately 4 weeks
Medical management	Standard precautions; no specific treatment; provide supportive care (ABCs)

Bacteria

Unlike viruses, bacteria do not require a host to multiply and live. These single-celled microorganisms reproduce rapidly and are much more complex and larger than viruses. They can grow up to 100 times larger than the largest virus. Bacteria contain all the cellular structures of a normal cell and are completely self-sufficient. Most bacterial infections can be treated with antibiotics.

Most bacterial infections will generally begin with flulike symptoms, which can make it quite difficult for health care providers to identify whether the cause is a biologic attack or a natural epidemic.

Words of Wisdom

Because humans are acceptable hosts and vectors for many viruses and bacteria, use standard precautions at all times. If you fail to use standard precautions, you may not only become a host for a virus, but you may spread it as well. Remember, a virus spreads from person to person to survive, and many infectious diseases present like common colds.

Inhalation and Cutaneous Anthrax (*Bacillus anthracis*)

Anthrax is caused by deadly bacteria that lay dormant in a spore (protective shell). When exposed to the optimal temperature and moisture, the germ will be released from the spore. The routes of entry for anthrax bacteria are inhalation, cutaneous, and gastrointestinal (from consuming food that contains spores) **Figure 40-13**. The inhalational form, or pulmonary anthrax, is the most deadly and often presents as a severe cold. Pulmonary anthrax is associated with a 90% death rate if untreated. Antibiotics can be used to treat anthrax successfully. There is also a vaccine to prevent anthrax infections **Table 40-6**.

Plague (Bubonic/Pneumonic)

The 14th century plague that ravaged Asia, the Middle East, and finally Europe (the Black Death) killed an estimated 33 to 42 million people. Later on, in the early 19th century, almost 20 million people in India and China died due to plague. The plague's natural vectors are infected rodents and fleas. When a person is bitten by an infected flea or comes into contact with an infected rodent (or the waste of the rodent), the person can contract bubonic plague.

Figure 40-13 Cutaneous anthrax.

Courtesy of James H. Steele/CDC.

Table 40-5 Characteristics of Viral Hemorrhagic Fevers

Dissemination	Direct contact with infected body fluids; can be aerosolized for use in an attack
Communicability	Moderate from person to person or contaminated items
Route of entry	Direct contact with infected body fluids
Signs and symptoms	Sudden onset of fever, weakness, muscle pain, headache, and sore throat; all followed by vomiting and, as the virus runs its course, internal and external bleeding
Medical management	Standard precautions; no specific treatment; provide supportive care (ABCs) and treat for shock and hypotension, if present

Table 40-6 Characteristics of Anthrax

Dissemination	Aerosol
Communicability	Only in the cutaneous form (rare)
Route of entry	Inhalation of spore, skin contact with spore, or direct contact with skin wound (cutaneous)
Signs and symptoms	Flulike symptoms, fever, respiratory distress with tachycardia, shock, pulmonary edema, and respiratory failure after 3 to 5 days of flulike symptoms
Medical management	Inhalation: Standard precautions, oxygen, ventilatory support if in pulmonary edema or respiratory failure, and transport Cutaneous: Standard precautions, apply dry sterile dressing to prevent accidental contact with wound and fluids

Bubonic plague infects the **lymphatic system** (a passive circulatory system in the body that bathes the tissues in lymph and works with the immune system). When this occurs, the patient's **lymph nodes** (area of the lymphatic system where infection-fighting cells are housed) become infected and grow. The glands of the nodes will grow large (up to the size of a tennis ball) and round, forming **buboes** Figure 40-14. If left untreated, the infection may spread through the body, leading to sepsis and possibly death. This form of plague is not contagious and is not likely to be seen in a bioterrorist incident.

Pneumonic plague is a lung infection, also known as plague pneumonia, that results from inhalation of plague bacteria. This form of the disease is contagious and has a much higher death rate than the bubonic form Table 40-7.

Figure 40-14 **A.** Plague buboe at lymph node under arm. **B.** Plague buboe at lymph node on neck.

A, B: Courtesy of CDC.

Neurotoxins

Neurotoxins are the most deadly substances known to humans. The strongest neurotoxin is 15,000 times more lethal than VX and 100,000 times more lethal than sarin. These toxins are produced from plants, marine animals, molds, and bacteria. The route of entry for these toxins is through ingestion, inhalation from aerosols, or injection. Unlike viruses and bacteria, neurotoxins are not contagious and the onset of symptoms is faster. Although these biologic toxins have immense destructive potential, they have not been used successfully as a WMD.

Botulinum Toxin

The most potent neurotoxin is botulinum, which is produced by bacteria. When introduced into the body, this neurotoxin affects the nervous system's ability to function. Voluntary muscle control diminishes as the toxin spreads. Eventually the toxin causes muscle paralysis that begins at the head and face and spreads downward throughout the body. The patient's accessory muscles and diaphragm will become paralyzed, and the patient will go into respiratory arrest Table 40-8.

Table 40-7	Characteristics of Plague
Dissemination	Aerosol
Communicability	Bubonic: low, only from contact with fluid in buboes Pneumonic: high, from person to person
Route of entry	Ingestion, inhalation, or cutaneous
Signs and symptoms	Fever, headache, muscle pain and tenderness, pneumonia, shortness of breath, extreme lymph node pain and enlargement (bubonic)
Medical management	Standard precautions, provide supportive care (ABCs), oxygen if indicated, and transport

Ricin

While not as deadly as botulinum, **ricin** is still five times more lethal than VX. This toxin is derived from mash that is left from the castor bean **Figure 40-15**. When introduced into the body, ricin causes pulmonary edema and respiratory and circulatory failure leading to death **Table 40-9**.

The clinical picture depends on the route of exposure. The toxin is quite stable and extremely toxic by many routes of exposure, including inhalation. It is likely that 1 to 3 mg of ricin can kill an adult, and the ingestion of one seed can most likely kill a child.

Although all parts of the castor bean are actually poisonous, it is the seeds that are the most toxic. Castor bean ingestion causes a rapid onset of nausea, vomiting, abdominal cramps, and severe diarrhea, followed by vascular collapse. Death usually occurs on the third day in the absence of appropriate medical intervention.

Table 40-8 Characteristics of Botulinum Toxin

Dissemination	Aerosol or food supply sabotage or injection
Communicability	None
Route of entry	Ingestion, inhalation
Signs and symptoms	Dry mouth, intestinal obstruction, urinary retention, constipation, nausea and vomiting, abnormal pupil dilation, blurred vision, double vision, drooping eyelids, difficulty swallowing, difficulty speaking, and respiratory failure as the result of paralysis
Medical management	Provide supportive care (ABCs), oxygen, and transport; provide ventilatory support in case of paralysis of the respiratory muscles; vaccine available

Ricin is least toxic by the oral route. This is probably a result of poor absorption in the gastrointestinal tract, some digestion in the gut, and, possibly, some expulsion of the agent as caused by the rapid onset of vomiting. Ingestion causes local hemorrhage and necrosis of the liver, spleen, kidneys, and gastrointestinal tract. Signs and symptoms appear 4 to 8 hours after exposure.

YOU are the Provider — PART 4

On arriving at the scene, you are directed to the patients by the staging officer. They have been properly decontaminated and placed on a large tarp in a safe location. Patient No. 1 is conscious but disoriented; the front of her shirt is covered with blood and she is in obvious respiratory distress. Patient No. 2 is conscious and alert but is also experiencing respiratory distress; he has numerous lacerations and abrasions on his face. Patient No. 3 is conscious, alert, and ambulatory; he is holding his left arm against his body. Patient No. 4 is unconscious, breathing rapidly, and has burns to her face and neck.

7. On the basis of the number of patients and their apparent conditions, how many ambulances and EMTs should be present at the scene?

Signs and symptoms of ricin ingestion are as follows:

- Fever
- Chills
- Headache
- Muscle aches
- Nausea
- Vomiting
- Diarrhea
- Severe abdominal cramping
- Dehydration
- Gastrointestinal bleeding
- Necrosis of the liver, spleen, kidneys, and gastrointestinal tract

Figure 40-15

These seemingly harmless castor beans contain the key ingredient for ricin, one of the most potent toxins known to humans.

Courtesy of Brian Prechtel/USDA.

Inhaling ricin will cause nonspecific weakness, cough, fever, hypothermia, and hypotension. Symptoms occur about 4 to 8 hours after inhalation, depending on the inhaled dose. The onset of profuse sweating some hours later signifies the termination of the symptoms.

Signs and symptoms of ricin inhalation are as follows:

- Fever
- Chills
- Nausea
- Local irritation of eyes, nose, and throat
- Profuse sweating
- Headache
- Muscle aches
- Nonproductive cough
- Chest pain
- Dyspnea
- Pulmonary edema
- Severe lung inflammation
- Cyanosis
- Seizures
- Respiratory failure

Treat with both respiratory support and cardiovascular support as needed. Early intubation and ventilation, combined with treatment of pulmonary edema, are appropriate. Intravenous fluids and electrolyte replacement are useful to treat the dehydration caused by profound vomiting and diarrhea.

Table 40-10 summarizes the biologic agents.

Words of Wisdom

In a mass-casualty incident, it is important to frequently communicate with your patient. Remember, your patient is probably scared and does not know what is going on. Explain to your patient any delays that are occurring, as well as the actions you are taking, so you may alleviate the patient's fears.

Table 40-9 Characteristics of Ricin

Dissemination	Released into indoor or outdoor air (aerosol) Food and water contamination
Communicability	None
Route of exposure	Inhalation, ingestion, injection
Signs and symptoms	Inhaled: cough, difficulty breathing, tightness in chest, nausea, muscle aches, pulmonary edema, and hypoxia Ingested: nausea and vomiting, internal bleeding, and death Injection: no signs except swelling at the injection site and death
Medical management	Provide supportive care (ABCs); no treatment or vaccine available

Table 40-10 Biologic Agents

Disease	Transmission Person to Person	Incubation Period	Duration of Illness	Lethality (approximate case fatality rates)
Inhalation anthrax	No	1 to 6 d	3 to 5 d (usually fatal if untreated)	High
Pneumonic plague	High	2 to 3 d	1 to 6 d (usually fatal)	High unless treated within 12 to 24 h
Smallpox	High	7 to 17 d (average, 12 d)	4 wk	High to moderate
Viral hemorrhagic fevers	Moderate	4 to 21 d	Death within 7 to 16 d	High to moderate, depending on type of fever
Botulinum poisoning	No	1 to 5 d	Death within 24 to 72 h; lasts months if patient does not die	High without respiratory support
Ricin poisoning	No	18 to 24 h	Death within 10 to 12 d for ingestion	High

Other EMT Roles During a Biologic Event

Syndromic Surveillance

Syndromic surveillance is the monitoring, usually by local or state health departments, of patients presenting to emergency departments and alternative care facilities, the recording of EMS call volume, and the use of over-the-counter medications. Patients with signs and symptoms that resemble influenza are particularly important. Local and state health departments monitor for an unusual influx of patients with these symptoms in hopes of discovering an outbreak early. The role of EMS in syndromic surveillance is valuable in the overall tracking of a biologic terrorist event or infectious disease outbreak. Quality assurance and dispatch operations need to be aware of an unusual number of calls from patients with unexplainable symptom clusters coming from a particular region or community.

Points of Distribution (Strategic National Stockpile)

Points of distribution (PODs) are existing facilities that are used as mass distribution sites for antibiotics, antidotes, vaccinations, and other medications and supplies during an emergency.

Figure 40-16 The Centers for Disease Control and Prevention Strategic National Stockpile can deliver one of many push packs to any location in the country within 12 hours of an emergency.

Courtesy of the Strategic National Stockpile/CDC.

These medications may be released in deliveries called “push packs” by the Centers for Disease Control and Prevention (CDC) Strategic National Stockpile **Figure 40-16**. These push packages have a delivery time of 12 hours anywhere in the country and contain antibiotics, chemical antidotes, antitoxins, life-support medications, intravenous administration supplies, airway maintenance supplies, and medical/surgical items. In some regions, local and state municipalities have started to stockpile their own supplies to reduce the time delay.

EMTs, AEMTs, and paramedics may be called on to assist in the delivery of the medications to the public (depending on local emergency management planning). Your role may include triage, treatment of seriously ill patients, and patient transport to the hospital. Most plans for PODs include at least one ambulance on standby to transport seriously ill patients.

Radiologic/Nuclear Devices

What Is Radiation?

Ionizing radiation is energy that is emitted in the form of rays, or particles. This energy can be found in **radioactive material**, such as rocks and metals. Radioactive material is any material that emits radiation. This material is unstable, and it attempts to stabilize itself by changing its structure in a natural process called **decay**. As the substance decays, it gives off radiation, until it stabilizes. The process of radioactive decay can take from as little as minutes to billions of years; meanwhile, the substance remains radioactive.

The energy that is emitted from a strong radiologic source is **alpha**, **beta**, **gamma (x-ray)**, or **neutron radiation**. Alpha is the least harmful penetrating type of radiation and cannot penetrate through most objects. In fact, a sheet of paper or the body's skin can easily stop it. Beta radiation is slightly more penetrating than alpha and requires a layer of clothing to stop it. Gamma rays travel faster and have more energy than alpha and beta rays. These rays easily penetrate through the human body and require lead or several inches of concrete to prevent penetration. Neutron particles are among the most powerful forms of radiation. Neutrons easily penetrate through lead and require several feet of concrete to stop them **Figure 40-17**.

Sources of Radiologic Material

There are thousands of radioactive materials found on the earth. These materials are generally used for purposes that benefit humankind, such as medicine, killing germs in food (irradiating), and construction. Once radiologic material has been used for its purpose, the material remaining is called radiologic waste. Radiologic waste remains radioactive but has no more usefulness. These materials can be found at the following locations:

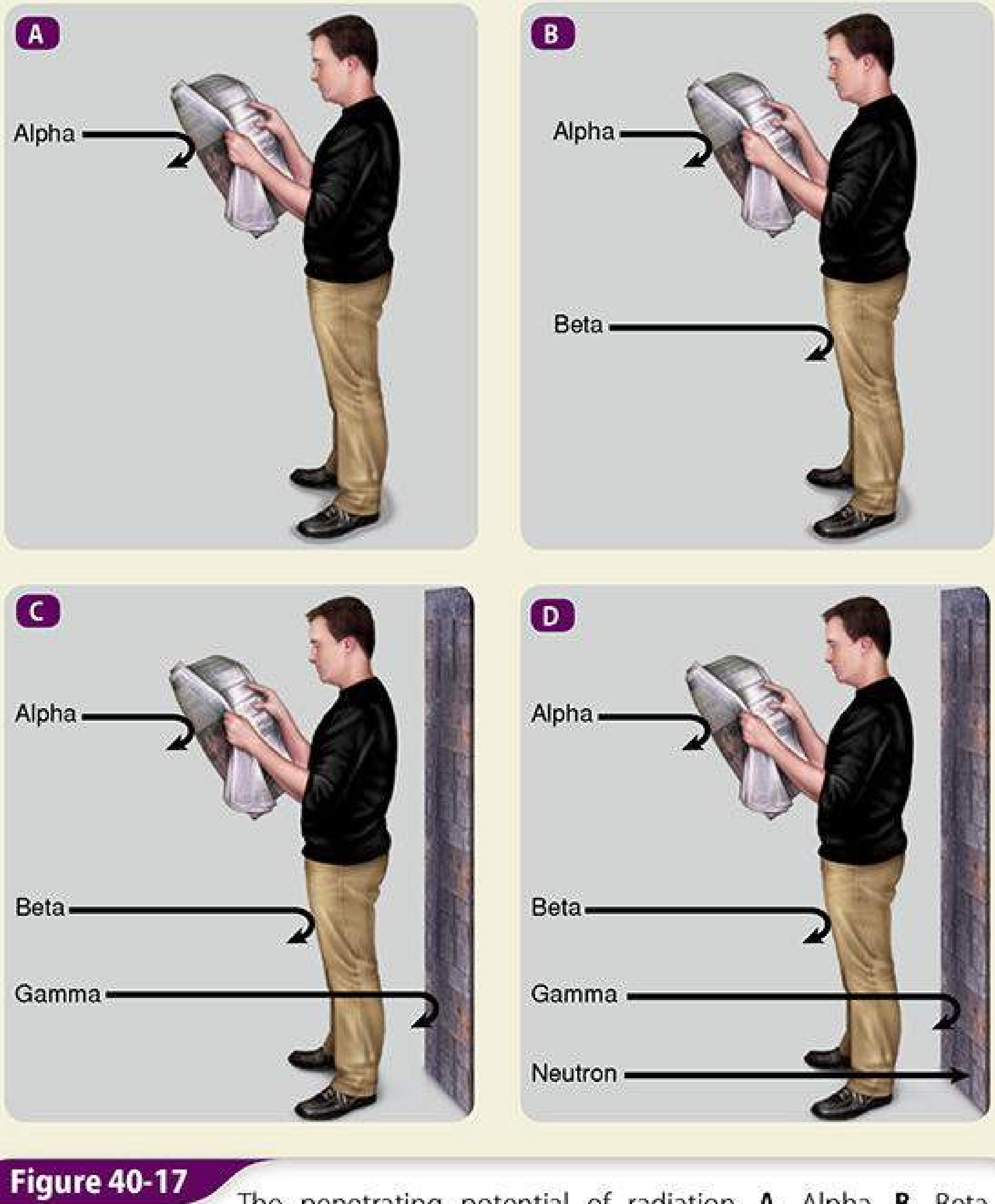


Figure 40-17 The penetrating potential of radiation. **A.** Alpha. **B.** Beta. **C.** Gamma. **D.** Neutron.

- Hospitals and other health care facilities with radiology departments

- Colleges and universities
- Nuclear power plants
- Chemical and industrial sites

Not all radioactive material is tightly guarded, and the waste is often not guarded at all. This makes radioactive material and substances appealing to terrorists.

Radiologic Dispersal Devices (RDD)

A **radiologic dispersal device (RDD)** is any container that is designed to disperse radioactive material. This would generally require the use of a bomb, hence the nickname "**dirty bomb**." A dirty bomb has the potential to cause injury not only as a result of the radioactive material, but also from the explosive material used to deliver it. Just the thought of an RDD creates fear in a population, and so the ultimate goal of some terrorists—fear—is accomplished. In reality, however, the destructive capability of a dirty bomb is limited to the explosives that are attached to it. Therefore, if the explosive is sufficient to kill 10 people without radioactive material, it will also kill 10 people with the radioactive material added. There may be long-term injuries and illness associated with the use of an RDD, yet not much more than the bomb by itself would create. In short, the dirty bomb is an ineffective WMD.

Nuclear Energy

Nuclear energy is artificially made by altering (splitting) radioactive atoms. The result is an immense amount of energy that usually takes the form of heat. Nuclear material is used in medicine, weapons, naval vessels, and power plants. Nuclear material gives off all forms of radiation, including neutrons (the most deadly type). Like radioactive material, when nuclear material is no longer useful it becomes waste that is still radioactive.

Nuclear Weapons

The destructive energy of a nuclear explosion is unlike any other weapon in the world. That is why nuclear weapons are kept in only secure facilities throughout the world. There are nations that have ties to terrorists and that have actively attempted to build nuclear weapons. However, as yet, these nations do not have the ability to deliver a nuclear weapon, such as a missile or bomb.

There is also the deterrent of complete mutual annihilation. Therefore, the likelihood of a nuclear attack is extremely remote.

Unfortunately, however, since the collapse of the former Soviet Union, the whereabouts of many small nuclear devices is unknown. These small suitcase-sized nuclear weapons are called **Special Atomic Demolition Munitions (SADM)**. The SADM, or "suitcase nuke," was designed to destroy individual targets, such as important buildings, bridges, tunnels, and large ships. Some of these are believed to be missing. Information or updates on the whereabouts of these devices have not been made public.

Symptomatology

Patients exposed to a known or suspected source of excessive radiation are considered victims of acute radiation toxicity. The effects of radiation exposure will vary depending on the amount of radiation received and the route of entry. Radiation can be introduced into the body by all routes of entry as well as through the body (irradiation). Patients can inhale radioactive dust from nuclear fallout or from a dirty bomb or have radioactive liquid absorbed into their body through their skin. Once inside the body, the radiation source will irradiate the person from within rather than from an external source (such as x-ray equipment). Some common signs of acute radiation sickness are listed in Table 40-11. Additional injuries will occur with a nuclear blast such as thermal and blast trauma, trauma from flying objects, and eye injuries.

Table 40-11	Common Signs of Acute Radiation Toxicity
Low exposure	Nausea, vomiting, diarrhea, dizziness, headache
Moderate exposure	First-degree burns, hair loss, compromised immune system (death of white blood cells), and cancer
Severe exposure	Second- and third-degree burns, cancer, and death

Medical Management

Being exposed to a radiation source does not make a patient contaminated or radioactive. However, when patients have a radioactive source on their bodies (such as debris from a dirty bomb), they are contaminated and must be initially cared for by a HazMat responder. Once the patient is decontaminated and there is no threat to you, you may begin treating the ABCs and treat the patient for any burns or trauma. As always, wear appropriate PPE. Secure in plastic bags any body fluids obtained from the patient. Place all body fluids in containers and properly disposed of them with other potentially radioactive waste.

Protective Measure

There are no suits or protective gear designed to completely shield you from radiation. The people who work in high-risk areas wear specific protection like lead-lined suits; however, this equipment is not available to EMTs. The best ways to protect yourself from the effects of radiation are to use time and distance and shield yourself using buildings and walls for protection. Do not enter a HazMat area unless you are trained as a HazMat responder and have proper training in the use of self-contained breathing apparatus.

- **Time.** Radiation has a cumulative effect on the body. The less time that you are exposed to the source, the less the effects will be. If you realize the patient is near a radiation source, leave the area immediately.
- **Distance.** Radiation is limited as to how far it can travel. Depending on the type of radiation, moving only a few feet is often enough to remove you from immediate danger. Alpha radiation cannot travel more than a few inches but gamma rays can travel hundreds or thousands of meters. Take this into account when responding to a nuclear or radiologic incident and make certain that responders are stationed far enough away from the incident.
- **Shielding.** Remember, the path of all radiation can be stopped by a specific object. It will be impossible for you to recognize the type of radiation being emitted or even from which direction it is coming. Therefore, always assume you are dealing with the strongest form of radiation and use concrete shielding (such as buildings or walls) between yourself and the incident. The importance of shielding cannot be overemphasized.

Incendiary and Explosive Devices

Incendiary and explosive devices come in various shapes and sizes. Incendiary devices are weapons used to start fires. Terrorists use flamethrowers, chemicals, Molotov cocktails, or other explosive devices for this purpose. Although you are not required to recognize all of the possible types of explosive devices, including improvised explosive devices (IED), it is important for you to be able to identify an object you believe is a potential device, notify the proper authorities, and safely evacuate the area. Always remember that there is the possibility of a secondary device when you are responding to the scene of an incendiary or explosive device call.

Mechanisms of Injury

The type and severity of wounds sustained from incendiary and explosive devices primarily depend on the patient's distance from the epicenter of the explosion. Patients close to the epicenter of the explosion are likely to suffer from all wound-causing agents of the munitions. Patients who are farther away from the epicenter are likely to experience a combination of blast injuries from the explosion and penetrating trauma injuries from primary and secondary projectiles created by the explosion.

YOU are the Provider **PART 5**

The patients have been triaged and appropriately treated. After the transportation officer notifies the receiving facilities about the patients' injuries and their exposure to radiation, they are transported. After decontaminating yourselves and the ambulance, you and your crew discuss the incident, including terrorism in general.

8. What type of terrorist group was most likely responsible for this incident?
9. What level of knowledge of terrorism and weapons of mass destruction should you possess?

Blast injuries occur in a number of ways.

- **Primary blast injury**. Due solely to the direct effects of the pressure wave on the body. The injury from the primary blast is seen almost exclusively in the hollow organs of the body—the lungs, intestines, and inner ears. An injury to the lungs causes the greatest morbidity and mortality.
- **Secondary blast injury**. Penetrating or non-penetrating injury that results from being struck by flying debris, such as ordnance projectiles or secondary missiles, that has been set in motion by the explosion. Objects are propelled by the force of the blast and strike the victim, causing injury.
- **Tertiary blast injury**. Results from whole-body displacement and subsequent traumatic impact with environmental objects (eg, trees, buildings, and vehicles). Other indirect effects include crush injury from the collapse of structures (buildings, bunkers, or tunnels).
- **Quaternary blast injury**. Any other injury caused by a blast occurs in this way. This includes toxic inhalation of combustion gases, burns, a medical emergency (like a myocardial infarction) sustained while fleeing the scene of an explosion, and even a mental health disorder that develops immediately after or days to weeks after detonation of an explosive device.

The Physics of an Explosion

When a substance is detonated, a solid or liquid is chemically converted into large volumes of gas under high pressure with resultant explosive energy release. Propellants, like gunpowder, are explosives designed to release energy relatively slowly compared with high-energy explosives, which are designed to detonate very quickly. This generates a pressure pulse in the shape of a spherical blast wave that expands in all directions from the point of explosion. Flying debris and high winds commonly cause conventional blunt and penetrating trauma.

Tissues at Risk

Hollow organs such as the middle ear, lungs, and gastrointestinal tract are most susceptible to pressure changes. The junction between tissues of different densities and exposed tissues such as the head and neck are prone to injury as well. The ear is the organ system most sensitive to blast injuries. The patient may report ringing or pain in the ears or some loss of hearing, and blood may be visible in the ear canal. Permanent hearing loss is possible.

Primary **pulmonary blast injuries** occur as contusions and hemorrhages. When the explosion occurs in an open space, the patient's side that is toward the explosion is usually injured, but the injury can be bilateral when the patient is located in a confined space. The patient may report tightness or pain in the chest and may cough up blood and have tachypnea or other signs of respiratory distress. Subcutaneous emphysema (crackling under the skin) over the chest may be palpated, indicating the presence of a pneumothorax. Pneumothorax is common and may require emergency decompression.

Solid organs are relatively protected from shockwave injury but may be injured by secondary missiles or a hurled body. Hollow organs, however, may be injured by similar mechanisms as lung tissue. Petechiae, or pinpoint hemorrhages that show up on the skin, to large hematomas are the most visible sign.

According to the CDC, blast lung is the most common cause of death from blast injury. Neurologic injuries and head trauma are also common causes of fatality from blast injury. Subarachnoid (beneath the arachnoid layer covering the brain) and subdural (beneath the outermost covering of the brain) hematomas are often seen. Permanent or transient neurologic deficits may be secondary to concussion, intracerebral bleeding, or air embolism. Instant but transient unconsciousness, with or without retrograde amnesia, may be initiated not only by head trauma, but also by cardiovascular problems. Bradycardia and hypotension are common after an intense pressure wave from an explosion.

Extremity injuries, including traumatic amputations, are common and patients may die of massive hemorrhage without the rapid application of a tourniquet.

YOU are the Provider — SUMMARY

1. On the basis of the dispatch information, how should you approach this incident?

The fact that a vehicle has crashed into an abortion clinic and exploded should raise your index of suspicion that this incident is the result of terrorism because, in most cases, vehicles rarely “explode” when they crash into something. In this incident, the explosion could have been meant to disperse a weaponized chemical. If you suspect a terrorist event has occurred, there are certain actions you need to take. When responding to the scene, take a route that is uphill and upwind from the incident scene if feasible, keeping in mind that wind direction and speed can change very quickly. Do not enter the scene where the incident has occurred; stage your ambulance in a safe location and wait for further information from law enforcement or the incident commander. If the incident command system (ICS) has not already been established, establish command and ensure adequate resources are dispatched including those with the capacity to assess and manage potential safety threats.

2. What indicators suggest that an incident is the result of terrorism?

Information from dispatch, such as the location and type of incident, the number of patients, and victims’ statements may be the first indicators that an incident is the result of terrorism. For example, is the incident location a monument, government building, or a specific structure such as a temple, church, or abortion clinic? Are there multiple patients with similar symptoms, such as difficulty breathing? Are victims fleeing the scene making statements, such as “Everyone is passing out,” or “There was a loud explosion.”

3. On the basis of the HazMat team’s findings, what has most likely occurred?

The presence of radiation in the area following an explosion indicates that a radiologic dispersal device (RDD) was used. The destructive power of an RDD is limited to the explosive that is attached to it; a bomb that is powerful enough to kill 10 people without radioactive material will also kill 10 people when the radioactive material is added. Injury and death caused by an RDD are the result of the explosive pressure wave and blunt and penetrating trauma—just like any other explosion. The addition of radiation, although not likely to cause immediate health problems, could result in people experiencing long-term injury or illness depending on the type and amount of radiation involved, the means of exposure (eg, absorption, inhalation, or ingestion), and the length of exposure.

4. What should be done first to ensure the scene is safe for you and other EMS personnel to enter?

The HazMat team has identified radiation in the area of the incident; however, you have not received information regarding what has been done to make the scene safe for you to enter. Therefore, *do not* enter the scene until you have been given specific instructions by the HazMat team! Exposure to a radiation source does not make a patient contaminated or radioactive; however, if the patient has a radioactive source on his or her body, such as debris from a dirty bomb, the patient is contaminated and must be initially decontaminated by HazMat personnel. Once the patients have been properly decontaminated and moved to a safe area, you will be allowed to begin the processes of assessment and treatment.

5. Given the situation, what are some unique concerns about this incident?

In the past, terrorists have been known to plant additional explosives (secondary devices) that were set to detonate after the initial device. Secondary devices are primarily intended to injure emergency responders and secure media coverage. These devices may not be in the same location as the primary device. The secondary device could be a package or briefcase that has been planted across the street or it could be an electronic device, such as a cell phone, that is designed to detonate when activated.

Although the HazMat team has secured the scene initially, you must realize that the scene can easily become unsafe. Do not rely on others to keep you safe; it is *your* responsibility to constantly reassess the scene for indicators of danger. A subtle change in wind direction during an incident involving radiation or an increase in the number of patients who are contaminated can place you in danger.

6. What types of injuries should you expect to encounter?

Although the victims may experience the effects of radiation exposure (eg, skin burns), depending on the amount of radiation exposure, their most immediately life-threatening injuries will be the result of the explosion itself.

The severity of the injuries during an explosion depends primarily on the location of the victims relative to the epicenter of the blast; the closer they are to the explosion, the more severe their injuries will be. Injuries resulting from explosions may range from severe burns, blunt and penetrating trauma, crush injuries, and inhalation injury. It is important to note that life-threatening injuries can occur to victims who are outside of the blast epicenter. For example, a person standing some distance from the explosion can easily sustain a penetrating injury to the chest, head, or abdomen when he or she is struck by flying debris.

7. On the basis of the number of patients and their apparent conditions, how many ambulances and EMTs should be present at the scene?

Your general impression of the scene has revealed that there are four patients—one of whom appears to be unconscious. Even though the other three patients are conscious, this does not mean that they do not have life-threatening injuries.

Assume all four patients have critical injuries until they have been triaged. One ambulance and two EMTs can effectively care for only one critically injured patient at a time. Therefore, there should be a total of four ambulances and eight EMTs at the scene—two EMTs and one ambulance per patient.

8. What type of terrorist group was most likely responsible for this incident?

In this incident, a single actor crashed his vehicle into an abortion clinic and detonated a dirty bomb in the process. This behavior suggests a single-issue terrorist who felt strongly enough about his cause to destroy a clinic, release radiation to induce further injury, and take his own life in the process.

Abortion has been a topic of great debate for many years, and terrorism has been used by antiabortion groups in the past. Several abortion clinics were bombed in Atlanta; other attacks have occurred when a gunman opened fire on clinic employees.

9. What level of knowledge of terrorism and weapons of mass destruction should you possess?

You are not expected to be an expert in terrorism and weapons of mass destruction (WMDs). However, you are expected to be aware of the various types of threats—just like any other citizen—and recognize certain indicators of terrorism when responding to an incident. As an EMT, you should possess a basic working knowledge of the different types of WMDs that terrorists could use; signs and symptoms and treatment of victims of WMDs; measures to take to ensure personal safety and safety of the patient; and knowledge of the ICS.

Patient No. 1

Triage Tag
No. 240351

Move the Walking Wounded	MINIMAL
NO Respirations after head tilt	EXPECTANT
	IMMEDIATE
☐ Respirations–over 30	
☐ Perfusion–capillary refill over 2 seconds	IMMEDIATE
☐ Mental status–unable to follow simple commands	IMMEDIATE
Otherwise	DELAYED

MAJOR INJURIES: Open chest and abdominal injuries

HOSPITAL DESTINATION: Harbor Bay Trauma Center

ORIENTED ×☐ DISORIENTED ☒ UNCONSCIOUS ☐

TIME	PULSE	B/P	RESPIRATION
1025	118	80/60	26 (labored)
1030	110	94/64	24 (labored)

PERSONAL INFORMATION:

NAME: Lisa Malone

MALE ☐ FEMALE ☒ AGE: 41 WEIGHT: 57 kg (126 lb)

MEDICAL COMPLAINTS/HISTORY

Penetrating injuries to chest and abdomen; shard of glass impaled in chest; abdominal evisceration; history of high blood pressure

EXPECTANT No 240351

IMMEDIATE No 240351

Patient No. 2

Triage Tag
No. 240352

Move the Walking Wounded	MINIMAL
NO respirations after head tilt	EXPECTANT
	IMMEDIATE
☐ Respirations–over 30	
☐ Perfusion–capillary refill over 2 seconds	IMMEDIATE
☐ Mental status–unable to follow simple commands	IMMEDIATE
Otherwise	DELAYED

MAJOR INJURIES: Possible pneumothorax, deformed left femur

HOSPITAL DESTINATION: Harbor Bay Trauma Center

ORIENTED ×4 ☒ DISORIENTED ☐ UNCONSCIOUS ☐

TIME	PULSE	B/P	RESPIRATION
1026	112	100/58	28 (labored)
1031	118	98/60	28 (labored)

PERSONAL INFORMATION:

NAME: Stanley Green

MALE ☒ FEMALE ☐ AGE: 34 WEIGHT: 75 kg (165 lb)

MEDICAL COMPLAINTS/HISTORY

Difficulty breathing; multiple abrasions and lacerations; left femur deformity; no medical history

EXPECTANT No 240352

IMMEDIATE No 240352

Patient No. 3

Triage Tag
No. 240353

Move the Walking Wounded	MINIMAL
NO respirations after head tilt	EXPECTANT
☐ Respirations–over 30	IMMEDIATE
☐ Perfusion–capillary refill over 2 seconds	IMMEDIATE
☐ Mental status–unable to follow simple commands	IMMEDIATE
Otherwise	DELAYED

MAJOR INJURIES: Possible ruptured eardrums, left forearm deformity

HOSPITAL DESTINATION: Harbor Bay Trauma Center

ORIENTED × ☒4 DISORIENTED ☐ UNCONSCIOUS ☐

TIME	PULSE	B/P	RESPIRATION
1030	100	132/92	14
1040	98	128/88	14

PERSONAL INFORMATION:

NAME: Brett Lackey

MALE ☒ FEMALE ☐ AGE: 50 WEIGHT: 82 kg (181 lb)

MEDICAL COMPLAINTS/HISTORY

Difficulty hearing; left arm deformity; minor abrasions to arms and face; history of depression

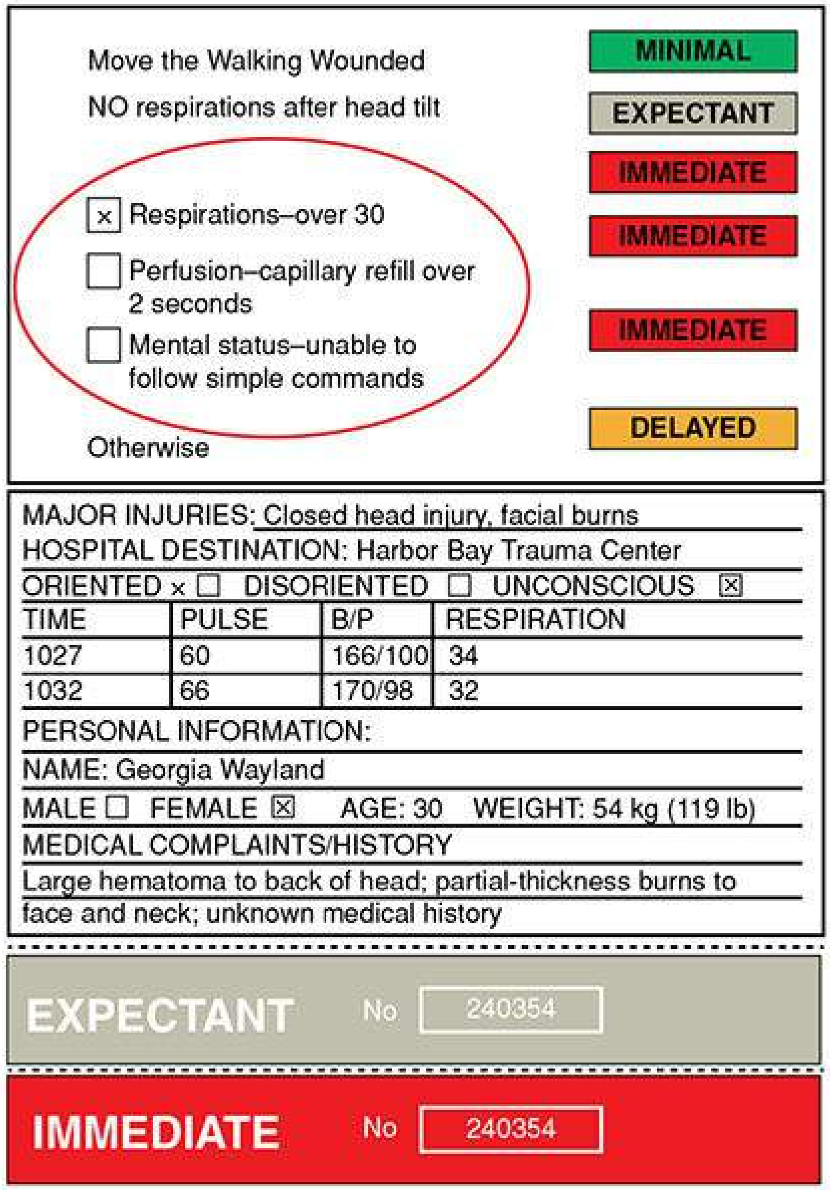
EXPECTANT No 240353

IMMEDIATE No 240353

DELAYED No 240353

Patient No. 4

Triage Tag
No. 240354



Prep Kit

Ready for Review

- As a result of the increase in terrorist activity, it is possible that you, as an EMT could witness a terrorist event. You must be mentally and physically prepared for the possibility of a terrorist event.
- Types of groups that tend to use terrorism include religious extremist groups/doomsday cults, extremist political groups, cyber terrorists, and single-issue groups.
- A weapon of mass destruction (WMD) is any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports). These can be biologic, nuclear, incendiary, chemical, and explosive weapons (B-NICE).

- Indicators that may give you clues as to whether the emergency is the result of a terrorist attack include the type of location, type of call, number of patients, victims' statements, and preincident indicators.
- If you suspect that a terrorist or an event involving a WMD has occurred, ensure that the scene is safe. If you have any doubt that it may not be safe, do not enter. Wait for assistance.
- Terrorists may set secondary devices that are designed to explode after the initial bomb, thus injuring responders and media coverage. Constantly assess and reassess the scene for safety.
- Chemical agents are manufactured liquid, gas, or solid substances that can have devastating effects on living organisms.
- Persistency and volatility describe how long the agent will stay on the surface before it evaporates, and the route of exposure is how the agent most effectively enters the body.
- Biologic agents are organisms that cause disease.
- Biologic agents include viruses such as smallpox and those that cause viral hemorrhagic fevers; bacteria such as those that cause anthrax and plague; and neurotoxins such as botulinum toxin and ricin.
- Nuclear or radiologic weapons produced from radioactive waste material can create a massive amount of destruction.
- Ionizing radiation is energy that can enter the human body and cause damage.
- Explosive and incendiary devices come in various shapes and sizes. It is important to be able to identify an object you believe is a potential device and notify the proper authorities, while safely evacuating the area.

Vital Vocabulary

aging The process by which the temporary bond between the organophosphate and acetylcholinesterase undergoes hydrolysis, resulting in a permanent covalent bond.

alpha A type of energy that is emitted from a strong radiologic source; it is the least harmful penetrating type of radiation and cannot travel more than a few inches or penetrate most objects.

anthrax A disease caused by deadly bacteria *(Bacillus anthracis)* that lay dormant in a spore (protective shell); the germ is released from the spore when exposed to the optimal temperature and moisture. The routes of entry are inhalation, cutaneous, and gastrointestinal (from consuming food that contains spores).

Antidote Treatment Nerve Agent Auto-Injector (ATNAA) A nerve agent antidote kit containing atropine and pralidoxime chloride; delivered as a single dose through one needle.

bacteria Microorganisms that reproduce by binary fission. These single-cell creatures reproduce rapidly. Some can form spores (encysted variants) when environmental conditions are harsh.

beta A type of energy that is emitted from a strong radiologic source; is slightly more penetrating than alpha and requires a layer of clothing to stop it.

B-NICE A memory device to recall the types of weapons of mass destruction: biologic, nuclear, incendiary, chemical, and explosive.

botulinum Produced by bacteria, this is the most potent neurotoxin known. When introduced into the body, this neurotoxin affects the nervous system's ability to function and causes botulism.

buboes Enlarged lymph nodes (up to the size of a tennis ball) that are characteristic in people infected with the bubonic plague.

bubonic plague Bacterial infection that effects the lymphatic system. It is transmitted by infected rodents and fleas and characterized by acute malaise, fever, and the formation of tender, enlarged, inflamed lymph nodes that appear as lesions, called buboes. Also called the Black Death.

chlorine (Cl) The first chemical agent ever used in warfare. It has a distinct odor of bleach and creates a green haze when released as a gas. Initially it produces upper airway irritation and a choking sensation.

contact hazard The term used to describe danger posed by a chemical whose primary route of entry into the body is through the skin; posed by a hazardous agent that gives off very little or no vapors; also called a skin hazard.

contagious An infectious disease that spreads from one human to another; communicable.

covert An act in which the public safety community generally has no prior knowledge of the time, location, or nature of the attack.

cross-contamination Occurs when a person is contaminated by an agent as a result of coming into contact with another contaminated person.

cyanide An agent that affects the body's ability to use oxygen. It is a colorless gas that has an odor similar to almonds. The effects begin on the cellular level and are very rapidly seen at the organ and system levels.

decay A natural process in which a material that is unstable attempts to stabilize itself by changing its structure.

dirty bomb Name given to an explosive radiologic dispersal device.

disease vector An animal that spreads a disease, once infected, to another animal.

dissemination The means by which a terrorist will spread an agent, for example, by poisoning the water supply or aerosolizing the agent into the air or ventilation system of a building.

domestic terrorism Terrorism that is carried out by people in their own country.

DuoDote Auto-Injector A nerve agent antidote kit containing atropine and pralidoxime chloride; delivered as a single dose through one needle.

G agents Early nerve agents that were developed by German scientists in the period after World War I and into World War II. There are three such agents: sarin, soman, and tabun.

gamma (x-ray) A type of energy that is emitted from a strong radiologic source that travels faster and has more energy than alpha and beta rays. These rays easily penetrate through the human body and require lead or several inches of concrete to prevent penetration.

incubation The period of time between a person being exposed to an agent to the first time when symptoms appear.

international terrorism Terrorism that is carried out by people in a country other than their own; also known as cross-border terrorism.

ionizing radiation Energy that is emitted in the form of rays, or particles.

LD_{50} The standard measure of the dose amount of an agent or substance that will kill 50% of a population who are exposed to this level.

lewisite (L) A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.

lymph nodes The area of the lymphatic system where infection-fighting cells are housed.

lymphatic system A passive circulatory system in the body that transports a plasmalike liquid called lymph, a thin fluid that bathes the tissues of the body.

miosis Excessively constricted pupil; often bilateral after exposure to nerve agents.

mutagen A substance that mutates, damages, and changes the structures of DNA in the body's cells.

nerve agents A class of chemical called organo-phosphates; they function by blocking an essential enzyme in the nervous system, which causes the body's organs to become overstimulated and burn out.

neurotoxins Biologic agents that are the most deadly substances known to humans; they include botulinum toxin and ricin.

neutron radiation The type of energy that is emitted from a strong radiologic source, involving particles that are among the most powerful forms of radiation; the particles easily penetrate through lead and require several feet of concrete to stop them.

off-gassing The release of an agent after exposure, for example from a person's clothes that have been exposed to the agent.

persistency Describes how long a chemical agent will stay on a surface before it evaporates.

phosgene A pulmonary agent that is a product of combustion, resulting from a fire at a textile factory or house or from metalwork or burning Freon. It is a very potent agent that has a delayed onset of symptoms, usually hours.

phosgene oxime (CX) A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.

pneumonic plague A lung infection, also known as plague pneumonia, that is the result of inhalation of plague-causing bacteria.

points of distribution (PODs) Existing facilities used as mass distribution sites for antibiotics, antidotes, vaccinations, and other medications and supplies during an emergency.

primary blast injury Injuries caused by an explosive pressure wave on the hollow organs of the body.

pulmonary blast injuries Pulmonary trauma resulting from short-range exposure to the detonation of high-energy explosives.

quaternary blast injury A blast injury that falls into one of the following categories: burns, crush injuries, toxic inhalation, medical emergencies, or mental health disorders.

radioactive material Any material that emits radiation.

radiologic dispersal device (RDD) Any container that is designed to disperse radioactive material.

ricin A neurotoxin derived from mash that is left from the castor bean; causes pulmonary edema and respiratory and circulatory failure leading to death.

route of exposure The manner by which a toxic substance enters the body.

sarin (GB) A nerve agent that is one of the G agents; a highly volatile colorless and odorless liquid that turns from liquid to gas within seconds to minutes at room temperature.

secondary blast injury A penetrating or nonpenetrating injury caused by ordnance projectiles or secondary missiles.

secondary device A secondary explosive used by terrorists, set to explode after the initial bomb.

smallpox A highly contagious disease; it is most contagious when blisters begin to form.

soman (GD) A nerve agent that is one of the G agents; twice as persistent as sarin and five times as lethal; it has a fruity odor, as a result of the type of alcohol used in the agent, and is a contact and an inhalation hazard that can enter the body through skin absorption and through the respiratory tract.

Special Atomic Demolition Munitions (SADM) Small suitcase-sized nuclear weapons that were designed to destroy individual targets, such as important buildings, bridges, tunnels, and large ships.

state-sponsored terrorism Terrorism that is funded and/or supported by nations that hold close ties with terrorist groups.

sulfur mustard (H) A vesicant; it is a brownish, yellowish oily substance that is generally considered very persistent; has the distinct smell of garlic or mustard and, when released, is quickly absorbed into the skin and/or mucous membranes and begins an irreversible process of damaging the cells. Also called mustard gas.

syndromic surveillance The monitoring, usually by local or state health departments, of patients presenting to emergency departments and alternative care facilities, the recording of EMS call volume, and the use of over-the-counter medications.

tabun (GA) A nerve agent that is one of the G agents; is 36 times more persistent than sarin and approximately half as lethal; has a fruity smell and is unique because the components used to manufacture the agent are easy to acquire and the agent is easy to manufacture.

tertiary blast injury An injury from whole-body displacement and subsequent traumatic impact with environmental objects.

V agent (VX) One of the G agents; it is a clear, oily agent that has no odor and looks like baby oil; more than 100 times more lethal than sarin and is extremely persistent.

vapor hazard The term used to describe danger posed by an agent that enters the body through the respiratory tract.

vesicants Blister agents; the primary route of entry for this agent is through the skin.

viral hemorrhagic fevers (VHF) A group of diseases caused by viruses that include the Ebola, Rift Valley, and yellow fevers, among others. This group of viruses causes the blood in the body to seep out from the tissues and blood vessels.

viruses Germs that require a living host to multiply and survive.

volatility How long a chemical agent will stay on a surface before it evaporates.

weapon of mass casualty (WMC) Any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports); also known as a weapon of mass destruction (WMD).

weapon of mass destruction (WMD) Any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports); also known as a weapon of mass casualty (WMC).

weaponization The creation of a weapon from a biologic agent generally found in nature and that causes disease; the agent is cultivated, synthesized, and/or mutated to maximize the target population’s exposure to the germ.

Assessment
in Action

You and your partner are dispatched to stand by for a suspected WMD incident in the federal courthouse. You are aware that a controversial trial is currently in session. This morning, a suspected IED exploded in the packed courtroom, resulting in multiple injuries. You are staged a few blocks away from the incident with police, fire, and other ambulances. The police bomb squad is assessing the scene to ensure it is safe to approach. When you are cleared to enter, the scene is chaotic. Many of the injured are now lying outside on the lawn in front of the courthouse. Police report that those closest to the IED were either critically injured or killed. Incident command is promptly established, and you are immediately assigned to the treatment site.

1. Staging for this suspected WMD incident should be:

   A. upwind and uphill from the incident.
   B. upwind and downhill from the incident.
   C. downwind and uphill from the incident.
   D. downwind and downhill from the incident.

2. Why is it important to follow the requests of the incident commander?

   A. The incident commander best understands incident needs.
   B. It is federal law to follow the ICS structure for patient care.
   C. The incident commander leads the fire department, not EMS.
   D. The incident commander represents a higher level of care.

3. A 35-year-old patient is holding his ear and moaning. What is your most serious concern for this patient?

   A. Ringing or pain in the ears

B. Possibility of associated pulmonary injury
C. Blood in the ear canal
D. Possibility of hearing loss

4. A 67-year-old patient reports tightness in his chest. The patient is coughing up blood and is in respiratory distress. During the physical assessment, you notice subcutaneous emphysema. What is the condition most likely to be?

   A. Exacerbation of asthma
   B. Myocardial infarction
   C. Pulmonary embolism
   D. Pulmonary blast injury

5. A 50-year-old patient is lying on the grass with petechiae (pinpoint hemorrhages on the skin). This patient may have:

   A. hollow organ injury.
   B. solid organ injury.
   C. neurologic injury.
   D. psychologic injury.

6. You perform a physical assessment on the 50-year-old patient with petechiae. Assessing for traumatic impact from flying debris is most important in the:

   A. extremities.
   B. head and neck.
   C. back.
   D. buttocks.

7. You continue the physical assessment on the 50-year-old patient. You find flying debris in the patient's lower back, leading you to suspect that there may be internal damage to the:

   A. hollow organs.
   B. solid organs.
   C. extremities.
   D. head.

8. What are the differences between primary, secondary, and tertiary blast injuries?

9. Other than the specific effects of blast injury, what other kinds of things should you assess a patient for who is involved in a WMD incident?

10. Explain how pulmonary WMD agents inflict damage and the signs and symptoms of exposure.

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SECTION
10

The Team Approach to Health Care

41 A Team Approach to Health Care

CHAPTER 41

A Team Approach to Health Care

National EMS Education Standard Competencies

There are no National EMS Education Standard Competencies for this chapter.

Knowledge Objectives

1. Define continuum of care. (p 1489)
2. List the five essential elements of a group. (p 1491)
3. Explain the advantages of a team over a group; include the advantages of regularly training and practicing together. (pp 1490–1491)
4. List the five essential elements of a team. (pp 1491–1493)
5. Explain how crew resource management (CRM) can be useful in the prehospital environment. (pp 1493–1494)
6. List the five critical elements necessary to ensure effective transfer of patient care from one provider to another. (pp 1494–1495)
7. List the five steps a receiving health care provider should perform when taking a patient care report (PCR). (p 1495)
8. Describe the four-step process of assisting with advanced life support (ALS) skills. (p 1495)
9. Discuss the importance of preoxygenation when performing endotracheal (ET) intubation. (p 1496)
10. Describe the six steps of the BE MAGIC intubation procedure. (pp 1497–1499)
11. Describe the signs that indicate a complication with an intubated patient. (p 1500)
12. Explain the importance of ensuring patient comfort during a vascular access procedure. (pp 1500, 1502)
13. Describe the steps EMTs can take to troubleshoot interpersonal conflicts. (pp 1503–1504)

Skills Objectives

There are no skills objectives for this chapter.

Introduction

As an EMT, you are a critical member of the emergency health care team that includes not only first responders, paramedics, and other EMTs, but also physicians, nurses, and other personnel who will help care for your patient throughout the duration of his or her injury or illness **Figure 41-1**. You play a pivotal role bringing emergency medicine into patients' homes, assisting with advanced patient care skills, and ensuring the effective transfer of patient care to emergency department (ED) staff when you arrive at the hospital.

As an EMT, you will need to do more than acquire clinical knowledge and master necessary skills. You must also learn to be an effective team member. Essentially, this means communicating and collaborating with others who may have different backgrounds and levels of expertise than you have. By working as a team, emergency health care providers—from the first responders in the field to the physicians in the hospital—can improve patient and provider safety and deliver better emergency care. For basic life support (BLS) and advanced life support (ALS) providers to perform well together, each team member must share a common goal and demonstrate excellent communication skills. This chapter will provide an overview of the team health care approach and discuss how diversity among providers' backgrounds, skills, and abilities can strengthen a team. The chapter will also discuss how to assist with advanced skills and manage interpersonal conflict.

Figure 41-1 As an EMT, you will work with various health care providers along the continuum of care.

The positive impact of effective teamwork on the delivery of health care is highlighted by such programs as The World Health Organization's *Being a Team Player* and in the American Heart Association's *Chain of Survival*.

An Era of Team Health Care

Today, it is understood that for the delivery of EMS to be effective, health care providers must work together toward a unified goal of patient care excellence. Historically, however, this was not always the case. Previous models of emergency care often consisted of providers who worked separately, passing the patient from one individual or group to the next. Gradually, emergency health care providers recognized that by working as a unified team from first patient contact to patient discharge, it was possible to improve individual and team performance, patient and provider safety and, ultimately, patient outcome. This concept is known as the **continuum of care**.

Community Paramedicine and Mobile Integrated Healthcare Teams

Community paramedicine and **mobile integrated healthcare (MIH)** teams may be the best example of the team concept of continuum of care. Recall from Chapter 1, *EMS Systems,* that in the MIH model, health care is provided within the community rather than at a physician's office or hospital. The success of MIH programs have shown that EMS providers, working as a unified team with in-hospital and other community health care providers, can improve patient outcomes, increase patient satisfaction, and reduce health care costs.

Differences Among Teams

The structure and effectiveness of emergency health care teams differ from system to system. EMS providers may be trained as Emergency Medical Responders (EMRs) or may be BLS- or ALS-certified. They may be volunteers or full-time employees, and they may be based in police or fire departments, hospitals, or private agency settings. Multiple EMS agencies across different regions or response districts may respond to the same 9-1-1 call. Because of the variety of providers, agencies, and systems involved in each call, it may be difficult for all of the providers to function as one unified team. For instance, you may find it challenging to share patient assessment information and integrate newly arriving providers into ongoing care. As the chapter will discuss, such challenges can be overcome by ensuring effective communication and mutual respect. In this case, as new responders arrive, it is helpful to think of them as "joining the team" as opposed to "taking over."

Types of Teams

Depending on the EMS system in which you work, you may consistently interact with the same team members. Other systems may require emergency health care providers to assemble their teams "on the fly" for each individual call.

Regular Teams

Some EMS systems rely on regular teams. In this model, EMTs consistently interact with the same partner or team and often become familiar with the other emergency health care providers and hospital staff with whom they frequently interact. Regular teams often train together. Team members who frequently train and work together are more likely to move smoothly from one step in the procedure to the next, performing as one seamless unit. By contrast, team members who train and work together less often may need more explicit verbal direction to accomplish their tasks, potentially leading to patient care delays.

Temporary Teams

Temporary teams are common in volunteer EMS systems. In this model, EMTs work with providers with whom they do not regularly interact, or may not even know. This creates a special challenge. For a temporary team to function effectively, providers must work within an environment that supports and promotes collaboration rather than competition. It is crucial to have a clear understanding of the roles, responsibilities, and capabilities of each team member. One of the best ways to accomplish this is to train together when possible.

Special Teams

Some EMS systems form special teams whose members have particular knowledge, skills, abilities, equipment, and/or training to serve a specialized role within the larger emergency health care team. Examples include:

- Fire Team
- Rescue Team
- Hazardous Materials (HazMat) Team
- Tactical EMS Team
- Special Event EMS Team
- EMS Bike Team
- In-Hospital Patient Care Technicians
- MIH Technicians

Groups Versus Teams

Do not assume any gathering of EMS providers responding together on a call is a “team.” True emergency response teams have better interaction, performance, and patient outcomes than groups of health care providers who do not share a team dynamic.

Groups

The National Incident Management System (NIMS) defines a group as “The organizational level that divides the incident according to functional levels of operation. Groups perform special functions, often across geographic boundaries.” When operating under NIMS, EMS providers may often work as a group in this sense. In the context of this chapter, the term *group* is used in the more general sense.

YOU are the Provider **PART 1**

At 0905 hours, you are dispatched to a private home at 6 Catoonah Street for a 72-year-old man who is “unresponsive.” The dispatcher has no additional information to provide. An EMR crew from the fire department has been dispatched and will likely arrive before you. The weather is clear and sunny, the temperature is 82°F (27.8°C), and the traffic is light. Your response time to the scene is approximately 6 minutes.

1. How will you work together as a team with the EMRs?
2. How will members of this team decide who will perform each role?

You must be able to distinguish between a group of providers gathered together on an emergency call and a true team. In the context of EMS, a **group** consists of individual health care providers working independently to help the patient. Some examples of EMS groups are triage, treatment, and transport groups at a mass-casualty incident. In contrast, a **team** consists of a group of health care providers who are assigned specific roles and are working interdependently in a coordinated manner under a designated leader.

In 1945, the Research Center for Group Dynamics first defined the five essential elements of a group that people must share. These elements include:

- A common goal
- An image of themselves as “a group”
- A sense of continuity of the group (an understanding that the group may work together more than once, even in a slightly different configuration)
- A set of shared values (how the group wants to get things done)
- Different roles within the group (often self-assigned)

Once a group has formed, the ability to function as a true emergency response team depends on the way in which its members work together.

Dependent, Independent, and Interdependent Groups

Dependent

In dependent groups, each individual is told what to do, and often how to do it, by his or her supervisor or group leader. Group members rely on the group leader for task assignments, troubleshooting, and virtually all decisions, thus limiting the group’s ability to adapt and deliver critical medical care in an uncontrolled field environment.

Independent

In independent groups, each individual is responsible for his or her own area (either a physical space or set of tasks). Members of an independent group may receive support and guidance from a supervisor or group leader, but do not have to wait for an assignment before taking action as they would in a dependent group. Although independent group members may work on the same patient, each person is focused on individual goals (starting an intravenous [IV] line, splinting an arm, etc), rather than on working together to achieve a unified goal. The classic example of a poor outcome of independent group work is the perfectly splinted and packaged trauma patient, who is dead on arrival at the ED from a poorly managed airway that no one had noticed.

Interdependent

EMTs and other health care providers who work interdependently are functioning as a true team. While each provider may still be assigned to a particular area or task, everyone in an interdependent group works together with shared responsibilities, accountability, and a common goal (the best possible patient outcome), as opposed to focusing on the goals of their own individual areas.

Effective Team Performance

Building on the five essential elements of a group, you will learn the five essential elements that health care providers must share to perform as an effective team.

A Shared Goal

Every health care provider on the team, from EMT to paramedic to emergency physician, must be committed to a common goal—typically, the best possible patient outcome. While this may seem like common sense, evidence of providers not working as a team can be heard in such alarming phrases as, “Why take the time to splint the patient if they’re only going to undo it in the ED?” and “There was no point in doing good CPR if the paramedic wasn’t even trying to save the patient.”

Clear Roles and Responsibilities

To achieve a common goal, each provider must know what needs to be done and what is expected of him or her. An excellent example of this is the pit crew approach to cardiopulmonary resuscitation (CPR) for cardiac arrest situations **Figure 41-2**. The term originated in motor racing, in which teams of technicians rapidly assess and repair vehicles in a matter of seconds. Similarly, pit crew CPR consists of defining each intervention that needs to be addressed during cardiac arrest (compressions, defibrillation, airway management, vascular access, medications) and training providers *before* the call to rapidly identify, prioritize, and take over any areas that are not being addressed as soon as they arrive on scene. The effectiveness of pit crew CPR is dependent on defining clear roles and responsibilities among team members. It is an outstanding example of how training together can allow providers with different certifications from different agencies to rapidly come together as a team to improve outcomes for critically ill patients.

Figure 41-2 In the pit crew CPR model, providers train how to rapidly identify, prioritize, and take over any areas that are not being addressed as soon as they arrive on scene.

Diverse and Competent Skill Sets

As discussed, EMS providers often have varying levels of certification or licensure. Think of these diverse backgrounds and skill sets not as obstacles, but as opportunities to fill roles and responsibilities within a high-performing team. Again, the best way for a team to be effective during an emergency call is to practice with one another and become familiar with each other's tools, techniques, capabilities, and preferences, so that each team member is competent *before* the call comes in.

Effective Collaboration and Communication

For team members to collaborate successfully, you must communicate effectively with one another. Four important elements of team communication include:

YOU are the Provider **PART 2**

When you arrive on scene, a frantic bystander waves you inside. She tells you, "It's my husband! He isn't breathing!" As you walk to the front door, the fire officer meets you and tells you two EMRs are already inside caring for the patient. The scene is safe. Inside you find the patient, an older man, lying in a supine position on the floor of the living room. He is being ventilated with a bag-valve mask (BVM) by one EMR as another EMR performs a reassessment. As you approach the patient with your equipment bag, airway kit, and automatic external defibrillator (AED), the EMR looks up and tells you, "We've lost a pulse." He immediately starts chest compressions while you prepare the AED.

Recording Time: 2 Minutes

Appearance	Motionless
Level of consciousness	Unconscious and unresponsive
Airway	Open; maintained by fire department EMRs
Breathing	Absent; BVM ventilations at a rate of 1 breath every 5 seconds
Circulation	No pulse; skin, cool and pale; CPR has been started

3. Which roles will need to be assigned to perform cardiac arrest resuscitation?

4. The AED analyzes the patient's heart rhythm and advises you to deliver a shock. How can your team maximize patient perfusion and minimize "hands-off" time during this part of the cardiac arrest?

- **A clear message.** Speak calmly, confidently, and concisely so that the information delivered or the action requested is clear to your listeners.
- **Closed loop communication.** When a team member speaks, you should repeat the message back to him or her. This technique helps confirm that you heard and understand the message, and will act on it.
- **Courtesy.** All team members expect and deserve to be spoken to politely.
- **Constructive intervention.** Sometimes it is necessary for you to respectfully question or correct team members (or the team leader) if you believe a mistake has been or is about to be made. This technique is not only allowed and encouraged—it is essential for effective team performance.

Supportive and Coordinated Leadership

The **team leader** is the team member who provides role assignments, coordination, oversight, centralized decision making, and support for the team to accomplish their goals and achieve desired results. The team leader is often defined by policy, procedure, or statute. He or she may be the most senior provider in the group or the person with the highest level certification. A team leader who simply commands others is not leading a team; he or she is simply directing a dependent group. A key differentiation between a team leader and a group leader is that a team leader helps the individual team members to not only do their jobs (provides support) but also to work together (facilitates coordination). In this way, a team leader helps the team produce a better outcome than is possible with a simple group. Team leaders also foster communication and team dynamics using concepts such as crew resource management and team **situational awareness** (the knowledge and understanding of one's surroundings and the ability to recognize potential threats to safety).

Crew Resource Management

Crew resource management (CRM) is, in short, a way for team members to work together with the team leader to develop and maintain a shared understanding of the emergency situation. CRM allows team members with different skill sets to collaborate and communicate, fulfill their roles and responsibilities, and achieve the shared goal of the best possible patient outcome **Figure 41-3**. The concept of CRM says that each member is responsible for maintaining awareness of the current patient situation and sharing any critical information with the team leader. Likewise, the team leader is responsible for listening to any critical information provided by you or other team members, and incorporating it into his or her decision making.

Figure 41-3 Collaboration and communication are crucial aspects of crew resource management.

In the loud and often hectic environment in which EMS providers work, when you believe there is an immediate or potential problem that must be brought to the attention of the team leader, CRM recommends use of the PACE mnemonic:

P *Probe.* Look or ask to confirm the problem.

A *Alert.* Communicate the problem to the team leader.

C *Challenge.* If the issue is not corrected, then clearly challenge the team's present course of action that is leading to the problem. For example, "Lieutenant, I think this additional action should be taken. Do you agree?"

E *Emergency.* If the problem is clear and critical (such as an immediate safety issue), then immediately communicate the emergency to the entire team.

The CRM concept does not mean you are free to ignore the chain of command within the incident command system or NIMS structure. It means you are empowered to provide the team leader and other team members with immediate feedback in the event of a potential threat to patient or crew safety. It means the team, as a whole, recognizes the importance of every individual's input and that the team is committed to creating open lines of communication. CRM empowers people to speak clearly and concisely when they detect a problem or potential problem.

Transfer of Patient Care

While effective health care teams work together from first patient contact to patient discharge, clearly not all providers will be present throughout the entire continuum of care. At several points along the continuum, the patient's care will be transferred, or "handed off," from one unit of providers on the team to another. These transfers introduce the possibility of critical patient care errors, especially when they occur several times and in different settings along the continuum of care. Effective teams minimize the number of transfers during patient care, and adhere to strict and careful guidelines when such transfers are unavoidable.

Just like in a relay race, a proper transfer of patient care will allow the team to keep moving forward with patient care. When incorrect information is handed off, information is miscommunicated, or care is interrupted, the team is forced to move backward, resulting in a loss of valuable time and effort. For this reason, it is important for you to trust other team members—even those who work at different levels or for different agencies. For example, if an EMR reports a patient had a syncopal episode, but the patient is now alert, then do not assume the EMR's information is incorrect.

General Guidelines

If possible, a single person, the team leader, should coordinate the patient's transfer of care and report the patient information. Whenever the verbal transfer of care occurs, all team members should do their best to ensure the following:

1. **Uninterrupted critical care.** Whenever possible, the team member giving the report and the team member taking the report should hand off lifesaving care (such as performing chest compressions) to another team member, allowing them to focus on the transfer of care.
2. **Minimal interference.** The transfer of patient care should occur in a location with the least interference possible.
3. **Respectful interaction.** Each team member involved in the transfer must be respectful of members' different roles and recognize the importance of each role.
4. **Common priorities.** Both the team member giving the report and the team member taking the report must focus on their common priorities (critical assessment findings and patient care) vital for the best possible patient outcome.

YOU are the Provider — PART 3

After the AED reanalyzes and advises a shock, you clear the patient and deliver the defibrillation, quickly directing the two EMRs to rotate compressors and continue CPR. As the EMRs continue compressions and BVM ventilations, the paramedics arrive.

Recording Time: 5 Minutes	
Respirations	Absent; ventilations are being assisted
Pulse	Absent; fire department EMR performing CPR
Skin	Cool and cyanotic
Blood pressure	Not obtainable; the patient has no pulse
Oxygen saturation (SpO_2)	Not obtainable; the patient has no pulse

While your partner gathers a medical history from the patient's wife and the fire officer collects the patient's medications, one of the paramedics asks you to assist her in setting up to intubate the patient.

5. What can you do to assist the paramedic with intubation of the patient?
6. When should you give the patient's medical history and medication list to the paramedic?

5. **Common language or system.** Whenever possible, a mutually agreed-upon and standardized patient handoff format should be used.

See Chapter 4, *Communications and Documentation*, for information on PCRs.

Words of Wisdom

Whether it be from a bystander, an EMR, or a fellow EMT, when taking a patient handoff report, the receiving care provider should do the following:

- **Eye Contact.** Make eye contact with the individual giving a report. This helps both providers to stop other noncritical work and focus on the transfer of information and patient care.
- **Environment.** The very nature of EMS means we do not have the level of control over the environment that we would like. However, when taking a report, make every effort to create or move to an environment that is quieter and less distracting.
- **Ensure Understanding.** Ask any questions to ensure you understand what was reported.
- **Sum up.** Quickly summarize the critical components of the handoff to allow the reporting team member to correct any misunderstandings and to reinforce the information to the new team members taking over patient care.
- **Supplement.** Obtain any relevant paperwork or other materials that will be helpful for communicating information to the next set of health care providers.

BLS and ALS Providers Working Together

In the world of prehospital emergency care, BLS and ALS care cannot exist without each other. For example, if a patient experiences sudden cardiac arrest, then BLS care (high-quality CPR and defibrillation) are the core interventions around which ALS providers build their resuscitative efforts. It would be a mistake to think of BLS care as only the “first steps” of ALS care. As an EMT, you may begin BLS efforts early, but keep in mind that BLS efforts must continue throughout the continuum of care. To successfully stabilize and treat the patient’s condition, you must carefully coordinate your efforts with the advanced tools and techniques used by ALS providers. Remember, excellent communication skills and teamwork are essential elements of emergency medicine. Each member of the EMS team must work in harmony with one goal in mind—high-quality patient care.

Where BLS Care Ends and ALS Care Begins

Many patient care skills can be considered advanced; however, the tools and techniques that you can use as an EMT versus those that are reserved for ALS providers vary from system to system. What may be a “paramedic only” skill in your EMS system may be common for an Advanced Emergency Medical Technician (AEMT) or EMT to perform in another.

As discussed in Chapter 3, *Medical, Legal, and Ethical Issues*, it is your responsibility to understand what is allowed by the scope of practice, standard of care, and local protocols where you work. If you work outside these bounds, such as performing a skill for which you are not authorized, then you risk legal liability. This liability is not reduced because you were unaware you were “not supposed to do that.”

It is just as important to understand that, as a key part of the emergency team, there are many ways in which you can assist paramedics and other ALS providers with advanced procedures.

For an EMS team to effectively perform an advanced skill, they should train and practice together. While a good EMT knows what he or she is allowed to do in assisting with an advanced procedure, a great EMT has the foundational knowledge to understand the procedure. Most important, you must understand that when using any advanced tool or technique, the focus is always on achieving a goal (solving a clinical problem) rather than simply completing a procedure.

Assisting With ALS Skills

As an EMT, there are many different ALS skills with which you may be able to assist. The exact list of ALS procedures and how they are to be performed will vary from system to system. In general, assisting follows a four-step process: (1) patient preparation, (2) equipment set up, (3) performing the procedure, and (4) continuing care.

Assisting With Placement of Advanced Airways

Endotracheal (ET) intubation is the insertion of a tube into the trachea to maintain and protect the airway. The ET tube can be inserted through the mouth or through the nose. In either case, the ET tube passes directly through the larynx between the vocal cords and then into the trachea. You may also be asked to assist with the placement of other advanced airway devices.

Patient Preparation

The first step in preparing a patient for ET intubation is oxygenation. Recall from Chapter 10, *Airway Management*, that **oxygenation** is the process of loading oxygen molecules onto hemoglobin molecules in the bloodstream. Good oxygenation often includes BVM ventilation (including the use of an oral or nasal airway) and ensuring a proper seal, ventilation rate, volume of ventilation, and time for patient exhalation. Oxygen enters the bloodstream through the process of diffusion. The more oxygen that is available in the alveoli, the longer the patient can maintain adequate gas exchange in the lungs while the intubation procedure is being performed **Figure 41-4**. This critical phase of the intubation procedure is called **preoxygenation**.

Maintain a high-flow nasal cannula on the patient during the preoxygenation phase and leave the nasal cannula in place during the intubation attempt, a period of time when BVM ventilation and chest rise and fall is not possible. This technique, called **apneic oxygenation**, allows for continuous oxygen delivery down the airways during all phases of the intubation procedure.

Preoxygenation is a critical step in advanced airway management. Always follow your local protocols regarding the sequence of this procedure.

Equipment Set Up

Equipment sets vary depending on local protocols, provider preference, and whether **direct laryngoscopy** or **video laryngoscopy** will be used. (Direct laryngoscopy is visualization of the vocal cords with a laryngoscope, while video laryngoscopy is visualization of the vocal cords using a video camera and monitor.) These differences emphasize why it is important for team members to train and practice together. Typically, intubation equipment sets include:

- Personal protective equipment (PPE), including face mask and eye shield
- Suction unit with rigid, tonsil-tip (Yankauer) and nonrigid, whistle-tip (French) catheters
- Laryngoscope handle and blade (sized for the patient)
- Magill forceps
- ET tube (sized for the patient)

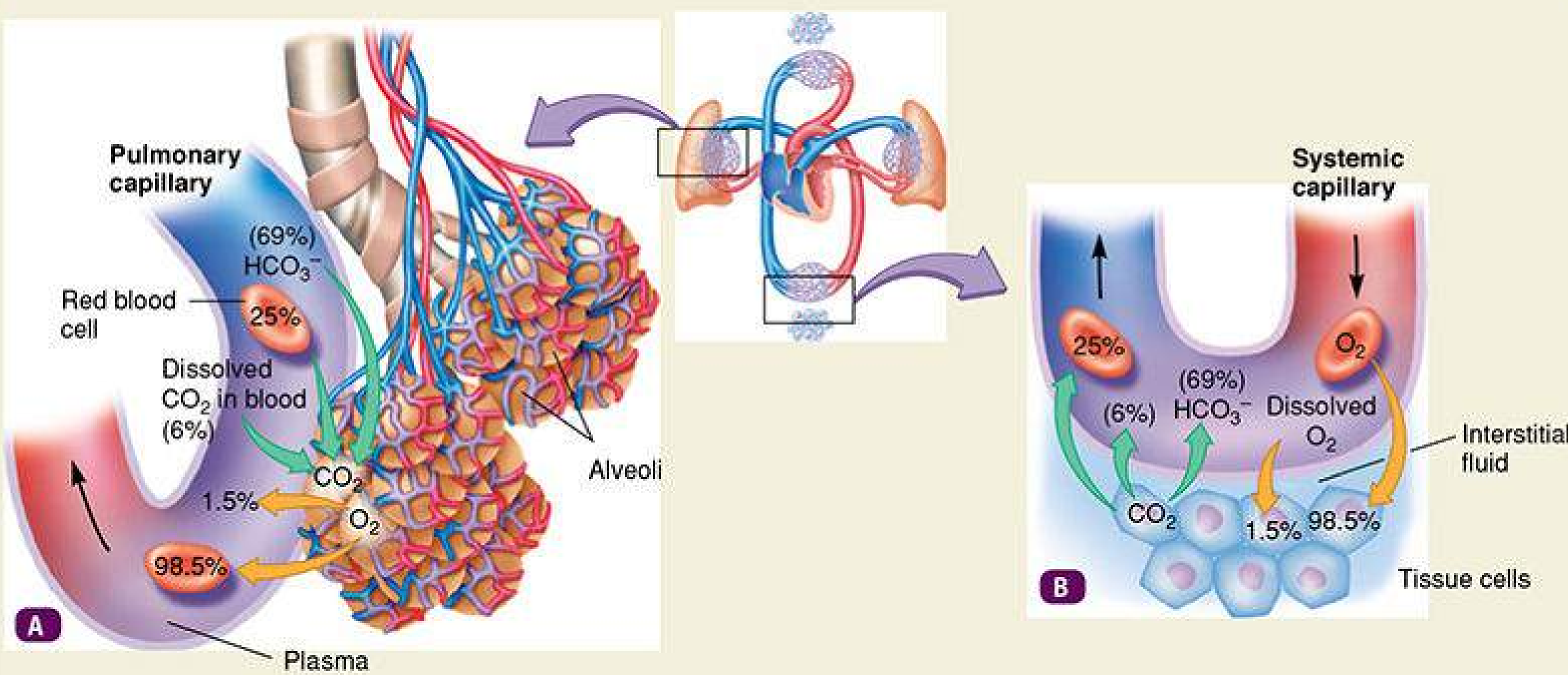

Figure 41-4 **A.** Alveolar-capillary exchange. Oxygen-rich air enters the alveoli, where it crosses into the bloodstream. Carbon dioxide leaves the blood and enters the alveoli. **B.** Capillary cellular exchange. Throughout the body, carbon dioxide from the cells enters the capillaries, and oxygen leaves the capillaries and enters the cells. Carbon dioxide is returned to the lungs in red blood cells (25%), in the form of bicarbonate (69%), and dissolved in blood (6%).

- Stylette or tube introducer (**gum elastic bougie**)

- Water-soluble lubricant
- 10-mL syringe
- Confirmation device(s), including waveform end-tidal CO_2 monitors and/or colorimetric device
- Commercial ET tube securing device
- Alternate airway management devices, such as a supraglottic airway and/or cricothyrotomy kit

Words of Wisdom

When assembling the intubation equipment, you may have time to take extra steps, such as opening the ET tube package, lubricating the end of the ET tube with the water-soluble lubricant, attaching the 10-mL syringe, testing the cuff and pilot balloon, and checking the laryngoscope's light source.

Performing the Procedure

While the details of endotracheal intubation may vary depending on available equipment, difficulties encountered, and provider preference, you can remember the six typical steps by using the **BE MAGIC** mnemonic:

B Perform *BVM* preoxygenation.

E *Evaluate* for airway difficulties.

M *Manipulate* the patient.

A *Attempt* first-pass intubation.

GI Use a supra*Glottic* or *Intermediate* airway if unable to intubate.

C *Confirm* successful intubation/*Correct* any issues.

BVM preoxygenation. As discussed previously, it is crucial that you adequately preoxygenate the patient before the intubation procedure, especially critical patients **Figure 41-5**. Do not hyperventilate the patient during the preoxygenation phase, because this may cause gastric distention and increase the risk of aspiration. Hyperventilation may also cause hypotension. Focus on maintaining a good seal, achieving chest rise and fall, and delivering breaths at a rate appropriate for the patient's age (1 breath every 6 seconds for an adult, and 1 breath every 3 to 5 seconds for an infant or child).

Evaluate for airway difficulties. While you preoxygenate the patient, an ALS provider should evaluate the patient to identify any factors that will present difficulties during the procedure—for example, trauma or anatomic deformities to the airway. It is crucial that difficulties be identified before the procedure begins. You may assist with this process, as well as the preparation of any equipment that will be needed to address the problem(s).

Figure 41-5 One EMT or the paramedic may prepare the intubation equipment while another EMT continues to ventilate and preoxygenate the patient.

Manipulate the patient. Before the procedure can begin, position the patient so that the ALS provider can visualize the vocal cords. Use towels, blankets, and pillows to ramp, position, and otherwise manipulate the patient so that the first attempted intubation will be successful. The ideal position is achieved when the patient's ear canal is on the same horizontal plane as his or her sternal notch, known as the sniffing position Figure 41-6.

Attempt intubation. When the ALS provider is ready to begin the intubation attempt, remove the oral airway and disconnect the mask from the bag in preparation for connecting the bag to the ET tube. Always keep the mask and airway within reach in case the first attempt is unsuccessful and you need to ventilate the patient with the BVM once more. Likewise, keep suction equipment at hand in case you need to suction the patient's airway. The ALS provider will begin by inserting the laryngoscope blade into the patient's mouth and will use it to move structures in the airway, such as the tongue and epiglottis, to gain a view of the vocal cords through which the ET tube will pass Figure 41-7.

Special Populations

It may be difficult for the ALS provider to visualize the vocal cords in bariatric and pediatric patients or patients with suspected cervical spine injuries. Expect to have particularly hands-on involvement with these patients. It is usually necessary to open (undo) a cervical collar to perform intubation. As the cervical collar is opened, you may be asked to maintain cervical spine immobilization while an ALS provider attempts intubation. Good communication and coordination between team members is critical during these advanced procedures.

Figure 41-6 The sniffing position: Position the patient so that the ear canal is on the same horizontal plane as the sternal notch.

Figure 41-7 The ALS provider will use the laryngoscope blade to visualize the target of the vocal cords through which the ET tube will pass.

The ALS provider may ask you for assistance in manipulating the patient's larynx (external laryngeal manipulation) or otherwise positioning the patient for a better view **Figure 41-8**. You may also be asked to hand over the ET tube, gum elastic bougie, suction catheter, or other equipment to the ALS provider.

Supraglottic or intermediate airway. Should the intubation attempts fail, it may be your responsibility to prepare and hand over the supraglottic or intermediate airway device or, in systems where it is allowed, you may place the airway devices themselves **Figure 41-9**.

Confirm intubation/correct issues. If the intubation procedure appears successful, then work with your team to confirm intubation success. You may attach the end-tidal waveform CO_2 detector in line between the ET tube and the bag. You may also either ventilate the patient while another provider checks for positive breath sounds in the absence of gastric sounds, or you may listen while another team member ventilates **Figure 41-10**. A successfully intubated patient should have bilateral breath sounds present and gastric (or epigastric) sounds should be absent. Either absence of breath sounds or presence of gastric sounds suggests the ET tube was improperly inserted into the esophagus. If the intubation is confirmed as successful, then you may assist in securing the ET tube **Figure 41-11**. If the intubation cannot be confirmed, or if the ET tube appears to be properly placed but airway or breathing issues remain, then you may assist other team members in correcting these issues.

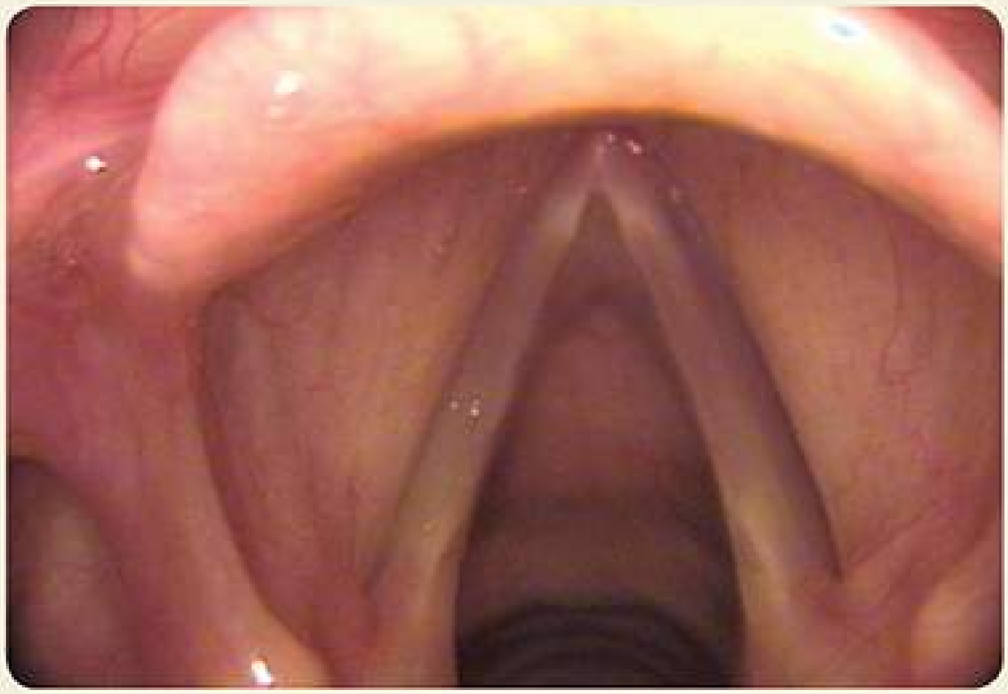

Figure 41-8 The cuff of the ET tube must pass through the vocal cords. The ALS provider will attempt to directly visualize this, but may be able to intubate even if the cords are not visible.

Courtesy of James P. Thomas, M.D. (voicedoctor.net).

Words of Wisdom

An ALS provider may place an oral airway back into the patient’s mouth after a successful intubation attempt to prevent the patient from biting down on the ET tube.

Figure 41-9 Supraglottic airway devices. **A.** The King LT is a single lumen supraglottic airway device. **B.** The laryngeal mask airway device. **C.** The i-gel airway device.

Figure 41-10 Ventilate while listening for breath sounds to confirm successful placement of the ET tube.

Figure 41-11 Ensure the ET tube does not move while it is being secured or at any point during patient care.

Words of Wisdom

The position of the ET tube is unstable before the tube is secured with tape or a mechanical device. Make sure the ET tube is not dislodged by movement at this point in the procedure, or at any time during patient care.

Continuing Care

Once an intubation attempt has been confirmed as successful, the job of airway management is not over for the EMS team. You must continue to observe all of the patient's monitor readings, as well as monitor for signs of potential complications, including:

- **Absence of an end-tidal CO_2 level.** Alert team members if the end-tidal CO_2 waveform suddenly disappears. (This is a sign the ET tube may have shifted out of the proper position.)
- **Decreasing SpO_2 level.** Alert team members if the SpO_2 level begins to drop, especially below 94%. (This is a sign the ET tube may have shifted out of the proper position.)
- **Increasing resistance when ventilating.** The person assigned the task of ventilation should monitor for increasing resistance when the bag is squeezed for ventilation. When increasing resistance is felt, it could indicate a critical airway or breathing problem that must be addressed, such as the advanced airway device has been mistakenly placed into the esophagus rather than into the trachea, referred to as esophageal intubation. When the ET tube is placed in the esophagus, ventilation results in air being pumped into the stomach, which increases the size of the patient's stomach and leads to gastric distention.
- **Other physical signs of poor ventilation and perfusion.** Physical signs include pale skin and cyanosis.
- **Improper positioning or dislodgement of the ET tube.** Each time the patient is moved, it is important to reassess the placement of the ET tube. Verify proper ET tube position by ensuring breath sounds are present, gastric sounds are absent, an end-tidal CO_2 waveform is visible during ventilation, SpO_2 values are stable or rising, and the ET tube is secured at the proper depth marking Figure 41-12.

Vascular Access

Vascular access is a procedure that gains access to a patient's circulatory system in order to inject or remove fluids, medicines, or blood products. Vascular access is usually obtained through an intravenous catheter placed in a vein, but sometimes through a needle or catheter placed in an artery or a needle placed into bone.

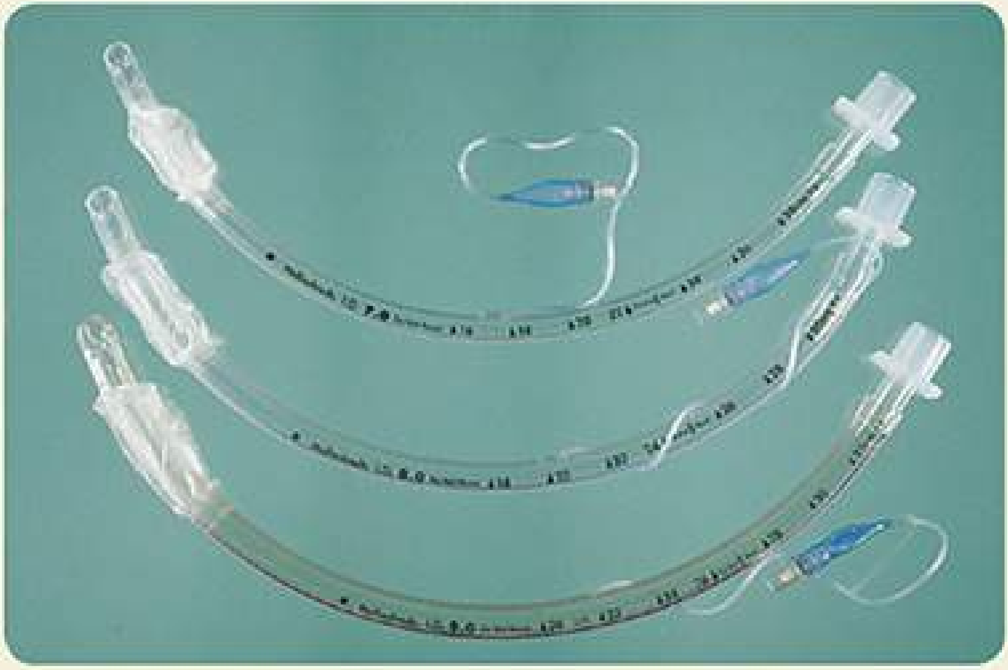

Figure 41-12 Centimeter markings on the ET tube are used to ensure insertion to the appropriate depth.

Patient Preparation

The first step in preparing a patient for a vascular access procedure may involve positioning the patient and other EMS equipment so the ALS provider has enough room to make the attempt. Patient preparation may also involve explaining the procedure, and the reason for it, to the patient. You must ensure the patient is comfortable and calm so that he or she is less likely to move during the procedure.

Equipment Set Up

IV equipment sets vary depending on local protocols as well as EMS agency and provider preference. Regardless, regular team training, practice, and familiarity with the equipment involved in vascular access procedures can make an enormous difference in team performance and patient care. In the case of vascular access, you may be asked to gather the equipment and/or assemble some parts of the vascular access system, including spiking (inserting a needle into) the bag of IV solution.

While vascular access may involve either IV or intraosseous (IO) access, the procedure and equipment list will be generally the same:

- PPE, including properly sized gloves
- A properly sized bag or syringe of the IV solution (selected by the ALS provider)
- IV tubing and drip set (selected by the ALS provider)
  - Macrodrip set (10 to 15 gtt [drops]/mL) for general use and trauma
  - Microdrip set (60 gtt/mL) for medication infusion

- Skin preparation pads, typically alcohol prep pads and/or betadine solution
- Adhesive tape, torn into several pieces about 1 inch (2.5 cm) in length, to help secure the tubing to the patient's body
- Gauze, 2 × 2 inches (50 × 50 mm) or 4 × 4 inches (101 × 101 mm)
- Commercial IV securing system (a device to help secure the tubing instead of, or together with, adhesive tape; optional)
- IV "pigtail" catheter (a small section of IV tubing that connects to the hub of the IV catheter and can be easily connected and disconnected from the primary IV tubing; optional)
- If IV access:
  - Venous constricting band (sometimes referred to as a venous tourniquet)
  - IV catheter (size selected by the ALS provider)

Words of Wisdom

Clean, Sterile, and Aseptic Technique

Some advanced procedures are considered invasive because they involve creating openings in the body or inserting devices in the body. During invasive procedures, you must utilize the appropriate technique (clean, aseptic, or sterile), to prevent the spread of infection—especially if the patient is already sick.

Clean technique refers to minimizing the amount of pathogens or "unclean" materials that you pick up or transfer through the use of routine handwashing, nonsterile protective gloves, etc.

Aseptic technique is often used for fast, invasive procedures such as starting an IV line and refers to techniques and procedures that help ensure that pathogens are not introduced anywhere in the procedure (such as sterilization of equipment or use of antiseptics or disinfectants).

Sterile technique is often used during long, highly invasive surgical procedures and involves thorough decontamination, as well as the use of sterile fields around the procedure and full-scale, sterile PPE.

When you assist with ALS skills such as spiking an IV bag, it is important for you to use aseptic technique. Ensure that no nonsterile items (nonsterile gloves, the outside of the IV bag, the patient's skin, etc) come in contact with the sterile parts of the IV system (the tubing spike, the IV bag port, the end of the IV tubing, etc).

- If IO access:
  - IO needle (size selected by the ALS provider)
  - Mechanical IO driver or insertion device (depending on IO system)

Spiking the Bag

An ALS provider may ask you to spike the IV bag. To spike the bag with the administration set, follow these steps.

Begin by removing the rubber pigtail found on the end of the IV bag by pulling on it. The bag is still sealed and will not leak until the piercing spike of the IV administration set punctures this port. Remove the protective cover from the sterile piercing spike **Figure 41-13**.

Next, slide the spike into the IV bag port until you see fluid enter the drip chamber **Figure 41-14**. Invert the bag. Squeeze and release the drip chamber until about half full. Unclamp the tubing (to allow fluid into the tubing to prime the line and flush the air out of the tubing).

Let the fluid flow until air bubbles are removed from the line before turning the roller clamp wheel to stop the flow.

Next, go back and check the drip chamber; it should be only half filled. The fluid level must be visible to calculate drip rates. If the fluid level is too low, then squeeze the IV bag until it fills. If the chamber is too full, then invert the IV bag and squeeze the chamber to empty the fluid back into the bag. Hang the bag in the appropriate location with the end of the IV tubing easily accessible.

Figure 41-13 Remove the pigtail from the port on the IV bag and the cover from the spike on the administration set.

Choose the drip set indicated by the ALS provider, and attach it to the fluid bag indicated by the ALS provider. Fill the drip chamber halfway by squeezing it Figure 41-15. Flush or "bleed" the tubing to remove any air bubbles by opening the roller clamp Figure 41-16. Make sure no bubbles are floating in the tubing.

Saline locks (buff caps) are access devices used to maintain an active IV site without running fluids through the vein Figure 41-17. Saline locks, also called heparin caps and heparin locks, are used primarily for patients who do not need additional fluids but may need rapid medication delivery. Procedures will vary based on local protocol, available equipment, and provider preference. One way to set up a saline lock is to attach it to the end of an IV catheter and fill it with approximately 2 mL of normal saline to keep blood from clotting at the end of the catheter. Saline remains in the port without entering the vein.

Figure 41-14 Slide the spike into the IV bag port.

Figure 41-15 Prepare the solution and tubing to be used. Fill the drip chamber halfway by squeezing it.

Figure 41-16 Flush or "bleed" the tubing to remove any air bubbles by opening the roller clamp.

Performing the Procedure

While the ALS provider is establishing IV or IO access, you may help to stabilize (or in some instances, restrain) the patient's limbs or simply hold the patient's hand and provide him or her comfort **Figure 41-18**. You may also be asked to assist the ALS provider by handing over equipment as requested.

Figure 41-17

A saline lock is attached to the end of an intravenous catheter and filled with approximately 2 mL of normal saline.

Continuing Care

Once vascular access is established, continue patient care by observing the access site for swelling, bleeding, discoloration, or leaking. Also, observe the IV tubing to see if it is improperly blocked, clamped, kinked, or if the bag of IV solution is empty **Figure 41-19**.

Figure 41-18 While the ALS provider starts the IV line, you can help ensure that the patient's arm does not move.

Figure 41-19 Observe for the accumulation of blood, IV fluid, or air in the area of the insertion site.

Courtesy of Rhonda Hunt.

Troubleshooting Team Conflicts

As outlined in this chapter, applying the principles of effective emergency health care teams will help to minimize interpersonal conflicts. However, because most emergency health care teams consist of highly trained, enthusiastic, and dedicated people, it is inevitable that conflict will arise from time to time. When conflict occurs, keep in mind the following five techniques:

YOU are the Provider — PART 4

The patient is intubated and has an IV line established. Before any medications are administered, the patient regains a pulse, even though he remains unconscious. You transport the patient to the local hospital, which is only a few minutes away. The paramedic gives a radio report while en route.

Recording Time: 17 Minutes	
Level of consciousness	Unconscious and unresponsive
Respirations	6 breaths/min (baseline); ventilations are being assisted
Pulse	104 beats/min
Skin	Pale and cyanotic
Blood pressure	104/80 mm Hg
Spo_2	92% (with assisted ventilation)

Upon arrival, you bring the patient into the resuscitation room where the ED members of your team await.

7. In the ED, if the paramedic is giving the handoff report, then who will ensure that patient care is continued during the transfer of care?
8. During the transfer of patient care, at what point is the EMS unit of the team relieved of responsibility for caring for the patient?

- **The patient comes first.** Regardless of interpersonal conflicts that may arise, the patient's needs must always come first.

- **Do not engage.** If the problem causing the conflict does not directly and immediately impact patient care, then do not engage. Have the discussion after the call, when more positive communication may be possible.
- **Keep your cool.** Maintain your composure. If you feel that the conflict is over a critical component of patient care, then follow the PACE mnemonic discussed previously. If it is not, then begin by taking a deep breath and slowly counting to 10.
- **Separate the person from the issue.** If the conflict arises from the behavior of another team member and the conflict cannot be delayed or avoided, then focus on the behavior itself rather than the individual.
- **Choose your battles.** Remember, there is strength in the diversity of team members. Not everyone will work in exactly the same way, and that is a good thing. Avoid engaging in conflict over minor issues in patient care that center around one provider "style" over another.

YOU are the Provider — SUMMARY

1. How will you work together as a team with the EMRs?

Because the EMRs will arrive at the scene before you, they will have begun patient care. When you arrive, begin by making contact with the EMR in charge while your partner assists the other EMRs. You should gather information about the patient's current condition as well as the care that has already been provided, so you understand the patient care priorities as well as which roles need to be filled and what tasks need to be completed. This information-gathering step will allow you to seamlessly integrate into the patient care team for the call already in progress.

2. How will members of this team decide who will perform each role?

Throughout the emergency call, provider roles and responsibilities will change as patient needs and available resources change. In some cases, certain roles will need to be filled by providers with specific levels of expertise or advanced certifications. In other cases, local protocol will often require the highest-certified or most senior provider to be the team leader. Be aware that it will not always be necessary (and may even set the team back) for an arriving responder to take over simply because they have a higher certification. For example, if you arrive on this scene to find the patient in respiratory arrest with an EMR already providing ventilations, then it may not be helpful to stop the EMR and have him hand over the procedure. The most helpful way, assuming there are no higher patient priorities at that time, would be for you to step into another necessary, but as of yet unfilled, role.

3. Which roles will need to be assigned to perform cardiac arrest resuscitation?

At this point in the call, there are seven providers on scene: the fire officer, the EMR who is ventilating, the EMR who is performing chest compressions, you, your partner, the paramedic, and the paramedic's partner.

The highest-priority role (providing high-quality cardiac compressions) has already been filled by the EMR from the fire department. However, be aware that it may be necessary to relieve a provider who has been doing CPR for more than a few minutes, because he or she may become fatigued and start to perform ineffective compressions. Your partner can fulfill this role.

The second highest-priority role is to apply and use a cardiac monitor or AED. If only two responders are on scene, then the provider in this role will be the team leader. In this scenario, the paramedic can fulfill this role.

Depending on local protocol, the next role is to manage the patient's airway and breathing. If the person filling this role is a BLS provider, then he or she will utilize a BVM, oxygen, and airway adjuncts as allowed by local protocol. If an ALS provider arrives, then he or she may assume this role from a BLS provider. In this scenario, this role has already been filled by the second EMR.

If advanced providers are available, then the next role is to gain vascular access and administer medication. In this situation, the paramedic's partner can fulfill this role.

If enough providers are available, then a fifth role is that of team leader. His or her tasks include gathering patient history and assessment information, formulating a resuscitation plan, and coordinating all of the other roles. Here, the fire officer can fulfill this role.

4. The AED analyzes the patient's heart rhythm and advises you to deliver a shock. How can your team maximize patient perfusion and minimize "hands off" time during this part of the cardiac arrest?

The provider performing CPR (the EMR) should resume compressions immediately after the shock is delivered, without having to be directed to do so by the team leader.

In general, methods for minimizing "hands off" time will depend greatly on the amount of training and practice the providers on the resuscitation team have had prior to the call. After any defibrillation, CPR should resume immediately after the shock is delivered, regardless of the patient's cardiac rhythm—unless the patient has obvious signs of circulation (such as movement, breathing, or speaking). In a well-coordinated team, all team members should understand this priority, even if the team members hold different levels of certifications or are from different organizations. However, team members who have not practiced or worked together before are likely to wait until they are given specific direction from a team leader because they do not know what to expect next. In cardiac resuscitation, this can lead to delays in the resumption of CPR, which negatively affects the patient's chances of successful resuscitation.

5. What can you do to assist the paramedic with intubation of the patient?

The intubation procedure will typically follow the BE MAGIC mnemonic process, but the specific steps will depend on several factors, including your level of training and provider preference. As with any ALS procedure, assisting with intubation typically follows the four-step process of patient preparation, equipment set up, performing the procedure, and continuing care.

In this case, patient preparation is complete, because proper BVM ventilation has been ongoing. The paramedic may wish to evaluate the patient for difficult airway issues while you set up the intubation equipment, or the paramedic may wish to set up the equipment.

You will most surely assist in the continuation of care, especially if you fill the role of airway and breathing provider. You will continue to observe end-tidal CO_2 level, SpO_2 level, and other monitor readings. You should watch out for indicators of pending or immediate airway issues, such as gastric inflation, increasing resistance when squeezing the BVM, and signs of poor patient ventilation or perfusion.

6. When should you give the patient's medical history and medication list to the paramedic?

As a single ALS provider arriving on scene of a cardiac resuscitation, the paramedic will have a number of roles that he or she may need to fill. The most obvious role is that of team leader. However, a dilemma the paramedic may face is that he or she may be the only one able to complete certain ALS level tasks such as cardiac rhythm interpretation, obtaining vascular access, and medication administration.

As a result, the exact answer to this question will depend on the specifics of the situation. Generally, most ALS providers assuming the role of team leader upon arrival will want an immediate report of priority patient concerns, priority assessment, medical history, and key interventions that have been performed. This brief, priority-only report is typically verbal, not written. Therefore, in this case, you should provide a verbal report to the paramedic as soon as possible upon her arrival.

While not always possible, it is recommended that the full patient demographics, medical history, medication list, and other pertinent information be written down in a clear format and turned over to the paramedic team leader for additional reference, and then turned over to the team members upon arrival at the ED.

7. In the ED, if the paramedic is giving the handoff report, then who will ensure that patient care is continued during the transfer of care?

It is important for other team members to avoid interrupting or causing interference with the hand-off report. It is just as important for team members to ensure that priority treatments (think ABCs) are continued during the transfer of care until treatments are assumed by the receiving team members.

It is for this reason that many team-focused patient handoff protocols specify that all priority treatments must be completely taken over by the receiving team before the handoff report is given. This ensures that the team's complete attention can be given to the person (in this case, the paramedic) providing the report. Many protocols even include a specific, so-called moment of silence to ensure that the report is given only once and that all team members received the information. This is especially important during critical care handoffs such as this cardiac arrest, but this concept can also apply to severe trauma, and "alert" situations such as STEMI, stroke, and sepsis.

8. During the transfer of patient care, at what point is the EMS unit of the team relieved of responsibility for

caring for the patient?

It is crucial for team members to ensure that patient care continues through any transition of team members, from the time you arrive on scene to join the team to the moment you hand off care to your team members in the ED.

Once the handoff is complete, it is important for you to ask if your team members in the ED have any remaining questions or need anything else from you. Do not make assumptions. Ask explicit questions aloud, such as “Do you have any questions?” and “Is there anything else that you need from me?” You should receive a clear response from the team members to whom you are handing off patient care.

EMS Patient Care Report (PCR)

Date: 7-20-17	**Incident No.:** 0101855	**Nature of Call:** Unresponsive		**Location:** 6 Catoonah St.	
Dispatched: 0905	**En Route:** 0905	**At Scene:** 0912	**Transport:** 0925	**At Hospital:** 0932	**In Service:** 1000

Patient Information

Age: 72 **Sex:** M **Weight (in kg [lb]):** 90 kg estimated (198 lb)	**Allergies:** Cipro **Medications:** Avastatin **Past Medical History:** Lung cancer **Chief Complaint:** Cardiac arrest

Vital Signs

Time: 0910	**BP:** Unable to obtain	**Pulse:** 71	**Respirations:** 8	**Spo_2:** 82%
Time: 0912	**BP:** N/A	**Pulse:** 0	**Respirations:** 0	**Spo_2:** N/A
Time: 0919	**BP:** N/A	**Pulse:** 0	**Respirations:** 0	**Spo_2:** N/A
Time: 0925	**BP:** N/A	**Pulse:** 0	**Respirations:** 0	**Spo_2:** N/A
Time: 0931	**BP:** 104/80	**Pulse:** 104	**Respirations:** 6 baseline, ventilations assisted	**Spo_2:** 92%, ventilations assisted

EMS Treatment (circle all that apply)

Oxygen @ 15 L/min via (circle one): **NC NRM BVM**		**Assisted Ventilation**	**Airway Adjunct**	**CPR**
Defibrillation	**Bleeding Control**	**Bandaging**	**Splinting**	**Other:** Assisted with ET intubation and vascular access

Narrative

Unit 118-1 co-dispatched with fire department EMRs and paramedic unit to a private residence for a 72-year-old male "unresponsive patient." Upon arrival patient was reported to be in respiratory arrest under care of EMRs. Upon reassessment patient found to be pulseless and apneic. CPR initiated by EMRs. AED applied by EMS. Shock advised and delivered. CPR continued rotating compressors every 2 minutes. Patient history of lung cancer obtained from spouse. Paramedic arrival at 0915. EMS assisted with advanced airway placement and vascular access. Before medications were administered, patient regained pulse, but remained unconscious. Patient loaded for transport with assistance of EMRs. Patient transported without further change in status or additional treatment. Paramedic gave radio report en route. Upon arrival at ED, care was assumed by ED staff. Verbal report was given to attending physician (team leader). Written patient history and medications were given to RN (resuscitation team recorder). ED staff confirmed no further questions. Transfer of care complete at 0935. Unit 118-1 cleared the hospital and returned to service at 1000 hrs.
End of report

Prep Kit

Ready for Review

- Emergency health care providers must know how to work effectively as a unified team, from first patient contact to patient discharge. Ensuring consistent patient care across all team members is known as the continuum of care.
- While some EMS systems will allow EMTs to work together in regular teams, others will require providers to assemble their teams "on the fly" for each call (temporary teams). It is especially important for team members to train and practice together if they are from different organizations.
- An effective team must work interdependently toward a shared goal (best possible patient outcome) instead of focusing on individual, task-based goals (such as splinting an arm or starting an IV line).
- An effective team must have clearly defined roles and responsibilities. The diverse and highly competent team members must communicate and collaborate efficiently under supported and coordinated leadership.
- An effective team must have a team leader to coordinate and guide decision making. For this to be possible, every member must be responsible for maintaining individual situational awareness and conveying critical information to each other and to the team leader.
- For all emergency health care providers to work together successfully, they must be well versed in efficient patient handoff techniques.
- The ALS skills with which you may assist will vary from EMS system to EMS system, but you will generally follow a four-step process: (1) patient preparation, (2) equipment set up, (3) performing the procedure, and (4) continuing care.

Vital Vocabulary

apneic oxygenation A technique in which oxygen administered via a high-flow nasal cannula is left in place during an intubation attempt, allowing for continuous oxygen delivery into the airways during all phases of the procedure.

aseptic technique A technique that helps ensure pathogens are not introduced anywhere in the procedure through the sterilization of equipment and use of antiseptics or disinfectants; often used for fast, invasive procedures, such as starting an IV line.

clean technique A technique in which the amount of pathogens or unclean materials picked up or transferred during a procedure is minimized through the use of routine handwashing and non-sterile protective gloves.

community paramedicine A health care model in which experienced paramedics receive advanced training to equip them to provide additional services in the prehospital environment, such as health evaluations, monitoring of chronic illnesses or conditions, and patient advocacy.

continuum of care The concept of consistent patient care across the entire health care team from first patient contact to patient discharge; working together with a unified goal, results in improved individual and team performance, better patient and provider safety, and improved patient outcome.

crew resource management (CRM) A set of procedures for use in environments where human error can have disastrous consequences. It empowers people within a team to communicate effectively with one another with a goal of improving team situational awareness, patient and crew safety, and overall communication.

direct laryngoscopy Visualization of the airway with a laryngoscope.

endotracheal (ET) intubation Insertion of an endotracheal tube directly through the larynx between the vocal cords and into the trachea to maintain and protect an airway.

esophageal intubation Improper placement of an advanced airway device into the esophagus rather than into the trachea.

group In the context of EMS, a collection of individual health care providers working independently to help the patient.

gum elastic bougie A flexible device that is inserted between the glottis under direct laryngoscopy; the endotracheal tube is threaded over the device, facilitating its entry into the trachea.

mobile integrated healthcare (MIH) A method of delivering health care that involves providing health care within the community rather than at a physician's office or hospital.

oxygenation The process of loading oxygen molecules onto hemoglobin molecules in the bloodstream.

preoxygenation The process of providing oxygen, often in combination with ventilation, prior to intubation in order to raise the oxygen levels of body tissues; a critical step in advanced airway management. This extends the time during which an advanced airway can be placed in an apneic patient, because the more oxygen that is available in the alveoli, the longer the patient can maintain adequate gas exchange in the lungs during the procedure.

saline locks (buff caps) Special types of intravenous devices filled with a small amount of normal saline to keep blood from clotting at the end of the catheter, allowing an IV site to be maintained without running fluids through the vein; also called heparin caps and heparin locks.

situational awareness Knowledge and understanding of one's surroundings and the ability to recognize potential risks to the safety of the patient or EMS team.

sterile technique A technique that involves thorough decontamination, as well as the use of sterile fields around the procedure and full-scale, sterile PPE; often used during long, highly invasive surgical procedures.

team In the context of EMS, a group of health care providers who are assigned specific roles and are working interdependently in a coordinated manner under a designated leader.

team leader The team member who provides role assignments, coordination, oversight, centralized decision making, and support for the team to accomplish their goals and achieve desired results.

vascular access A procedure that gains access to a patient's circulatory system in order to inject or remove fluids, medicines, or blood products. Vascular access is usually obtained through an intravenous catheter placed in a vein, but sometimes through a needle or catheter placed in an artery or a needle placed into bone.

video laryngoscopy Visualization of the vocal cords, and thereby placement of the endotracheal tube that is facilitated by use of a video camera and monitor.

Assessment *in Action*

You are dispatched to a private residence where a 48-year-old woman is lying supine on the bathroom floor. She is alone in the house. The patient is unresponsive, not breathing, and has a weak pulse. You secure her airway with an oral airway and ventilate her with a BVM at a rate of one breath every 5 seconds. An ALS transport ambulance arrives. The paramedic and her AEMT partner enter the house and approach you and the patient. You continue BVM ventilations. The paramedic prepares to intubate and the AEMT prepares to start an IV line.

1. At what point should you give your verbal report?

   A. Over the radio, prior to arrival of the ambulance
   B. Face to face, inside of the house
   C. Face to face, outside of the house
   D. Over the radio, after the ambulance leaves

2. Now that the ambulance has arrived, who will be the team leader?

   A. You, because you were the first provider on scene
   B. The AEMT, because the paramedic will be too busy intubating the patient
   C. The paramedic, because she is the highest-level provider on scene
   D. The hospital physician, because he provides medical control

3. After giving your report, which of the following roles is the most appropriate for you to assume?

   A. The role of team leader
   B. Assistant to the paramedic
   C. Assistant to the AEMT
   D. Request from the team leader

4. The paramedic asks you to assist her with intubation. Your first step should be to:

   A. prepare the patient by continuing to ventilate.
   B. assemble the equipment that the paramedic will need.

C. assist the paramedic as she places the ET tube.
D. care for and monitor the patient once she has been intubated.

5. The paramedic asks you to help position the patient to facilitate intubation. What is the best way to position the patient?

A. Raise the patient's legs.
B. Lift the patient's neck.
C. Help pad under the patient's shoulders.
D. Turn the patient on her side.

6. As you ventilate the intubated patient, which of the following observations would cause you to immediately alert the team leader?

A. Ventilation is causing the chest to rise.
B. The patient's cyanosis is disappearing.
C. The oxygen saturation level is now at 94%.
D. The BVM is offering more resistance.

7. After the paramedic relieves you of your task, you offer to assist the AEMT. He tells you he does not need any help, even though he is clearly having difficulty establishing an IV line. You should:

A. immediately inform the team leader that the AEMT needs help.
B. call the AEMT's supervisor.
C. not engage; calmly speak to the AEMT about the situation after the call.
D. not engage; assist the AEMT with the IV line.

8. After your other tasks are completed, you search the house for a medication list or other relevant medical information. To whom should you give this information?

A. The team leader
B. The AEMT
C. The physician at the ED
D. The patient's family

9. As the paramedic and AEMT prepare to transport, they begin to have a disagreement as to how best to package the patient. As they discuss this, you notice the paramedic is no longer ventilating the patient at the appropriate rate. How should you proceed?

10. How might you improve your team dynamic with the other providers in the future?

Glossary

abandonment Unilateral termination of care by the EMT without the patient's consent and without making provisions for transferring care to another medical professional with the skills and training necessary to meet the needs of the patient.

abdomen The body cavity that contains the major organs of digestion and excretion. It is located below the diaphragm and above the pelvis.

abdominal aortic aneurysm (AAA) A rapidly fatal condition in which the walls of the aorta in the abdomen weaken and blood leaks into the layers of the vessel, causing it to bulge.

abdominal-thrust maneuver The preferred method to dislodge a severe airway obstruction in adults and children; also called the Heimlich maneuver.

abduction Motion of a limb away from the midline.

abrasion Loss or damage of the superficial layer of skin as a result of a body part rubbing or scraping across a rough or hard surface.

abruptio placenta Premature separation of the placenta from the wall of the uterus.

absorption The process by which medications travel through body tissues until they reach the bloodstream.

access Gaining entry to an enclosed area and reaching a patient.

accessory muscles The secondary muscles of respiration. They include the neck muscles (sternocleidomastoids), the chest pectoralis major muscles, and the abdominal muscles.

acetabulum The depression on the lateral pelvis where its three component bones join, in which the femoral head fits snugly.

acidosis A pathologic condition that results from the accumulation of acids in the blood and body tissues.

acromioclavicular (AC) joint A simple joint where the bony projections of the scapula and the clavicle meet at the top of the shoulder.

action The therapeutic effect of a medication on the body.

activated charcoal An oral medication that binds and adsorbs ingested toxins in the gastrointestinal tract for treatment of some poisonings and medication overdoses. It is ground into a very fine powder that provides the greatest possible surface area for binding medications that have been taken by mouth; it is carried on the EMS unit.

active compression-decompression CPR A technique that involves compressing the chest and then actively pulling it back up to its neutral position or beyond (decompression); may increase the amount of blood that returns to the heart, and thus, the amount of blood ejected from the heart during the compression phase.

activities of daily living The basic activities a person usually accomplishes during a normal day, such as eating, dressing, and bathing.

acute abdomen A condition of sudden onset of pain within the abdomen, usually indicating peritonitis; immediate medical or surgical treatment is necessary.

acute coronary syndrome A group of symptoms caused by myocardial ischemia; includes angina and myocardial infarction.

acute myocardial infarction (AMI) A heart attack; death of heart muscle following obstruction of blood flow to it; in this context the attack is "new" or "happening right now."

acute stress reactions Reactions to stress that occur during a stressful situation.

Adam's apple A firm prominence of cartilage that forms the upper part of the larynx. It is more prominent in men than in women. Also called the thyroid cartilage.

addiction A state of overwhelming obsession or physical need to continue the use of a substance.

adduction Motion of a limb toward the midline.

adenosine triphosphate (ATP) The nucleotide involved in energy metabolism; used to store energy.

adolescents Children between ages 12 to 18 years.

adrenal glands Endocrine glands located on top of the kidneys that release adrenaline when stimulated by the sympathetic nervous system.

adrenergic Pertaining to nerves that release the neurotransmitter norepinephrine, or noradrenaline (such as adrenergic nerves, adrenergic response); also pertains to the receptors acted on by norepinephrine.

adsorption The process of binding or sticking to a surface.

advance directive Written documentation that specifies medical treatment for a competent patient should the patient become unable to make decisions; also called a living will or health care directive.

advanced EMT (AEMT) An individual who has training in specific aspects of advanced life support, such as intravenous therapy, and the administration of certain emergency medications.

advanced life support (ALS) Advanced lifesaving procedures, including cardiac monitoring, administration of intravenous fluids and medications, and the use of advanced airway adjuncts. EMTs may be trained in some of these areas.

adventitious breath sounds Abnormal breath sounds such as wheezing, stridor, rhonchi, and crackles.

aerobic metabolism Metabolism that can proceed only in the presence of oxygen.

afterload The force or resistance against which the heart pumps.

aging The process by which the temporary bond between the organophosphate and acetylcholinesterase undergoes hydrolysis, resulting in a permanent covalent bond.

agonal gasps Occasional, gasping breaths that occur after the heart has stopped; seen in dying patients.

agonist A medication that causes stimulation of receptors.

air ambulances Fixed-wing and rotary-wing (known as helicopters) aircrafts that have been modified for medical care; used to evacuate and transport patients with life-threatening injuries to treatment facilities.

air embolism The presence of air in the veins, which can lead to cardiac arrest if it enters the heart.

airborne transmission The spread of an organism via droplets or dust.

airway The upper airway tract or the passage above the larynx, which includes the nose, mouth, and throat.

alkalosis The buildup of excess base (lack of acids) in the body fluids.

allergen A substance that causes an allergic reaction.

allergic reaction The body's exaggerated immune response to an internal or surface agent.

alpha A type of energy that is emitted from a strong radiologic source; it is the least harmful penetrating type of radiation and cannot travel more than a few inches or penetrate most objects.

alpha-adrenergic receptors Portions of the nervous system that, when stimulated, can cause constriction of blood vessels.

altered mental status Any deviation from alert and oriented to person, place, time, and event, or any deviation from a patient's normal baseline mental status; may signal disease in the central nervous system or elsewhere in the body.

alveolar minute volume The volume of air moved through the lungs in 1 minute minus the dead space; calculated by multiplying tidal volume (minus dead space) and respiratory rate.

alveolar ventilation The volume of air that reaches the alveoli. It is determined by subtracting the amount of dead space air from the tidal volume.

alveoli The air sacs of the lungs in which the exchange of oxygen and carbon dioxide takes place.

ambient temperature The temperature of the surrounding environment.

ambulance A specialized vehicle for treating and transporting sick and injured patients.

American Standard Safety System A safety system for large oxygen cylinders, designed to prevent the accidental attachment of a regulator to a cylinder containing the wrong type of gas.

Americans With Disabilities Act (ADA) Comprehensive legislation that is designed to protect people with disabilities against discrimination.

amniotic sac The fluid-filled, baglike membrane in which the fetus develops.

amputation An injury in which part of the body is completely severed.

anaerobic metabolism The metabolism that takes place in the absence of oxygen; the main by-product is lactic acid.

anaphylactic shock Severe shock caused by an allergic reaction.

anaphylaxis An extreme, life-threatening, systemic allergic reaction that may include shock and respiratory failure.

anatomic position The position of reference in which the patient stands facing forward, arms at the side, with the palms of the hands forward.

anemic Describes a condition in which the patient has too few red blood cells, resulting in a decreased ability to transport oxygen throughout the body via the bloodstream.

aneurysm An abnormal enlargement of the wall of a blood vessel that results from weakening of the vessel wall.

angina pectoris Transient (short-lived) chest discomfort caused by partial or temporary blockage of blood flow to the heart muscle; also called *angina*.

angioedema Localized areas of swelling beneath the skin, often around the eyes and lips, but it can also involve other body areas as well.

anisocoria Naturally occurring uneven pupil size.

antagonist A medication that binds to a receptor and blocks other medications.

anterior The front surface of the body; the side facing you in the standard anatomic position.

anterograde (posttraumatic) amnesia Inability to remember events after an injury.

anthrax A disease caused by deadly bacteria (*Bacillus anthracis*) that lay dormant in a spore (protective shell); the germ is released from the spore when exposed to the optimal temperature and moisture. The routes of entry are inhalation, cutaneous, and gastrointestinal (from consuming food that contains spores).

antidote A substance that is used to neutralize or counteract a poison.

Antidote Treatment Nerve Agent Auto-Injector (ATNAA) A nerve agent antidote kit containing atropine and pralidoxime chloride; delivered as a single dose through one needle.

antivenin A serum that counteracts the effect of venom from an animal or insect.

aorta The main artery leaving the left side of the heart, which receives blood from the left ventricle and delivers it to all the other arteries that carry blood to the tissues of the body.

aortic aneurysm A weakness in the wall of the aorta that makes it susceptible to rupture.

aortic valve The one-way valve that lies between the left ventricle and the aorta and keeps blood from flowing back into the left ventricle after the left ventricle ejects its blood into the aorta; one of four heart valves.

apex (apices) The pointed extremity of a conical structure.

Apgar score A scoring system for assessing the status of a newborn that assigns a number value to each of five areas.

aphasia The inability to understand and/or produce speech.

apnea Absence of spontaneous breathing.

apneic oxygenation A technique in which oxygen administered via a high-flow nasal cannula is left in place during an intubation attempt, allowing for continuous oxygen delivery into the airways during all phases of the procedure.

apparent life-threatening event (ALTE) An event that causes unresponsiveness, cyanosis, and apnea in an infant, who then resumes breathing with stimulation.

appendicitis Inflammation or infection of the appendix.

appendicular skeleton The portion of the skeletal system that comprises the arms, legs, pelvis, and shoulder girdle.

appendix A small, tubular structure that is attached to the lower border of the cecum in the lower right quadrant of the abdomen.

applied ethics The manner in which principles of ethics are incorporated into professional conduct.

arterial air embolism Air bubbles in the arterial blood vessels.

arterioles The smallest branches of arteries leading to the vast network of capillaries.

arteriosclerosis A disease that causes the arteries to thicken, harden, and calcify.

artery A blood vessel, consisting of three layers of tissue and smooth muscle, that carries blood away from the heart.

articular cartilage A pearly white layer of specialized cartilage covering the articular surfaces (contact surfaces on the ends) of bones in synovial joints.

artifact A tracing on an ECG that is the result of interference, such as patient movement, rather than the heart's electrical activity.

ascites Fluid in the abdomen.

aseptic technique A technique that helps ensure pathogens are not introduced anywhere in the procedure, achieved by sterilization of equipment, or use of antiseptics or disinfectants; often used for fast, invasive procedures such as starting an IV line.

aspiration In the context of airway, the introduction of vomitus or other foreign material into the lungs.

aspirin (acetylsalicylic acid or ASA) A medication that is an antipyretic (reduces fever), analgesic (reduces pain), anti-inflammatory (reduces inflammation), and a potent inhibitor of platelet aggregation (clumping).

assault Unlawfully placing a patient in fear of bodily harm.

asthma An acute spasm of the smaller air passages, called bronchioles, associated with excessive mucus production and with swelling of the mucous lining of the respiratory passages.

asystole The complete absence of all heart electrical activity.

ataxic respirations Irregular, ineffective respirations that may or may not have an identifiable pattern.

atelectasis Collapse of the alveolar air spaces of the lungs.

atherosclerosis A disorder in which cholesterol and calcium build up inside the walls of the blood vessels, forming plaque, eventually leading to a partial or complete blockage of blood flow.

atrium One of two (right and left) upper chambers of the heart. The right receives blood from the vena cava and delivers it to the right ventricle. The left receives blood from pulmonary veins and delivers it to the left ventricle.

aura A sensation experienced before a seizure; serves as a warning sign that a seizure is about to occur.

auscultate To listen to sounds within an organ with a stethoscope.

autism spectrum disorder (ASD) A group of complex disorders of brain development, characterized by difficulties in social interaction, repetitive behaviors, and verbal and nonverbal communication.

automated external defibrillator (AED) A device that detects treatable life-threatening cardiac arrhythmias (ventricular fibrillation and ventricular tachycardia) and delivers the appropriate electrical shock to the patient.

automatic transport ventilator (ATV) A ventilation device attached to a control box that allows the variables of ventilation to be set. It frees the EMT to perform other tasks while the patient is being ventilated.

automaticity The ability of cardiac muscle cells to contract without stimulation from the nervous system.

autonomic nervous system The part of the nervous system that regulates involuntary activities of the body, such as heart rate, blood pressure, and digestion of food.

AVPU scale A method of assessing the level of consciousness by determining whether the patient is awake and alert, responsive to verbal stimuli or pain, or unresponsive; used principally early in the assessment process.

avulsion An injury in which soft tissue is torn completely loose or is hanging as a flap.

axial loading injuries Injuries in which load is applied along the vertical or longitudinal axis of the spine, which results in load being transmitted along the entire length of the vertebral column; for example, falling from a height and landing on the feet in an upright position.

axial skeleton The part of the skeleton comprising the skull, spinal column, and rib cage.

B-NICE A memory device to recall the types of weapons of mass destruction: biologic, nuclear, incendiary, chemical, and explosive.

backboard A long, flat board made of rigid, rectangular material that is used to provide support to a patient who is suspected of having a hip, pelvic, spinal, or lower extremity injury; also called a spine board, trauma board, and longboard.

bacteria Microorganisms that reproduce by binary fission. These single-cell creatures reproduce rapidly. Some can form spores (encysted variants) when environmental conditions are harsh.

bacterial vaginosis An overgrowth of bacteria in the vagina; characterized by itching, burning, or pain, and possibly a “fishy” smelling discharge.

bag-valve mask (BVM) A device with a one-way valve and a face mask attached to a ventilation bag; when attached to a reservoir and connected to oxygen, it delivers more than 90% supplemental oxygen.

ball-and-socket joint A joint that allows internal and external rotation, as well as bending.

bariatrics A branch of medicine concerned with the management (prevention or control) of obesity and allied diseases.

barotrauma Injury caused by pressure to enclosed body surfaces, for example, from too much pressure in the lungs.

barrier device A protective item, such as a pocket mask with a valve, that limits exposure to a patient’s body fluids.

base station Any radio hardware containing a transmitter and receiver that is located in a fixed place.

basic life support (BLS) Noninvasive emergency lifesaving care that is used to treat medical conditions, including airway obstruction, respiratory arrest, and cardiac arrest.

basilar skull fractures Usually occur following diffuse impact to the head (such as falls, motor vehicle crashes); generally result from extension of a linear fracture to the base of the skull and can be difficult to diagnose with a radiograph.

basket stretcher A rigid stretcher commonly used in technical and water rescues that surrounds and supports the patient yet allows water to drain through holes in the bottom; also called a Stokes litter.

battery Unlawfully touching a patient or providing emergency care without consent.

Battle sign Bruising behind an ear over the mastoid process that may indicate a skull fracture.

behavior How a person functions or acts in response to his or her environment.

behavioral crisis The point at which a person's reactions to events interfere with activities of daily living; this becomes a psychiatric emergency when it causes a major life interruption, such as attempted suicide.

bends A painful condition seen in divers who ascend too quickly, in which gas, especially nitrogen, forms bubbles in blood vessels and other tissues; also called decompression sickness.

beta A type of energy that is emitted from a strong radiologic source; is slightly more penetrating than alpha and requires a layer of clothing to stop it.

beta-adrenergic receptors Portions of the nervous system that, when stimulated, can cause an increase in the force of contraction of the heart, an increased heart rate, and bronchial dilation.

biceps The large muscle that covers the front of the humerus.

bilateral A body part or condition that appears on both sides of the midline.

bile ducts The ducts that convey bile between the liver and the intestine.

bills of lading The shipping papers used for transport of chemicals over roads and highways; also referred to as freight bills.

bioethics The study of ethics related to issues that arise in health care.

birth canal The vagina and cervix.

blanch To turn white.

blind spots Areas of the road that are blocked from your view by your vehicle or mirrors.

blood pressure (BP) The pressure that the blood exerts against the walls of the arteries as it passes through them.

bloodborne pathogens Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus and human immunodeficiency virus (HIV).

bloody show A small amount of blood in the vagina that appears at the beginning of labor and may include a plug of pinktinged mucus that is discharged when the cervix begins to dilate.

blow-out fracture A fracture of the orbit or of the bones that support the floor of the orbit.

blunt trauma An impact on the body by objects that cause injury without penetrating soft tissues or internal organs and cavities.

body mechanics The relationship between the body's anatomical structures and the physical forces associated with lifting, moving, and carrying; the ways in which the body moves to achieve a specific action.

botulinum Produced by bacteria, this is the most potent neurotoxin known. When introduced into the body, this neurotoxin affects the nervous system's ability to function and causes botulism.

brachial artery The major vessel in the upper extremities that supplies blood to the arm.

bradycardia A slow heart rate, less than 60 beats/min.

bradypnea Slow respiratory rate; in a child it is an ominous sign that indicates impending respiratory arrest.

brain The controlling organ of the body and center of consciousness; functions include perception, control of reactions to the environment, emotional responses, and judgment.

brain stem The area of the brain between the spinal cord and cerebrum, surrounded by the cerebellum; controls functions that are necessary for life, such as respiration.

breach of confidentiality Disclosure of information without proper authorization.

breath sounds An indication of air movement in the lungs, usually assessed with a stethoscope.

breath-holding syncope Loss of consciousness caused by a decreased breathing stimulus.

breech presentation A delivery in which the buttocks come out first.

bronchial breath sounds Normal breath sounds made by air moving through the bronchi.

bronchioles Subdivision of the smaller bronchi in the lungs; made of smooth muscle and dilate or constrict in response to various stimuli.

bronchiolitis Inflammation of the bronchioles that usually occurs in children younger than 2 years and is often caused by the respiratory syncytial virus.

bronchitis An acute or chronic inflammation of the lung that may damage lung tissue; usually associated with cough and production of sputum and, depending on its cause, sometimes fever.

buboes Enlarged lymph nodes (up to the size of a tennis ball) that are characteristic in people infected with the bubonic plague.

bubonic plague Bacterial infection that affects the lymphatic system. It is transmitted by infected rodents and fleas and characterized by acute malaise, fever, and the formation of tender, enlarged, inflamed lymph nodes that appear as lesions, called buboes. Also called the Black Death.

bulk storage containers Any container other than nonbulky storage containers such as fixed tanks, highway cargo tanks, rail tank cars, totes, and intermodal tanks. These are typically found in manufacturing facilities and are often surrounded by a secondary containment system to help control an accidental release.

burns Injuries in which soft-tissue damage occurs as a result of thermal heat, frictional heat, toxic chemicals, electricity, or nuclear radiation.

calcaneus The heel bone.

capillaries The small blood vessels that connect arterioles and venules; various substances pass through capillary walls, into and out of the interstitial fluid, and then on to the cells.

capillary refill A test that evaluates distal circulatory system function by squeezing (blanching) blood from an area such as a nail bed and watching the speed of its return after releasing the pressure.

capillary vessels The tiny blood vessels between the arterioles and venules that permit transfer of oxygen, carbon dioxide, nutrients, and waste between body tissues and the blood.

capnography A noninvasive method to quickly and efficiently provide information on a patient's ventilatory status, circulation, and metabolism; effectively measures the concentration of carbon dioxide in expired air over time.

capnometry The use of a capnometer, a device that measures the amount of expired carbon dioxide.

carbon dioxide Carbon dioxide is a component of air and typically makes up 0.3% of air at sea level; also a waste product exhaled during expiration by the respiratory system.

carbon dioxide retention A condition characterized by a chronically high blood level of carbon dioxide in which the respiratory center no longer responds to high blood levels of carbon dioxide.

carbon monoxide An odorless, colorless, tasteless, and highly poisonous gas that results from incomplete oxidation of carbon in combustion.

carboys Glass, plastic, or steel containers, ranging in volume from 5 to 15 gallons (19 to 57 L).

cardiac arrest When the heart fails to generate effective and detectable blood flow; pulses are not palpable in cardiac arrest, even if muscular and electrical activity continues in the heart.

cardiac muscle The heart muscle.

cardiac output (CO) A measure of the volume of blood circulated by the heart in 1 minute, calculated by multiplying the stroke volume by the heart rate.

cardiac tamponade (pericardial tamponade) Compression of the heart as the result of buildup of blood or other fluid in the pericardial sac, leading to decreased cardiac output.

cardiogenic shock A state in which not enough oxygen is delivered to the tissues of the body, caused by low output of blood from the heart. It can be a severe complication of a large acute myocardial infarction, as well as other conditions.

cardiopulmonary resuscitation (CPR) The combination of chest compressions and rescue breathing used to establish adequate ventilation and circulation in a patient who is not breathing and has no pulse.

carina Point at which the trachea bifurcates (divides) into the left and right mainstem bronchi.

carotid artery The major artery that supplies blood to the head and brain.

cartilage The smooth connective tissue that forms the support structure of the skeletal system and provides cushioning between bones; also forms the nasal septum and portions of the outer ear.

casualty collection area An area set up by physicians, nurses, and other hospital staff near a major disaster scene where patients can receive further triage and medical care.

cataracts Clouding of the lens of the eye or its surrounding transparent membranes.

cavitation A phenomenon in which speed causes a bullet to generate pressure waves, which cause damage distant from the bullet's path.

cecum The first part of the large intestine, into which the ileum opens.

cellular telephone A low-power portable radio that communicates through an interconnected series of repeater stations called "cells."

Centers for Disease Control and Prevention (CDC) The primary federal agency that conducts and supports public health activities in the United States. It is part of the US Department of Health and Human Services.

central nervous system (CNS) The brain and spinal cord.

central pulses Pulses that are closest to the core (central) part of the body where the vital organs are located; include the carotid, femoral, and apical pulses.

cerebellum One of the three major subdivisions of the brain, sometimes called the little brain; coordinates the various activities of the brain, particularly fine body movements.

cerebral edema Swelling of the brain.

cerebral palsy A group of disorders characterized by poorly controlled body movement.

cerebrospinal fluid (CSF) Fluid produced in the ventricles of the brain that flows in the subarachnoid space and bathes the meninges.

cerebrovascular accident (CVA) An interruption of blood flow to the brain that results in the loss of brain function; also called a stroke.

cerebrum The largest part of the three subdivisions of the brain, sometimes called the gray matter; made up of several lobes that control movement, hearing, balance, speech, visual perception, emotions, and personality.

certification A process in which a person, an institution, or a program is evaluated and recognized as meeting certain predetermined standards to provide safe and ethical patient care.

cervical spine The portion of the spinal column consisting of the first seven vertebrae that lie in the neck.

cervix The lower third, or neck, of the uterus; it is the narrowest portion of the uterus and opens into the vagina.

channel An assigned frequency or frequencies that are used to carry voice and/or data communications.

Chemical Transportation Emergency Center (CHEMTREC) An agency that assists emergency responders in identifying and handling hazardous materials transport incidents.

chemoreceptors Monitor the levels of O_2, CO_2, and the pH of the cerebrospinal fluid and then provide feedback to the respiratory centers to modify the rate and depth of breathing based on the body's needs at any given time.

chest compression fraction The total percentage of time during a resuscitation attempt in which active chest compressions are being performed.

chief complaint The reason a patient called for help; also, the patient's response to questions such as "What's wrong?" or "What happened?"

child abuse A general term applying to all forms of abuse and neglect of children.

chlamydia A sexually transmitted disease caused by the bacterium *Chlamydia trachomatis*.

chlorine (Cl) The first chemical agent ever used in warfare. It has a distinct odor of bleach and creates a green haze when released as a gas. Initially it produces upper airway irritation and a choking sensation.

cholecystitis Inflammation of the gallbladder.

chordae tendineae Thin bands of fibrous tissue that attach to the valves in the heart and prevent them from inverting.

chronic bronchitis Irritation of the major lung passageways from infectious disease or irritants such as smoke.

chronic obstructive pulmonary disease (COPD) A slow process of dilation and disruption of the airways and alveoli caused by chronic bronchial obstruction.

chyme The substance that leaves the stomach. It is a combination of all of the eaten foods with added stomach acids.

circulatory system The complex arrangement of connected tubes, including the arteries, arterioles, capillaries, venules, and veins, that moves blood, oxygen, nutrients, carbon dioxide, and cellular waste throughout the body.

clavicle The collar bone; it is lateral to the sternum and anterior to the scapula.

clean technique A technique in which the amount of pathogens or unclean materials picked up or transferred is minimized through the use of routine handwashing, nonsterile protective gloves, etc.

cleaning The process of removing dirt, dust, blood, or other visible contaminants from a surface.

closed abdominal injury An injury in which there is soft-tissue damage inside the body but the skin remains intact.

closed chest injury An injury to the chest in which the skin is not broken, usually caused by blunt trauma.

closed fracture Any break in a bone in which the overlying skin is not broken.

closed head injury Injury in which the brain has been injured but the skin has not been broken and there is no obvious bleeding.

closed incident An incident that is contained; all casualties are accounted for.

closed injuries Injuries in which damage occurs beneath the skin or mucous membrane but the surface of the skin remains intact.

closed-ended questions Questions that can be answered in short or single word responses.

coagulation The formation of a clot to plug an opening in an injured blood vessel and stop bleeding.

coccyx The last three or four vertebrae of the spine; the tail bone.

cold zone A safe area at a hazardous materials incident for the agencies involved in the operations. The incident commander, the command post, EMS providers, and other support functions necessary to control the incident should be located in this zone. Also referred to as the clean zone or the support zone.

colostomy A surgical procedure to create an opening (stoma) between the colon and the surface of the body.

coma A state of profound unconsciousness from which the patient cannot be roused.

combining vowel The vowel used to combine two word roots or a word root and suffix.

command In incident command, the position that oversees the incident, establishes the objectives and priorities, and develops a response plan.

command post The location of the incident commander at the scene of an emergency and where command, coordination, control, and communication are centralized.

commotio cordis A blunt chest injury caused by a sudden, direct blow to the chest that occurs only during the critical portion of a person's heartbeat.

communicable disease A disease that can be spread from one person or species to another.

communication The transmission of information to another person—verbally or through body language.

community paramedicine A health care model in which experienced paramedics receive advanced training to equip them to provide additional services in the prehospital environment, such as health evaluations, monitoring of chronic illnesses or conditions, and patient advocacy.

compartment syndrome Swelling within a confined anatomic compartment that produces dangerous pressure, characterized by extreme pain, decreased pain sensation, pain on stretching of affected muscles, and decreased power.

compensated shock The early stage of shock, in which the body can still compensate for blood loss.

compensatory damages Damages awarded in a civil lawsuit that are intended to restore the plaintiff to the same condition that he or she was in prior to the incident.

competent Able to make rational decisions about personal well-being.

complex access Entry that requires special tools and training and includes the use of force.

compliance The ability of the alveoli to expand when air is drawn in during inhalation.

concealment The use of objects to limit a person's visibility of you.

concussion A temporary loss or alteration of part or all of the brain's abilities to function without actual physical damage to the brain.

conduction The loss of heat by direct contact (eg, when a body part comes into contact with a colder object).

conductive hearing loss Hearing loss caused by a faulty transmission of sound waves.

congestive heart failure (CHF) A disorder in which the heart loses part of its ability to effectively pump blood, usually as a result of damage to the heart muscle and usually resulting in a backup of fluid into the lungs.

conjunctiva The delicate membrane that lines the eyelids and covers the exposed surface of the eye.

conjunctivitis Inflammation of the conjunctiva.

consent In the context of EMS, permission to render care.

contact burn A burn caused by direct contact with a hot object.

contact hazard The term used to describe danger posed by a chemical whose primary route of entry into the body is through the skin; posed by a hazardous agent that gives off very little or no vapors; also called a skin hazard.

contagious An infectious disease that spreads from one human to another; communicable.

container Any vessel or receptacle that holds material, including storage vessels, pipelines, and packaging.

contamination The presence of infectious organisms on or in objects such as dressings, water, food, needles, wounds, or a patient's body; also, the presence of foreign bodies such as dirt, gravel, or metal.

continuous positive airway pressure (CPAP) A method of ventilation used primarily in the treatment of critically ill patients with respiratory distress; can prevent the need for endotracheal intubation.

continuous quality improvement (CQI) A system of internal and external reviews and audits of all aspects of an EMS system.

continuum of care The concept of consistent patient care across the entire health care team from first patient contact to patient discharge; working together with a unified goal, results in improved individual and team performance, better patient and provider safety, and improved patient outcome.

contraindications Conditions that make a particular medication or treatment inappropriate because it would not help, or may actually harm, a patient.

contributory negligence A legal defense that may be raised when the defendant feels that the conduct of the plaintiff somehow contributed to any injuries or damages that were sustained by the plaintiff.

control zones Areas at a hazardous materials incident that are designated as hot, warm, or cold, based on safety issues and the degree of hazard found there.

contusion A bruise from an injury that causes bleeding beneath the skin without breaking the skin; also see ecchymosis.

convection The loss of body heat caused by air movement (eg, a breeze blowing across the body).

conventional reasoning A type of reasoning in which a child looks for approval from peers and society.

core temperature The temperature of the central part of the body (eg, the heart, lungs, and vital organs).

cornea The transparent tissue layer in front of the pupil and iris of the eye.

coronal plane An imaginary plane where the body is divided into front and back parts.

coronary arteries The blood vessels that carry blood and nutrients to the heart muscle.

coup-contrecoup brain injury A brain injury that occurs when force is applied to the head and energy transmission through brain tissue causes injury on the opposite side of original impact; coup injury occurs at the point of impact; contrecoup injury occurs on the opposite side of impact, as the brain rebounds.

cover The tactical use of an impenetrable barrier for protection.

covert An act in which the public safety community generally has no prior knowledge of the time, location, or nature of the attack.

CPR board A device that provides a firm surface under the patient's torso.

crackles Crackling, rattling breath sounds signaling fluid in the air spaces of the lungs; formerly called rales.

cranium The area of the head above the ears and eyes; the skull. It contains the brain.

credentialing An established process to determine the qualifications necessary to be allowed to practice a particular profession, or to function as an organization.

crepitus A grating or grinding sensation caused by fractured bone ends or joints rubbing together; also air bubbles under the skin that produce a crackling sound or crinkly feeling.

crew resource management (CRM) A set of procedures for use in environments where human error can have disastrous consequences. It empowers people within a team to communicate effectively with one another with a goal of improving team situational awareness, patient and crew safety, and overall communication.

cricoid cartilage A firm ridge of cartilage that forms the lower part of the larynx.

cricothyroid membrane A thin sheet of fascia that connects the thyroid and cricoid cartilages that make up the larynx.

critical incident stress management (CISM) A process that confronts the responses to critical incidents and defuses them, directing the emergency services personnel toward physical and emotional equilibrium.

cross-contamination Occurs when a person is contaminated by an agent as a result of coming into contact with another contaminated person.

croup An inflammatory disease of the upper respiratory system that may cause a partial airway obstruction and is characterized by a barking cough; usually seen in children.

crowning The appearance of the fetus's head at the vaginal opening during labor.

crush syndrome Significant metabolic derangement that develops when crushed extremities or body parts remain trapped for prolonged periods. This can lead to renal failure and death.

crushing injury An injury that occurs when a great amount of force is applied to the body.

cultural imposition When one person imposes his or her beliefs, values, and practices on another because he or she believes his or her ideals are superior.

cumulative stress reactions Prolonged or excessive stress.

cushion of safety Keeping a safe distance between your vehicle and any vehicles around you.

cyanide An agent that affects the body's ability to use oxygen. It is a colorless gas that has an odor similar to almonds. The effects begin on the cellular level and are very rapidly seen at the organ and system levels.

cyanosis A blue-gray skin color that is caused by a reduced level of oxygen in the blood.

cylinders Portable, compressed gas containers used to hold liquids and gases such as nitrogen, argon, helium, and oxygen. They have a range of sizes and internal pressures.

cystitis Inflammation of the bladder.

danger zone (hot zone) An area where people can be exposed to hazards such as electric wires, sharp metal edges, broken glass, toxic substances, lethal radiation, fire, or hazardous materials.

DCAP-BTLS A mnemonic for assessment in which each area of the body is evaluated for Deformities, Contusions, Abrasions, Punctures/penetrations, Burns, Tenderness, Lacerations, and Swelling.

dead space The portion of the tidal volume that does not reach the alveoli and thus does not participate in gas exchange; in some contexts, any portion of the airway that does contain air and cannot participate in gas exchange, such as the trachea and bronchi.

decay A natural process in which a material that is unstable attempts to stabilize itself by changing its structure.

deceleration The slowing of an object.

decision-making capacity Ability to understand and process information and make a choice regarding appropriate medical care.

decompensated shock The late stage of shock when blood pressure is falling.

decompression sickness A painful condition seen in divers who ascend too quickly, in which gas, especially nitrogen, forms bubbles in blood vessels and other tissues; see bends.

decontaminate To remove or neutralize radiation, chemical, or other hazardous material from clothing, equipment, vehicles, and personnel.

decontamination The process of removing or neutralizing radioactive, chemical, or other hazardous material from clothing, equipment, vehicles, patients, and responders and properly disposing of it.

decontamination area The designated area in a hazardous materials incident where all patients and responders must be decontaminated before going to another area.

decubitus ulcers Sores caused by the pressure of skin against a surface for long periods; can range from a pink discoloration of the skin to a deep wound that may invade into bone or organs; also known as bedsores.

dedicated line A special telephone line that is used for specific point-to-point communications; also known as a *hotline*.

deep Farther inside the body and away from the skin.

deep venous thrombosis The formation of a blood clot within the larger veins of an extremity, typically following a period of prolonged immobilization.

defamation The communication of false information about a person that is damaging to that person's reputation or standing in the community.

defibrillate To shock a fibrillating (chaotically beating) heart with specialized electric current in an attempt to restore a normal, rhythmic beat.

dehydration Loss of water from the tissues of the body.

delayed stress reactions Reactions to stress that occur after a stressful situation.

delirium A sudden change in mental status that is generally acute and reversible, characterized by disorientation, inability to focus, inattention, inability to think logically, memory loss, striking changes in personality and affect, hallucinations, delusions, or a decreased level of consciousness.

delirium tremens (DTs) A severe withdrawal syndrome seen in alcoholics who are deprived of ethyl alcohol; characterized by restlessness, fever, sweating, disorientation, agitation, and seizures; can be fatal if untreated.

dementia The slow onset of progressive disorientation, shortened attention span, and loss of cognitive function; this condition is generally chronic and irreversible.

demobilization The process of directing responders to return to their facilities when work at a disaster or masscasualty incident has finished, at least for those particular responders.

dependent edema Swelling in the part of the body closest to the ground, caused by collection of fluid in the tissues; a possible sign of congestive heart failure.

dependent lividity Blood settling to the lowest point of the body, causing discoloration of the skin; a definitive sign of death.

depositions Oral questions asked of parties and witnesses under oath.

depression A persistent mood of sadness, despair, and discouragement; may be a symptom of many different mental and physical disorders, or it may be a disorder on its own.

dermis The inner layer of the skin, containing hair follicles, sweat glands, nerve endings, and blood vessels.

designated officer The individual in the department who is charged with the responsibility of managing exposures and infection control issues.

developmental disability Insufficient development of the brain, resulting in some level of dysfunction or impairment.

diabetes mellitus A metabolic disorder in which the ability to metabolize carbohydrates (sugars) is impaired, usually because of a lack of insulin.

diabetic ketoacidosis (DKA) A form of hyperglycemia in uncontrolled diabetes in which certain acids accumulate when insulin is not available.

diamond carry A carrying technique in which one provider is located at the head end of the stretcher or backboard, one at the foot end, and one at each side of the patient; each of the two providers at the sides uses one hand to support the stretcher or backboard so that all are able to face forward as they walk.

diaphoretic Characterized by light or profuse sweating.

diaphragm A muscular dome that forms the undersurface of the thorax, separating the chest from the abdominal cavity. Contraction of this (and the chest wall muscles) brings air into the lungs. Relaxation allows air to be expelled from the lungs.

diastole The relaxation, or period of relaxation, of the heart, especially of the ventricles.

diastolic pressure The pressure that remains in the arteries during the relaxing phase of the heart's cycle (diastole) when the left ventricle is at rest.

diffusion A process in which molecules move from an area of higher concentration to an area of lower concentration.

digestion The processing of food that nourishes the individual cells of the body.

dilation Widening of a tubular structure such as a coronary artery.

diphtheria An infectious disease in which a membrane forms, lining the pharynx; this lining can severely obstruct the passage of air into the larynx.

direct contact Exposure or transmission of a communicable disease from one person to another by physical contact.

direct ground lift A lifting technique that is used for patients who are found lying supine on the ground with no suspected spinal injury.

direct laryngoscopy Visualization of the airway with a laryngoscope.

dirty bomb Name given to an explosive radiologic dispersal device.

disaster A widespread event that disrupts community resources and functions, in turn threatening public safety, citizens' lives, and property.

discovery The phase of a civil lawsuit where the plaintiff and defense obtain information from each other that will enable the attorneys to have a better understanding of the case, which will assist in negotiating a possible settlement or in preparing for trial. This phase includes depositions, interrogatories, and demands for production of records.

disease vector An animal that spreads a disease, once infected, to another animal.

disinfection The killing of pathogenic agents by direct application of chemicals.

dislocation Disruption of a joint in which ligaments are damaged and the bone ends are no longer in contact.

displaced fracture A fracture in which bone fragments are separated from one another, producing deformity in the limb.

dissecting aneurysm A condition in which the inner layers of an artery, such as the aorta, become separated, allowing blood (at high pressures) to flow between the layers.

dissemination The means by which a terrorist will spread an agent, for example, by poisoning the water supply or aerosolizing the agent into the air or ventilation system of a building.

distal Further from the trunk or nearer to the free end of the extremity.

distracting injury Any injury that prevents the patient from noticing other injuries he or she may have, even severe injuries; for example, a painful femur or tibia fracture that prevents the patient from noticing back pain associated with a spinal fracture.

distributive shock A condition that occurs when there is widespread dilation of the small arterioles, small venules, or both.

diverticulitis Inflammation in small pockets at weak areas in the muscle walls.

diving reflex The slowing of the heart rate caused by submersion in cold water.

do not resuscitate (DNR) orders Written documentation by a physician giving permission to medical personnel not to attempt resuscitation in the event of cardiac arrest.

documentation The recorded portion of the EMT's patient interaction, either written or electronic. This becomes part of the patient's permanent medical record.

domestic terrorism Terrorism that is carried out by people in their own country.

dorsal The posterior surface of the body, including the back of the hand.

dorsalis pedis artery The artery on the anterior surface of the foot between the first and second metatarsals.

dose The amount of medication given on the basis of the patient's size and age.

Down syndrome A genetic chromosomal defect that can occur during fetal development and that results in intellectual impairment as well as certain physical characteristics, such as a round head with a flat occiput and slanted, wide-set eyes.

drag Resistance that slows a projectile, such as air.

drowning The process of experiencing respiratory impairment from submersion or immersion in liquid.

drums Barrel-like containers used to store a wide variety of substances, including food-grade materials, corrosives, flammable liquids, and grease. May be constructed of low-carbon steel, polyethylene, cardboard, stainless steel, nickel, or other materials.

DuoDote Auto-Injector A nerve agent antidote kit containing atropine and pralidoxime chloride; delivered as a single dose through one needle.

duplex The ability to transmit and receive simultaneously.

durable power of attorney for health care A type of advance directive executed by a competent adult that appoints another individual to make medical treatment decisions on his or her behalf, in the event that the person making the appointment loses decision-making capacity.

duty to act A medicolegal term relating to certain personnel who either by statute or by function have a responsibility to provide care.

dysarthria Slurred speech.

dysbarism injuries Any signs and symptoms caused by the difference between the surrounding atmospheric pressure and the total gas pressure in various tissues, fluids, and cavities of the body.

dyspnea Shortness of breath or difficulty breathing.

dysrhythmia An irregular or abnormal heart rhythm.

early adult A young adult age 19 to 40 years.

ecchymosis A buildup of blood beneath the skin that produces a characteristic blue or black discoloration as the result of an injury; also see contusion.

eclampsia Severe hypertension in a pregnant woman, resulting in seizures (convulsions).

ectopic pregnancy A pregnancy that develops outside the uterus, typically in a fallopian tube.

edema The presence of abnormally large amounts of fluid between cells in body tissues, causing swelling of the affected area.

elder abuse Any action on the part of an older person's family member, caregiver, or other associated person that takes advantage of the older person's person, property, or emotional state.

emancipated minor A person who is under the legal age in a given state but, because of other circumstances, is legally considered an adult.

embolus A blood clot or other substance in the circulatory system that travels to a blood vessel where it causes a blockage.

embryo The early stage of development after the fertilization of the egg (first 10 weeks).

emergency A serious situation, such as injury or illness that threatens the life or welfare of a person or group of people and requires immediate intervention.

emergency doctrine The principle of law that permits a health care provider to treat a patient in an emergency situation when the patient is incapable of granting consent because of an altered level of consciousness, disability, the effects of drugs or alcohol, or the patient's age.

emergency medical care Immediate care or treatment.

emergency medical dispatch (EMD) A system that assists dispatchers in selecting appropriate units to respond to a particular call for assistance and provides callers with vital instructions until the arrival of EMS crews.

emergency medical responder (EMR) The first trained professional, such as a police officer, firefighter, lifeguard, or other rescuer, to arrive at the scene of an emergency to provide initial medical assistance.

emergency medical services (EMS) A multidisciplinary system that represents the combined efforts of several professionals and agencies to provide prehospital emergency care to the sick and injured.

emergency medical technician (EMT) An individual who has training in basic life support, including automated external defibrillation, use of a definitive airway adjunct, and assisting patients with certain medications.

emergency move A move in which the patient is dragged or pulled from a dangerous scene before assessment and care are provided.

Emergency Response Guidebook (ERG) A preliminary action guide for first responders operating at a hazardous materials incident in coordination with the US Department of Transportation's labels and placards marking system. Jointly developed by the DOT, the Secretariat of Communications and Transportation of Mexico, and Transport Canada.

emesis Vomiting.

emphysema A disease of the lungs in which there is extreme dilation and eventual destruction of the pulmonary alveoli with poor exchange of oxygen and carbon dioxide; it is one form of chronic obstructive pulmonary disease.

EMT-administered medication Administration of a medication by the EMT directly to the patient.

endocrine glands Glands that secrete or release chemicals that are used inside the body.

endocrine system The complex message and control system that integrates many body functions, including the release of hormones; also regulates metabolism and maintains homeostasis.

endometrium The lining of the inside of the uterus.

end-tidal CO_2 The amount of carbon dioxide present at the end of an exhaled breath.

endotracheal (ET) intubation Insertion of an endotracheal tube directly through the larynx between the vocal cords and into the trachea to maintain and protect an airway.

enteral medications Medications that enter the body through the digestive system.

entrapment To be caught (trapped) within a vehicle, room, or container with no way out or to have a limb or other body part trapped.

envenomation The act of injecting venom.

enzymes Substances designed to speed up the rate of specific biochemical reactions.

epidemic Occurs when new cases of a disease in a human population substantially exceed the number expected based on recent experience.

epidermis The outer layer of skin, which is made up of cells that are sealed together to form a watertight protective covering for the body.

epidural hematoma An accumulation of blood between the skull and the dura mater.

epiglottis A thin, leaf-shaped valve that allows air to pass into the trachea but prevents food and liquid from entering.

epiglottitis A disease in which the epiglottis becomes inflamed and enlarged and may cause an upper airway obstruction.

epilepsy A disorder in which abnormal electrical discharges occur in the brain, causing seizure and possible loss of consciousness.

epinephrine A substance produced by the body (commonly called adrenaline) that has a vital role in the function of the sympathetic nervous system; also, a drug produced by pharmaceutical companies, that increases pulse rate and blood pressure; the drug of choice for an anaphylactic reaction. It also eases breathing problems by decreasing muscle tone of the bronchiole tree.

epistaxis A nosebleed.

esophageal intubation The improper placement of an advanced airway device into the esophagus rather than into the trachea.

esophagus A collapsible tube that extends from the pharynx to the stomach; muscle contractions propel food and liquids through it to the stomach.

ethics The philosophy of right and wrong, of moral duties, and of ideal professional behavior.

ethnocentrism When a person considers his or her own cultural values as more important when interacting with people of a different culture.

eustachian tube A branch of the internal auditory canal that connects the middle ear to the oropharynx.

evaporation The conversion of water or another fluid from a liquid to a gas.

evisceration The displacement of organs outside of the body.

excited delirium A serious behavioral condition in which a person exhibits agitated behavior combined with disorientation, hallucinations, or delusions; also called agitated delirium or exhaustive mania.

exhalation The passive part of the breathing process in which the diaphragm and the intercostal muscles relax, forcing air out of the lungs.

expiratory reserve volume The amount of air that can be exhaled following a normal exhalation; average volume is about 1,200 mL in the average adult man.

exposure A situation in which a person has had contact with blood, body fluids, tissues, or airborne particles in a manner that suggests disease transmission may occur.

expressed consent A type of consent in which a patient gives verbal or nonverbal authorization for provision of care or transport.

extension The straightening of a joint.

external auditory canal The ear canal; leads to the tympanic membrane.

external respiration The exchange of gases between the lungs and the blood cells in the pulmonary capillaries; also called pulmonary respiration.

extremity lift A lifting technique that is used for patients who are supine or in a sitting position with no suspected extremity or spinal injuries.

extrication Removal of a patient from entrapment or a dangerous situation or position, such as removal from a wrecked vehicle, industrial incident, or collapsed building.

extrication supervisor In incident command, the person appointed to determine the type of equipment and resources needed for a situation involving extrication or special rescue; also called the rescue officer.

eyes forward position A head position in which the patient's eyes are looking straight ahead and the head and torso are in line.

fallopian tubes The tubes that extend from the uterus to the region of the ovary and through which the ovum passes from the ovary to the uterus; the primary location for fertilization of the ovum.

false imprisonment The confinement of a person without legal authority or the person's consent.

false motion Movement that occurs in a bone at a point where there is no joint, indicating a fracture; also called free movement.

fascia The fiberlike connective tissue that covers arteries, veins, tendons, and ligaments.

febrile seizures Seizures that result from sudden high fevers; most often seen in children.

Federal Communications Commission (FCC) The federal agency that has jurisdiction over interstate and international telephone and telegraph services and satellite communications, all of which may involve EMS activity.

femoral artery The major artery of the thigh, a continuation of the external iliac artery. It supplies blood to the lower abdominal wall, external genitalia, and legs. It can be palpated in the groin area.

femoral head The proximal end of the femur, articulating with the acetabulum to form the hip joint.

femur The thighbone; the longest and one of the strongest bones in the body.

fetal alcohol syndrome A condition caused by the consumption of alcohol by a pregnant woman; characterized by growth and physical problems, mental retardation, and a variety of congenital abnormalities.

fetus The developing, unborn infant inside the uterus, from 10 weeks after fertilization until birth.

fibula The outer and smaller bone of the two bones of the lower leg.

finance In incident command, the position in an incident responsible for accounting of all expenditures.

first-responder vehicles Specialized vehicles used to transport EMS equipment and personnel to the scenes of medical emergencies.

flail chest A condition in which three or more ribs are fractured in two or more places or in association with a fracture of the sternum so that a segment of the chest wall is effectively detached from the rest of the thoracic cage.

flame burn A burn caused by an open flame.

flank The region below the rib cage and above the hip.

flash burn A burn caused by exposure to very intense heat, such as in an explosion.

flexible stretcher A stretcher that is a rigid carrying device when secured around a patient but can be folded or rolled when not in use.

flexion The bending of a joint.

flutter valve A one-way valve that allows air to leave the chest cavity but not return; formed by taping three sides of an occlusive dressing to the chest wall, leaving the fourth side open as a valve; may also be part of a commercial vented occlusive dressing.

focused assessment A type of physical assessment typically performed on patients who have sustained nonsignificant mechanisms of injury or on responsive medical patients. This type of examination is based on the chief complaint and focuses on one body system or part.

fontanelles Areas where the neonate's or infant's skull has not fused together; usually disappear at approximately 18 months of age.

foodborne transmission The contamination of food or water with an organism than can cause disease.

foramen magnum A large opening at the base of the skull through which the brain connects to the spinal cord.

forcible restraint The act of physically preventing an individual from initiating any physical action.

four-person log roll The recommended procedure for moving a patient with a suspected spinal injury from the ground to a long backboard or other spinal immobilization device.

Fowler position An inclined position in which the head of the bed is raised.

fracture A break in the continuity of a bone.

freelancing When individual units or different organizations make independent and often inefficient decisions about the next appropriate action.

freight bills The shipping papers used for transport of chemicals along roads and highways; also referred to as bills of lading.

frontal bone The portion of the cranium that forms the forehead.

frostbite Damage to tissues as the result of exposure to cold; frozen or partially frozen body parts.

full-thickness (third-degree) burns Burns that affect all skin layers and may affect the subcutaneous layers, muscle, bone, and internal organs, leaving the area dry, leathery, and white, dark brown, or charred.

functional disorder A disorder in which there is no known physiologic reason for the abnormal functioning of an organ or organ system.

fundus The dome-shaped top of the uterus.

G agents Early nerve agents that were developed by German scientists in the period after World War I and into World War II. There are three such agents: sarin, soman, and tabun.

gag reflex A normal reflex mechanism that causes retching; activated by touching the soft palate or the back of the throat.

gallbladder A sac on the undersurface of the liver that collects bile from the liver and discharges it into the duodenum through the common bile duct.

gamma (x-ray) A type of energy that is emitted from a strong radiologic source that travels faster and has more energy than alpha and beta rays. These rays easily penetrate through the human body and require lead or several inches of concrete to prevent penetration.

gastric distention A condition in which air fills the stomach, often as a result of high volume and pressure during artificial ventilation.

gastroesophageal reflux disease (GERD) A condition in which the sphincter between the esophagus and the stomach opens, allowing stomach acid to move up into the esophagus, usually resulting in a burning sensation within the chest; also called acid reflux.

gel A semiliquid substance that is administered orally in capsule form or through plastic tubes.

general adaptation syndrome The body's response to stress that begins with an alarm response, followed by a stage of reaction and resistance, and then recovery or, if the stress is prolonged, exhaustion.

general impression The overall initial impression that determines the priority for patient care; based on the patient's surroundings, the mechanism of injury, signs and symptoms, and the chief complaint.

generalized tonic-clonic seizure A seizure that features rhythmic back-and-forth motion of an extremity and body stiffness, or extreme twitching of all of the body's muscles, that may last several minutes or more; formerly known as a grand mal seizure.

generic name The original chemical name of a medication (in contrast with one of its proprietary or trade names); the name is not capitalized.

genital system The reproductive system in men and women.

geriatrics The assessment and treatment of disease in someone who is 65 years or older.

germinal layer The deepest layer of the epidermis where new skin cells are formed.

gestational diabetes Diabetes that develops during pregnancy in women who did not have diabetes before pregnancy.

Glasgow Coma Scale (GCS) An evaluation tool used to determine level of consciousness, which evaluates and assigns point values (scores) for eye opening, verbal response, and motor response, which are then totaled; effective in helping predict patient outcomes.

glenoid fossa The part of the scapula that joins with the humeral head to form the glenohumeral joint.

globe The eyeball.

glottis The space in between the vocal cords that is the narrowest portion of the adult's airway; also called the glottic opening.

glucose One of the basic sugars; it is the primary fuel, in conjunction with oxygen, for cellular metabolism.

Golden Hour The time from injury to definitive care, during which treatment of shock and traumatic injuries should occur because survival potential is best; also called the Golden Period.

gonorrhea A sexually transmitted disease caused by *Neisseria gonorrhoeae*.

good air exchange A term used to distinguish the degree of distress in a patient with a mild airway obstruction. With good air exchange, the patient is still conscious and able to cough forcefully, although wheezing may be heard.

Good Samaritan laws Statutory provisions enacted by many states to protect citizens from liability for errors and omissions in giving good faith emergency medical care, unless there is wanton, gross, or willful negligence.

governmental immunity Legal doctrine that can protect an EMS provider from being sued or that may limit the amount of the monetary judgment that the plaintiff may recover; generally applies only to EMS systems that are operated by municipalities or other governmental entities.

greater trochanter A bony prominence on the proximal lateral side of the thigh, just below the hip joint.

gross negligence Conduct that constitutes a willful or reckless disregard for a duty or standard of care.

group In the context of EMS, a collection of individual health care providers working to help the patient.

grunting An "uh" sound heard during exhalation; reflects the child's attempt to keep the alveoli open; a sign of increased work of breathing.

guarding Involuntary muscle contractions (spasm) of the abdominal wall to minimize the pain of movement and protect the inflamed abdomen; a sign of peritonitis.

gum elastic bougie A flexible device that is inserted between the glottis under direct laryngoscopy; the endotracheal tube is threaded over the device, facilitating its entry into the trachea.

hair follicles The small organs that produce hair.

hallucinogen An agent that produce false perceptions in any one of the five senses.

hay fever An allergic response usually to outdoor airborne allergens such as pollen or sometimes indoor allergens such as dust mites or pet dander; also called allergic rhinitis.

hazardous materials Any substances that are toxic, poisonous, radioactive, flammable, or explosive and cause injury or death with exposure.

hazardous materials (HazMat) incident An incident in which a hazardous material is no longer properly contained and isolated.

head tilt–chin lift maneuver A combination of two movements to open the airway by tilting the forehead back and lifting the chin; not used for trauma patients.

health care directive A written document that specifies medical treatment for a competent patient, should he or she become unable to make decisions. Also known as an advance directive or a living will.

health care proxy A type of advance directive executed by a competent adult that appoints another individual to make medical treatment decisions on his or her behalf in the event that the person making the appointment loses decision-making capacity. Also known as a durable power of attorney for health care.

Health Insurance Portability and Accountability Act (HIPAA) Federal legislation passed in 1996. Its main effect in EMS is in limiting availability of patients' health care information and penalizing violations of patient privacy.

heart A hollow muscular organ that pumps blood throughout the body.

heart rate (HR) The number of heartbeats during a specific time (usually 1 minute).

heat cramps Painful muscle spasms usually associated with vigorous activity in a hot environment.

heat exhaustion A heat emergency in which a significant amount of fluid and electrolyte loss occurs because of heavy sweating; also called heat prostration or heat collapse.

heat stroke A life-threatening condition of severe hyperthermia caused by exposure to excessive natural or artificial heat, marked by warm, dry skin; severely altered mental status; and often irreversible coma.

hematemesis Vomited blood.

hematology The study and prevention of blood-related disorders.

hematoma A mass of blood that has collected within damaged tissue beneath the skin or in a body cavity.

hematuria Blood in the urine.

hemiparesis Weakness on one side of the body.

hemophilia A congenital abnormality in which the body is unable to produce clots, which results in uncontrollable bleeding.

hemopneumothorax The accumulation of blood and air in the pleural space of the chest.

hemoptysis The coughing up of blood.

hemorrhage Bleeding.

hemorrhagic stroke A type of stroke that occurs as a result of bleeding inside the brain.

hemostatic agent A chemical compound that slows or stops bleeding by assisting with clot formation.

hemothorax A collection of blood in the pleural cavity.

hepatitis Inflammation of the liver, usually caused by a viral infection, that causes fever, loss of appetite, jaundice, fatigue, and altered liver function.

hernia The protrusion of an organ or tissue through an abnormal body opening.

herpes simplex A common virus that is asymptomatic in 80% of people carrying it, but characterized by small blisters on the lips or genitals in symptomatic infections.

high-level disinfection The killing of pathogenic agents by using potent means of disinfection.

hinge joints Joints that can bend and straighten but cannot rotate; they restrict motion to one plane.

histamines Chemical substances released by the immune system in allergic reactions that are responsible for many of the symptoms of anaphylaxis, such as vasodilation.

history taking A step within the patient assessment process that provides detail about the patient's chief complaint and an account of the patient's signs and symptoms.

hollow organs Structures through which materials pass, such as the stomach, small intestines, large intestines, ureters, and urinary bladder.

homeostasis A balance of all systems of the body.

hormone A chemical substance produced by a gland that regulates the activity of organs and tissues; regulates many body functions, including metabolism, growth, and body temperature.

host The organism or individual that is attacked by the infecting agent.

hot zone The area immediately surrounding a hazardous materials spill or incident site that endangers life and health. All responders working in this zone must wear appropriate protective clothing and equipment. Entry requires approval by the incident commander or other designated officer.

human immunodeficiency virus (HIV) Acquired immunodeficiency syndrome (AIDS) is caused by HIV, which damages the cells in the body's immune system so that the body is unable to fight infection or certain cancers.

humerus The supporting bone of the upper arm.

hydroplaning Occurs when the tires of a vehicle are lifted off the road surface as a result of water "piling up" underneath them, making the vehicle feel as though it is floating.

hydrostatic pressure The pressure of water against the walls of its container.

hymenoptera A family of insects that includes bees, wasps, ants, and yellow jackets.

hypercarbia Increased carbon dioxide level in the bloodstream.

hyperglycemia An abnormally high blood glucose level.

hyperosmolar hyperglycemic nonketotic syndrome (HHNS) A life-threatening condition resulting from high blood glucose that typically occurs in older adults, and which causes altered mental status, dehydration, and organ damage.

hypertension Blood pressure that is higher than the normal range.

hypertensive emergency An emergency situation created by excessively high blood pressure, which can lead to serious complications such as stroke or aneurysm.

hyperthermia A condition in which the body core temperature rises to 101°F (38.3°C) or more.

hyperventilation Rapid or deep breathing that lowers the blood carbon dioxide level below normal; may lead to increased intrathoracic pressure, decreased venous return, and hypotension when associated with BVM use.

hyperventilation syndrome (panic attack) This syndrome occurs in the absence of other physical problems. The respirations of a person who is experiencing this syndrome may be as high as 40 shallow breaths/min or as low as only 20 very deep breaths/min.

hypnotic A sleep-inducing effect or agent.

hypoglycemia An abnormally low blood glucose level.

hypoperfusion A condition in which the circulatory system fails to provide sufficient circulation to maintain normal cellular functions; also called shock.

hypotension Blood pressure that is lower than the normal range.

hypothermia A condition in which the internal or core body temperature falls below 95°F (35°C).

hypovolemic shock A condition in which low blood volume, due to massive internal or external bleeding or extensive loss of body water, results in inadequate perfusion.

hypoxia A dangerous condition in which the body's tissues and cells do not have enough oxygen.

hypoxic drive A condition in which chronically low levels of oxygen in the blood stimulate the respiratory drive; seen in patients with chronic lung diseases.

ileostomy A surgical procedure to create an opening (stoma) between the small intestine and the surface of the body.

ileus Paralysis of the bowel, arising from any one of several causes; stops contractions that move material through the intestine.

ilium One of three bones that fuse to form the pelvic ring.

immune The body's ability to protect itself from acquiring a disease.

immune response The body's response to a substance perceived by the body as foreign.

immune system The body system that includes all of the structures and processes designed to mount a defense against foreign substances and disease-causing agents.

immunology The study of the body's immune system.

impaled objects Objects that penetrate the skin but remain in place.

impedance threshold device (ITD) A valve device placed between the endotracheal tube and a bag-valve mask that limits the amount of air entering the lungs during the recoil phase between chest compressions.

implied consent Type of consent in which a patient who is unable to give consent is given treatment under the legal assumption that he or she would want treatment.

in loco parentis Refers to the legal responsibility of a person or organization to take on some of the functions and responsibilities of a parent.

incident action plan An oral or written plan stating general objectives reflecting the overall strategy for managing an incident.

incident command system (ICS) A system implemented to manage disasters and mass-casualty incidents in which section chiefs, including finance, logistics, operations, and planning, report to the incident commander. Also referred to as the incident management system.

incident commander (IC) The individual who has overall command of the incident in the field.

incision A sharp, smooth cut in the skin.

incontinence Loss of bowel and/or bladder control; may be the result of a generalized seizure.

incubation The period of time between a person being exposed to an agent to the first time when symptoms appear.

index of suspicion Awareness that unseen life-threatening injuries or illness may exist.

indications The therapeutic uses for a specific medication.

indirect contact Exposure or transmission of disease from one person to another by contact with a contaminated object.

infancy The first year of life.

infant A young child age 1 month to 1 year.

infarction Death of a body tissue, usually caused by interruption of its blood supply.

infection The abnormal invasion of a host or host tissues by organisms such as bacteria, viruses, or parasites, with or without signs or symptoms of disease.

infection control Procedures to reduce transmission of infection among patients and health care personnel.

infectious disease A medical condition caused by the growth and spread of small, harmful organisms within the body.

inferior Below a body part or nearer to the feet.

inferior vena cava One of the two largest veins in the body; carries blood from the lower extremities and the pelvic and the abdominal organs to the heart.

influenza A virus that has crossed the animal/human barrier and infected humans and that kills thousands of people every year.

influenza type A Virus that has crossed the animal/human barrier and has infected humans, recently reaching a pandemic level with the H1N1 strain.

informed consent Permission for treatment given by a competent patient after the potential risks, benefits, and alternatives to treatment have been explained.

ingestion Swallowing; taking a substance by mouth.

inhalation The active, muscular part of breathing that draws air into the airway and lungs; also a medication delivery route.

inspiratory reserve volume The amount of air that can be inhaled after a normal inhalation; the amount of air that can be inhaled in addition to the normal tidal volume.

insulin A hormone produced by the islets of Langerhans (endocrine gland located throughout the pancreas) that enables glucose in the blood to enter cells; used in synthetic form to treat and control diabetes mellitus.

intermodal tanks Shipping and storage vessels that can be either pressurized or nonpressurized.

internal respiration The exchange of gases between the blood cells and the tissues.

international terrorism Terrorism that is carried out by people in a country other than their own; also known as cross-border terrorism.

interoperable communications system A communication system that uses voice-over-Internet-protocol (VoIP) technology to allow multiple agencies to communicate and transmit data.

interrogatories Written questions that the defense and plaintiff send to one another.

interstitial space The space in between the cells.

intervertebral disk The cushion that lies between two vertebrae.

intracerebral hematoma Bleeding within the brain tissue (parenchyma) itself; also referred to as an intraparenchymal hematoma.

intracranial pressure (ICP) The pressure within the cranial vault.

intramuscular (IM) injection An injection into a muscle; a medication delivery route.

intranasal (IN) A delivery route in which a medication is pushed through a specialized atomizer device called a mucosal atomizer device (MAD) into the naris.

intraosseous (IO) injection An injection into the bone; a medication delivery route.

intrapulmonary shunting Bypassing of oxygen-poor blood past nonfunctional alveoli to the left side of the heart.

intravenous (IV) injection An injection directly into a vein; a medication delivery route.

intravenous (IV) therapy The delivery of medication directly into a vein.

involuntary activities Actions of the body that are not under a person's conscious control.

involuntary muscle The muscle over which a person has no conscious control. It is found in many automatic regulating systems of the body.

ionizing radiation Energy that is emitted in the form of rays, or particles.

iris The muscle and surrounding tissue behind the cornea that dilate and constrict the pupil, regulating the amount of light that enters the eye; pigment in this tissue gives the eye its color.

ischemia A lack of oxygen that deprives tissues of necessary nutrients, resulting from partial or complete blockage of blood flow; potentially reversible because permanent injury has not yet occurred.

ischemic stroke A type of stroke that occurs when blood flow to a particular part of the brain is cut off by a blockage (eg, a blood clot) inside a blood vessel.

ischium One of three bones that fuse to form the pelvic ring.

jaundice Yellow skin or sclera that is caused by liver disease or dysfunction.

jaw-thrust maneuver Technique to open the airway by placing the fingers behind the angle of the jaw and bringing the jaw forward; used for patients who may have a cervical spine injury.

joint (articulation) The place where two bones come into contact.

joint capsule The fibrous sac that encloses a joint.

joint information center (JIC) An area designated by the incident commander, or a designee, in which public information officers from multiple agencies distribute information about the incident.

jugular vein distention A visual bulging of the jugular veins in the neck that can be caused by fluid overload, pressure in the chest, cardiac tamponade, or tension pneumothorax.

jump kit A portable kit containing items that are used in the initial care of the patient.

JumpSTART triage A sorting system for pediatric patients younger than 8 years or weighing less than 100 pounds (45 kg). There is a minor adaptation for infants because they cannot ambulate on their own.

kidnapping The seizing, confining, abducting, or carrying away of a person by force, including transporting a competent adult for medical treatment without his or her consent.

kidney stones Solid crystalline masses formed in the kidney, resulting from an excess of insoluble salts or uric acid crystallizing in the urine; may become trapped anywhere along the urinary tract.

kidneys Two retroperitoneal organs that excrete the end products of metabolism as urine and regulate the body's salt and water content.

kinetic energy The energy of a moving object.

Kussmaul respirations Deep, rapid breathing; usually the result of an accumulation of certain acids when insulin is not available in the body.

kyphosis A forward curling of the back caused by an abnormal increase in the curvature of the spine.

labia majora Outer fleshy lips covered with pubic hair that protect the vagina.

labia minora Inner fleshy lips devoid of pubic hair that protect the vagina.

labored breathing Breathing that requires greater than normal effort; may be slower or faster than normal and characterized by grunting, stridor, and use of accessory muscles.

laceration A deep, jagged cut in the skin.

lacrimal glands The glands that produce fluids to keep the eye moist; also called tear glands.

lactic acid A metabolic by-product of the breakdown of glucose that accumulates when metabolism proceeds in the absence of oxygen (anaerobic metabolism).

large intestine The portion of the digestive tube that encircles the abdomen around the small bowel, consisting of the cecum, the colon, and the rectum. It helps regulate water balance and eliminate solid waste.

larynx A complex structure formed by many independent cartilaginous structures that all work together; where the upper airway ends and the lower airway begins; also called the voice box.

lateral Parts of the body that lie farther from the midline; also called outer structures.

LD_{50} The standard measure of the dose amount of an agent or substance that will kill 50% of a population who are exposed to this level.

length-based resuscitation tape A tape used to estimate an infant or child's weight on the basis of length; appropriate drug doses and equipment sizes are listed on the tape.

lens The transparent part of the eye through which images are focused on the retina.

lesser trochanter The projection on the medial/superior portion of the femur.

leukotrienes Chemical substances that contribute to anaphylaxis; released by the immune system in allergic reactions.

lewisite (L) A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.

liaison officer In incident command, the person who relays information, concerns, and requests among responding agencies.

libel False and damaging information about a person that is communicated in writing.

licensure The process whereby a competent authority, usually the state, allows people to perform a regulated act.

life expectancy The average number of years a person can be expected to live.

ligament A band of fibrous tissue that connects bones to bones. It supports and strengthens a joint.

lightening The movement of the fetus down into the pelvis late in pregnancy.

limb presentation A delivery in which the presenting part is a single arm or leg.

linear skull fractures Account for 80% of skull fractures; also referred to as nondisplaced skull fractures; commonly occur in the temporal-parietal region of the skull; not associated with deformities to the skull.

liver A large, solid organ that lies in the right upper quadrant immediately below the diaphragm; it produces bile, stores glucose for immediate use by the body, and produces many substances that help regulate immune responses.

load-distributing band (LDB) A circumferential chest compression device composed of a constricting band and backboard that is either electrically or pneumatically driven to compress the heart by putting inward pressure on the thorax.

logistics In incident command, the position that helps procure and stockpile equipment and supplies during an incident.

lumbar spine The lower part of the back, formed by the lowest five nonfused vertebrae; also called the dorsal spine.

lumen The inside diameter of an artery or other hollow structure.

lymph A thin, straw-colored fluid that carries oxygen, nutrients, and hormones to the cells and carries waste products of metabolism away from the cells and back into the capillaries so that they may be excreted.

lymph nodes Tiny, oval-shaped structures located in various places along the lymph vessels that filter lymph.

lymphatic system A passive circulatory system in the body that transports a plasmalike liquid called lymph, a thin fluid that bathes the tissues of the body.

mandible The bone of the lower jaw.

manually triggered ventilation device A fixed flow rate ventilation device that delivers a breath every time its button is pushed; also referred to as a flow-restricted, oxygen-powered ventilation device.

manubrium The upper quarter of the sternum.

mass-casualty incident (MCI) An emergency situation involving three or more patients or that can place great demand on the equipment or personnel of the EMS system or has the potential to produce multiple casualties.

mastoid process The prominent bony mass at the base of the skull about 1 inch posterior to the external opening of the ear.

material safety data sheet (MSDS) A form, provided by manufacturers and compounders (blenders) of chemicals, containing information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal of a specific material; also known as a safety data sheet (SDS).

maxillae The upper jawbones that assist in the formation of the orbit, the nasal cavity, and the palate and hold the upper teeth.

mechanical piston device A device that depresses the sternum via a compressed gas-powered or electric-powered plunger mounted on a backboard.

mechanism of injury (MOI) The forces, or energy transmission, applied to the body that cause injury.

meconium Fetal stool. When appearing as a dark green material in the amniotic fluid, it can indicate distress or disease in the newborn; it can be aspirated into the fetus's lungs during delivery.

MED channels VHF and UHF channels that the Federal Communications Commission has designated exclusively for EMS use.

medial Parts of the body that lie closer to the midline; also called inner structures.

mediastinum Space within the chest that contains the heart, major blood vessels, vagus nerve, trachea, major bronchi, and esophagus; located between the two lungs.

medical control Physician instructions given directly by radio or cell phone (online/direct) or indirectly by protocol/guidelines (off-line/indirect), as authorized by the medical director of the service program.

medical director The physician who authorizes or delegates to the EMT the authority to provide medical care in the field.

medical emergencies Emergencies that are not caused by an outside force; illnesses or conditions.

medication A substance that is used to treat or prevent disease or relieve pain.

medication error Inappropriate use of a medication that could lead to patient harm.

medicolegal Relating to medical jurisprudence (law) or forensic medicine.

medivac Medical evacuation of a patient by helicopter.

medulla oblongata Nerve tissue that is continuous inferiorly with the spinal cord; serves as a conduction pathway for ascending and descending nerve tracts; coordinates heart rate, blood vessel diameter, breathing, swallowing, vomiting, coughing, and sneezing.

melena Black, foul-smelling, tarry stool containing digested blood.

meninges Three distinct layers of tissue that surround and protect the brain and the spinal cord within the skull and the spinal canal.

meningitis An inflammation of the meningeal coverings of the brain and spinal cord; it is usually caused by a virus or a bacterium.

meningococcal meningitis An inflammation of the meningeal coverings of the brain and spinal cord; can be highly contagious.

metabolism (cellular respiration) The biochemical processes that result in production of energy from nutrients within cells.

metered-dose inhaler (MDI) A miniature spray canister through which droplets or particles of medication may be inhaled through the mouth and into the lungs.

methicillin-resistant *Staphylococcus aureus* (MRSA) A bacterium that can cause infections in different parts of the body and is often resistant to commonly used antibiotics; it is transmitted by different routes, including the respiratory route, and can be found on the skin, in surgical wounds, in the bloodstream, lungs, and urinary tract.

midbrain The part of the brain that is responsible for helping to regulate the level of consciousness.

middle adult An adult age 41 to 60 years.

midsagittal plane (midline) An imaginary vertical line drawn from the middle of the forehead through the nose and the umbilicus (navel) to the floor, dividing the body into equal left and right halves.

mild airway obstruction Occurs when a foreign body partially obstructs the patient's airway. The patient is able to move adequate amounts of air, but also experiences some degree of respiratory distress.

minute volume The volume of air that moves in and out of the lungs per minute; calculated by multiplying the tidal volume and respiratory rate; also called minute ventilation.

miosis Excessively constricted pupil; often bilateral after exposure to nerve agents.

miscarriage The spontaneous passage of the fetus and placenta before 20 weeks; also called spontaneous abortion.

mobile data terminal (MDT) A small computer terminal inside the ambulance that directly receives data from the dispatch center.

mobile integrated healthcare (MIH) A method of delivering health care which involves providing health care within the community rather than at a physician's office or hospital.

morality A code of conduct that can be defined by society, religion, or a person, affecting character, conduct, and conscience.

morgue supervisor In incident command, the person who works with area medical examiners, coroners, and law enforcement agencies to coordinate the disposition of dead victims.

Moro reflex An infant reflex in which, when an infant is caught off guard, the infant opens his or her arms wide, spreads the fingers, and seems to grab at things.

motor nerves Nerves that carry information from the central nervous system to the muscles of the body.

mucosal atomizer device (MAD) A device that is used to change a liquid medication into a spray and push it into a nostril.

mucous membranes The linings of body cavities and passages that are in direct or indirect contact with the outside environment.

mucus The watery secretion of the mucous membranes that lubricates the body openings.

multigravida A woman who has had previous pregnancies.

multiplex The ability to transmit audio and data signals through the use of more than one communications channel.

multisystem trauma Trauma that affects more than one body system.

musculoskeletal system The bones and voluntary muscles of the body.

mutagen A substance that mutates, damages, and changes the structures of DNA in the body's cells.

mutual aid response An agreement between neighboring EMS systems to respond to mass-casualty incidents or disasters in each other's region when local resources are insufficient to handle the response.

myocardial contractility The ability of the heart muscle to contract.

myocardial contusion Bruising of the heart muscle.

myocardium The heart muscle.

narcotic A drug that produces sleep or altered mental consciousness.

nares The external openings of the nostrils. A single nostril opening is called a naris.

nasal cannula An oxygen-delivery device in which oxygen flows through two small, tubelike prongs that fit into the patient's nostrils; delivers 24% to 44% supplemental oxygen, depending on the flow rate.

nasal flaring Widening of the nostrils, indicating that there is an airway obstruction.

nasopharyngeal (nasal) airway Airway adjunct inserted into the nostril of an unresponsive patient or a patient with an altered level of consciousness who is unable to maintain airway patency independently.

nasopharynx The nasal cavity, or part of the pharynx that lies above the level of the roof of the mouth; formed by the union of facial bones and protects the respiratory tract from contaminants.

National EMS Scope of Practice Model A document created by the National Highway Traffic Safety Administration (NHTSA) that outlines the skills performed by various EMS providers.

National Incident Management System (NIMS) A Department of Homeland Security system designed to enable federal, state, and local governments and private-sector and nongovernmental organizations to effectively and efficiently prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism.

nature of illness (NOI) The general type of illness a patient is experiencing.

neglect Refusal or failure on the part of the parent or caregiver to provide life necessities.

negligence Failure to provide the same care that a person with similar training would provide.

negligence per se A theory that may be used when the conduct of the person being sued is alleged to have occurred in clear violation of a statute.

Neisseria meningitides A form of bacterial meningitis characterized by rapid onset of symptoms, often leading to shock and death.

neonate A newborn age birth to 1 month.

nephrons The basic filtering units in the kidneys.

nerve agents A class of chemical called organophosphates; they function by blocking an essential enzyme in the nervous system, which causes the body's organs to become overstimulated and burn out.

nervous system The system that controls virtually all activities of the body, both voluntary and involuntary.

neurogenic shock Circulatory failure caused by paralysis of the nerves that control the size of the blood vessels, leading to widespread dilation; seen in patients with spinal cord injuries.

neuropathy A group of conditions in which the nerves leaving the spinal cord are damaged, resulting in distortion of signals to or from the brain.

neurotoxins Biologic agents that are the most deadly substances known to humans; they include botulinum toxin and ricin.

neutron radiation The type of energy that is emitted from a strong radiologic source, involving particles that are among the most powerful forms of radiation; the particles easily penetrate through lead and require several feet of concrete to stop them.

nitroglycerin A medication that increases cardiac perfusion by causing blood vessels to dilate; EMTs may be allowed to assist the patient to self-administer the medication.

noise Anything that dampens or obscures the true meaning of a message.

nonbulk storage vessels Any container other than bulk storage containers such as drums, bags, compressed gas cylinders, and cryogenic containers. These hold commonly used commercial and industrial chemicals such as solvents, industrial cleaners, and compounds.

nondisplaced fracture A simple crack in the bone that has not caused the bone to move from its normal anatomic position; also called a hairline fracture.

nonrebreathing mask A combination mask and reservoir bag system that is the preferred way to give oxygen in the prehospital setting; delivers up to 90% inspired oxygen and prevents inhaling the exhaled gases (carbon dioxide).

norepinephrine A neurotransmitter and drug sometimes used in the treatment of shock; produces vasoconstriction through its alpha-stimulator properties.

nuchal cord An umbilical cord that is wrapped around the fetus's neck.

obesity A complex condition in which a person has an excessive amount of body fat.

obstructive shock Shock that occurs when there is a block to blood flow in the heart or great vessels, causing an insufficient blood supply to the body's tissues.

occiput The most posterior portion of the cranium.

occlusion A blockage, usually of a tubular structure such as a blood vessel.

occlusive dressing An airtight dressing that protects a wound from air and bacteria; a commercial vented version allows air to passively escape from the chest, while an unvented dressing may be made of petroleum jelly-based (Vaseline) gauze, aluminum foil, or plastic.

Occupational Safety and Health Administration (OSHA) The federal regulatory compliance agency that develops, publishes, and enforces guidelines concerning safety in the workplace.

off-gassing The release of an agent after exposure, for example from a person's clothes that have been exposed to the agent.

older adult An adult age 61 years or older.

oncotic pressure The pressure of water to move, typically into the capillary, as the result of the presence of plasma proteins.

open abdominal injury An injury in which there is a break in the surface of the skin or mucous membrane, exposing deeper tissue to potential contamination.

open-book pelvic fracture A life-threatening fracture of the pelvis caused by a force that displaces one or both sides of the pelvis laterally and posteriorly.

open chest injury An injury to the chest in which the chest wall itself is penetrated by a fractured rib or, more frequently, by an external object such as a bullet or knife.

open-ended questions Questions for which the patient must provide detail to give an answer.

open fracture Any break in a bone in which the overlying skin has been broken.

open head injury Injury to the head often caused by a penetrating object in which there may be bleeding and exposed brain tissue.

open incident An incident that is not yet contained; there may be patients to be located and the situation may be ongoing, producing more patients.

open injuries Injuries in which there is a break in the surface of the skin or the mucous membrane, exposing deeper tissue to potential contamination.

open pneumothorax An open or penetrating chest wall wound through which air passes during inspiration and expiration, creating a sucking sound; also referred to as a sucking chest wound.

operations In incident command, the position that carries out the orders of the commander to help resolve the incident.

opiate A subset of the opioid family, referring to natural, non-synthetic opioids.

opioid A synthetically produced narcotic medication, drug, or agent similar to the opiate morphine, but not derived from opium; used to relieve pain.

OPQRST A mnemonic used in evaluating a patient's pain: Onset, Provocation/palliation, Quality, Region/radiation, Severity, and Timing.

optic nerve A cranial nerve that transmits visual information to the brain.

oral By mouth; a medication delivery route.

oral glucose A simple sugar that is readily absorbed by the bloodstream; it is carried on the EMS unit.

orbit The eye socket, made up of the maxilla and zygoma.

organic brain syndrome Temporary or permanent dysfunction of the brain, caused by a disturbance in the physical or physiologic functioning of brain tissue.

orientation The mental status of a patient as measured by memory of person (name), place (current location), time (current year, month, and approximate date), and event (what happened).

oropharyngeal (oral) airway Airway adjunct inserted into the mouth of an unresponsive patient to keep the tongue from blocking the upper airway and to facilitate suctioning the airway, if necessary.

oropharynx A tubular structure that extends vertically from the back of the mouth to the esophagus and trachea; forms the posterior portion of the oral cavity, which is bordered superiorly by the hard and soft palates, laterally by the cheeks, and inferiorly by the tongue.

orthopnea Severe dyspnea experienced when lying down and relieved by sitting up.

osteoporosis A generalized bone disease, commonly associated with postmenopausal women, in which there is a reduction in the amount of bone mass leading to fractures after minimal trauma in either sex.

ovaries The primary female reproductive organs that produce sex hormones and an ovum, or egg, that, if fertilized, will develop into a fetus.

overdose An excessive quantity of a drug that, when taken or administered, can have toxic or lethal consequences.

over-the-counter (OTC) medications Medications that may be purchased directly by a patient without a prescription.

ovulation The process in which an ovum is released from a follicle.

oxygen A gas that all cells need for metabolism; the heart and brain, especially, cannot function without oxygen.

oxygen toxicity A condition of excessive oxygen consumption resulting in cellular and tissue damage.

oxygenation The process of delivering oxygen to the blood by diffusion from the alveoli following inhalation into the lungs.

paging The use of a radio signal and a voice or digital message that is transmitted to pagers (“beepers”) or desktop monitor radios.

palmar The forward facing part of the hand in the anatomic position.

palmar grasp An infant reflex that occurs when something is placed in the infant’s palm; the infant grasps the object.

palpate To examine by touch.

pancreas A flat, solid organ that lies below the liver and the stomach; it is a major source of digestive enzymes and produces the hormone insulin.

pancreatitis Inflammation of the pancreas.

pandemic An outbreak that occurs on a global scale.

paradoxical motion The motion of the portion of the chest wall that is detached in a flail chest; the motion—in during inhalation, out during exhalation—is exactly the opposite of normal chest wall motion during breathing.

paramedic An individual who has extensive training in advanced life support, including endotracheal intubation, emergency pharmacology, cardiac monitoring, and other advanced assessment and treatment skills.

parasympathetic nervous system A subdivision of the autonomic nervous system, involved in control of involuntary functions such as digestion of food and relaxation, mediated largely by the vagus nerve through the chemical acetylcholine.

parenteral medications Medications that enter the body by a route other than the digestive tract, skin, or mucous membranes.

parietal bones The bones that lie between the temporal and occipital regions of the cranium.

parietal pleura Thin membrane that lines the chest cavity.

paroxysmal nocturnal dyspnea Severe shortness of breath, especially at night after several hours of reclining; the person is forced to sit up to breathe.

partial (focal) seizure A seizure affecting a limited portion of the brain.

partial pressure Describes the amount of gas in air or dissolved in fluid, such as blood.

partial-thickness (second-degree) burns Burns that affect the epidermis and some portion of the dermis but not the subcutaneous tissue, characterized by blisters and skin that is white to red, moist, and mottled.

passive ventilation The act of air moving in and out of the lungs during chest compressions.

patella The knee cap; a specialized bone that lies within the tendon of the quadriceps muscle.

patent Open, clear of obstruction.

pathogen A microorganism that is capable of causing disease in a susceptible host.

pathophysiology The study of how normal physiologic processes are affected by disease.

patient-assisted medication When the EMT assists the patient with the administration of his or her own medication.

patient autonomy The right of a patient to make informed choices regarding his or her health care.

patient care report (PCR) The legal document used to record all patient care activities. This report has direct patient care functions but also administrative and quality control functions. Also known as prehospital care reports.

pediatric assessment triangle (PAT) A structured assessment tool used to rapidly form a general impression of the infant or child without touching him or her; consists of assessing appearance, work of breathing, and circulation to the skin.

pediatrics A specialized medical practice devoted to the care of the young.

peer-assisted medication When the EMT administers medication to him or herself or to a partner.

pelvic binder A device to splint the bony pelvis to reduce hemorrhage from bone ends, venous disruption, and pain.

pelvic inflammatory disease (PID) An infection of the fallopian tubes and the surrounding tissues of the pelvis.

penetrating trauma Injury caused by objects, such as knives and bullets, that pierce the surface of the body and damage internal tissues and organs.

penetrating wound An injury resulting from a sharp, piercing object.

peptic ulcer disease An abrasion of the stomach or small intestine.

per os (PO) Through the mouth; a medication delivery route; same as oral.

per rectum (PR) Through the rectum; a medication delivery route.

perfusion The circulation of oxygenated blood through body tissues and vessels.

pericardial effusion A collection of fluid between the pericardial sac and the myocardium.

pericardium The fibrous sac that surrounds the heart.

perineum In a female, the area between the vagina and the anus.

peripheral nervous system (PNS) The part of the nervous system that consists of 31 pairs of spinal nerves and 12 pairs of cranial nerves; these may be sensory nerves, motor nerves, or connecting nerves.

peristalsis The wavelike contraction of smooth muscle by which the ureters or other tubular organs propel their contents.

peritoneal cavity The abdominal cavity.

peritoneum The membrane lining the abdominal cavity (parietal peritoneum) and covering the abdominal organs (visceral peritoneum).

peritonitis Inflammation of the peritoneum.

persistency Describes how long a chemical agent will stay on a surface before it evaporates.

personal protective equipment (PPE) levels Protective equipment that blocks exposure to a pathogen or a hazardous material.

personal protective equipment (PPE) level The amount and type of protective equipment that an individual needs to avoid injury during contact with a hazardous material.

pertinent negatives Negative findings that warrant no care or intervention.

pertussis An airborne bacterial infection that affects mostly children younger than 6 years, in which the patient is feverish and exhibits a “whoop” sound on inspiration after a coughing attack; highly contagious through droplet infection. Also called whooping cough.

pharmacodynamics The process by which a medication works on the body.

pharmacology The study of the properties and effects of medications.

phosgene A pulmonary agent that is a product of combustion, resulting from a fire at a textile factory or house or from metalwork or burning Freon. It is a very potent agent that has a delayed onset of symptoms, usually hours.

phosgene oxime (CX) A blistering agent that has a rapid onset of symptoms and produces immediate, intense pain and discomfort on contact.

phrenic nerve Nerve that innervates the diaphragm; necessary for adequate breathing to occur.

pin-indexing system A system established for portable cylinders to ensure that a regulator is not connected to a cylinder containing the wrong type of gas.

pinna The external, visible part of the ear.

placards Signage required to be placed on all four sides of highway transport vehicles, railroad tank cars, and other forms of hazardous materials transportation; the sign identifies the hazardous contents of the vehicle, using a standardization system with 10¾-inch (27-cm) diamond-shaped indicators.

placenta The tissue attached to the uterine wall that nourishes the fetus through the umbilical cord.

placenta previa A condition in which the placenta develops over and covers the cervix.

planning In incident command, the position that ultimately produces a plan to resolve any incident.

plantar The bottom surface of the foot.

plasma A sticky, yellow fluid that carries the blood cells and nutrients and transports cellular waste material to the organs of excretion.

platelets Tiny, disc-shaped elements that are much smaller than the cells; they are essential in the initial formation of a blood clot, the mechanism that stops bleeding.

pleura The serous membranes covering the lungs and lining the thorax, completely enclosing a potential space known as the pleural space.

pleural effusion A collection of fluid between the lung and chest wall that may compress the lung.

pleural space The potential space between the parietal pleura and the visceral pleura; described as "potential" because under normal conditions, the space does not exist.

pleuritic chest pain Sharp, stabbing pain in the chest that is worsened by a deep breath or other chest wall movement; often caused by inflammation or irritation of the pleura.

pneumonia An infectious disease of the lung that damages lung tissue; its cause can be bacterial, viral, or fungal.

pneumonic plague A lung infection, also known as plague pneumonia, that is the result of inhalation of plague-causing bacteria.

pneumonitis Inflammation of the lung.

pneumothorax A partial or complete accumulation of air in the pleural space.

point tenderness Tenderness that is sharply localized at the site of the injury, found by gently palpating along the bone with the tip of one finger.

points of distribution (PODs) Existing facilities used as mass distribution sites for antibiotics, antidotes, vaccinations, and other medications and supplies during an emergency.

poison A substance whose chemical action could damage structures or impair function when introduced into the body.

polydipsia Excessive thirst that persists for long periods, despite reasonable fluid intake; often the result of excessive urination.

polyphagia Excessive eating; in diabetes, the inability to use glucose properly can cause a sense of hunger.

polypharmacy The use of multiple medications on a regular basis.

polyuria The passage of an unusually large volume of urine in a given period; in diabetes, this can result from the wasting of glucose in the urine.

pons An organ that lies below the midbrain and above the medulla and contains numerous important nerve fibers, including those for sleep, respiration, and the medullary respiratory center.

poor air exchange A term used to describe the degree of distress in a patient with a mild airway obstruction. With this, the patient often has a weak, ineffective cough, increased difficulty breathing, or possible cyanosis and may produce a high-pitched noise during inhalation (stridor).

portable stretcher A stretcher with a strong, rectangular, tubular metal frame and rigid fabric stretched across it.

position of function A hand position in which the wrist is slightly dorsiflexed and all finger joints are moderately flexed.

positional asphyxia Restriction of chest wall movements and/or airway obstruction; can rapidly lead to sudden death.

postconventional reasoning A type of reasoning in which a child bases decisions on his or her conscience.

posterior The back surface of the body; the side away from you in the standard anatomic position.

posterior tibial artery The artery just behind the medial malleolus; supplies blood to the foot.

postictal state The period following a seizure that lasts 5 to 30 minutes; characterized by labored respirations and some degree of altered mental status.

posttraumatic stress disorder (PTSD) A delayed stress reaction to a prior incident. Often the result of one or more unresolved issues concerning the incident and may relate to an incident that involved physical harm or the threat of physical harm.

potential energy The product of mass, gravity, and height, which is converted into kinetic energy and results in injury, such as from a fall.

power grip A technique in which the stretcher or backboard is gripped by inserting each hand under the handle with the palm facing up and the thumb extended, fully supporting the underside of the handle on the curved palm with the fingers and thumb.

power lift A lifting technique in which the EMT's back is held upright, with legs bent, and the patient is lifted when the EMT straightens the legs to raise the upper body and arms.

preconventional reasoning A type of reasoning in which a child acts almost purely to avoid punishment to get what he or she wants.

preeclampsia A pregnancy complication that is characterized by high blood pressure, headache, visual changes, and swelling of the hands and feet; also called pregnancy-induced hypertension or toxemia of pregnancy.

prefix Part of a term that appears before a word root, changing the meaning of the term.

pregnancy-induced hypertension A condition of late pregnancy that is characterized by headache, visual changes, and swelling of the hands and feet; also called preeclampsia or toxemia of pregnancy.

preload The precontraction pressure in the heart as the volume of blood builds up.

preoxygenation The process of providing oxygen, often in combination with ventilation, prior to intubation in order to raise the oxygen levels of body tissues; a critical step in advanced airway management. This extends the time during which an advanced airway can be placed in an apneic patient, because the more oxygen that is available in the alveoli, the longer the patient can maintain adequate gas exchange in the lungs during the procedure.

presbycusis An age-related condition of the ear that produces progressive bilateral hearing loss that is most noted at higher frequencies.

preschool-age Children between ages 3 to 6 years.

preschooler (preschool-age) A child age 3 to 6 years.

prescription medications Medications that are distributed to patients only by pharmacists according to a physician's order.

presentation The position in which an infant is born; defined by the part of the body that appears first.

priapism A painful, tender, persistent erection of the penis; can result from spinal cord injury, erectile dysfunction drugs, or sickle cell disease.

primary assessment A step within the patient assessment process that identifies and initiates treatment of immediate and potential life threats.

primary blast injury Injuries caused by an explosive pressure wave on the hollow organs of the body.

primary (direct) injury An injury to the brain and its associated structures that is a direct result of impact to the head.

primary prevention Efforts to prevent an injury or illness from ever occurring.

primary service area (PSA) The designated area in which the EMS agency is responsible for the provision of prehospital emergency care and transportation to the hospital.

primary triage A type of patient sorting used to rapidly categorize patients; the focus is on speed in locating all patients and determining an initial priority as their conditions warrant.

primigravida A woman who is experiencing her first pregnancy.

projectile Any object propelled by force, such as a bullet by a weapon.

prolapse of the umbilical cord A situation in which the umbilical cord comes out of the vagina before the fetus.

prone Lying face down.

prostate gland A small gland that surrounds the male urethra where it emerges from the urinary bladder; it secretes a fluid that is part of the ejaculatory fluid.

protected health information (PHI) Any information about health status, provision of health care, or payment for health care that can be linked to an individual. This is interpreted rather broadly and includes any part of a patient's medical record or payment history.

proximal Closer to the trunk.

proximate causation When a person who has a duty abuses it, and causes harm to another individual, the EMT, the agency, and/or the medical director may be sued for negligence.

psychiatric disorder An illness with psychological or behavioral symptoms and/or impairment in functioning caused by a social, psychologic, genetic, physical, chemical, or biologic disturbance.

psychiatric emergency An emergency in which abnormal behavior threatens a person's own health and safety or the health and safety of another person, for example when a person becomes suicidal, homicidal, or has a psychotic episode.

psychogenic shock Shock caused by a sudden, temporary reduction in blood supply to the brain that causes fainting (syncope).

psychosis A mental disorder characterized by the loss of contact with reality.

pubic symphysis A hard, bony, and cartilaginous prominence found at the midline in the lowermost portion of the abdomen where the two halves of the pelvic ring are joined by cartilage at a joint with minimal motion.

pubis One of three bones that fuse to form the pelvic ring.

public health Focused on examining the health needs of entire populations with the goal of preventing health problems.

public information officer (PIO) In incident command, the person who keeps the public informed and relates any information to the media.

public safety access point A call center, staffed by trained personnel who are responsible for managing requests for police, fire, and ambulance services.

pulmonary artery The major artery leading from the right ventricle of the heart to the lungs; carries oxygen-poor blood.

pulmonary blast injuries Pulmonary trauma resulting from short-range exposure to the detonation of high-energy explosives.

pulmonary circulation The flow of blood from the right ventricle through the pulmonary arteries and all of their branches and capillaries in the lungs and back to the left atrium through the venules and pulmonary veins; also called the lesser circulation.

pulmonary contusion Injury or bruising of lung tissue that results in hemorrhage.

pulmonary edema A buildup of fluid in the lungs, usually as a result of congestive heart failure.

pulmonary embolism A blood clot that breaks off from a large vein and travels to the blood vessels of the lung causing obstruction of blood flow.

pulmonary veins The four veins that return oxygenated blood from the lungs to the left atrium of the heart.

pulse The pressure wave created as the heart contracts and forces blood out of the left ventricle and into the major arteries.

pulse oximetry An assessment tool that measures oxygen saturation of hemoglobin in the capillary beds.

pulse pressure The difference between the systolic and diastolic pressures.

punitive damages Damages that are sometimes awarded in a civil lawsuit when the conduct of the defendant was intentional or constituted a reckless disregard for the safety of the public.

pupil The circular opening in the middle of the iris that admits light to the back of the eye.

putrefaction Decomposition of body tissues; a definitive sign of death.

quadrants Describes the sections of the abdominal cavity, in which two imaginary lines intersect at the umbilicus, dividing the abdomen into four equal areas.

quality control The responsibility of the medical director to ensure the appropriate medical care standards are met by EMTs on each call.

quaternary blast injury A blast injury that falls into one of the following categories: burns, crush injuries, toxic inhalation, medical emergencies, or mental health disorders.

rabid Infected with rabies.

raccoon eyes Bruising under the eyes that may indicate a skull fracture.

radial artery The major artery in the forearm; it is palpable at the wrist on the thumb side.

radiation The transfer of heat to colder objects in the environment by radiant energy; for example, heat gain from a fire.

radioactive material Any material that emits radiation.

radiologic dispersal device (RDD) Any container that is designed to disperse radioactive material.

radius The bone on the thumb side of the forearm.

rape Sexual intercourse forcibly inflicted on another person, against that person's will.

rapid extrication technique A technique to move a patient from a sitting position inside a vehicle to supine on a backboard in less than 1 minute when conditions do not allow for standard immobilization.

rapport A trusting relationship that you build with your patient.

reassessment A step within the patient assessment process performed at regular intervals during the assessment process to identify and treat changes in a patient's condition. This should occur every 5 minutes for a patient in unstable condition and every 15 minutes for a patient in stable condition.

recovery position A side-lying position used to maintain a clear airway in unconscious patients who are breathing adequately and do not have suspected injuries to the spine, hips, or pelvis.

rectum The lowermost end of the colon.

red blood cells Cells that carry oxygen to the body's tissues; also called erythrocytes.

reduce To return a dislocated joint or fractured bone to its normal position; to set.

referred pain Pain felt in an area of the body other than the area where the cause of pain is located.

rehabilitation area The area that provides protection and treatment to firefighters and other responders working at an emergency. Here, workers are medically monitored and receive any needed care as they enter and leave the scene.

rehabilitation supervisor In incident command, the person who establishes an area that provides protection for responders from the elements and the situation.

renal pelvis A cone-shaped area that collects urine from the kidneys and funnels it through the ureter into the bladder.

repeater A special base station radio that receives messages and signals on one frequency and then automatically retransmits them on a second frequency.

res ipsa loquitor When the EMT or an EMS system is held liable even when the plaintiff is unable to clearly demonstrate how an injury occurred.

rescue supervisor In incident command, the person appointed to determine the type of equipment and resources needed for a situation involving extrication or special rescue; also called the extrication officer.

residual volume The air that remains in the lungs after maximal expiration.

respiration The physiologic process of exchanging oxygen and carbon dioxide, or, in the context of environmental emergencies, the loss of body heat as warm air in the lungs is exhaled into the atmosphere and cooler air is inhaled.

respiratory compromise The inability of the body to move gas effectively.

respiratory syncytial virus (RSV) A virus that causes an infection of the lungs and breathing passages; can lead to other serious illnesses that affect the lungs or heart, such as bronchiolitis and pneumonia; highly contagious and spread through droplets.

respiratory system All the structures of the body that contribute to the process of breathing, consisting of the upper and lower airways and their component parts.

responsiveness The way in which a patient responds to external stimuli, including verbal stimuli (sound), tactile stimuli (touch), and painful stimuli.

reticular activating system Located in the upper brain stem; responsible for maintenance of consciousness, specifically one's level of arousal.

retina The light-sensitive area of the eye where images are projected; a layer of cells at the back of the eye that changes the light image into electric impulses, which are carried by the optic nerve to the brain.

retinal detachment Separation of the retina from its attachments at the back of the eye.

retractions Movements in which the skin pulls in around the ribs during inspiration.

retrograde amnesia The inability to remember events leading up to a head injury.

retroperitoneal Behind the abdominal cavity.

retroperitoneal space The space between the abdominal cavity and the posterior abdominal wall, containing the kidneys, certain large vessels, and parts of the gastrointestinal tract.

return of spontaneous circulation (ROSC) The return of a pulse and effective blood flow to the body in a patient who previously was in cardiac arrest.

reverse triage A triage process used in treating multiple victims of a lightning strike, in which efforts are focused on those who are in respiratory and cardiac arrest; differs from conventional triage where such patients would be classified as deceased.

Revised Trauma Score (RTS) A scoring system used for patients with head trauma.

rhonchi Coarse, low-pitched breath sounds heard in patients with chronic mucus in the upper airways.

ricin A neurotoxin derived from mash that is left from the castor bean; causes pulmonary edema and respiratory and circulatory failure leading to death.

rigor mortis Stiffening of the body muscles; a definitive sign of death.

rooting reflex An infant reflex that occurs when something touches an infant's cheek, and the infant instinctively turns his or her head toward the touch.

route of exposure The manner by which a toxic substance enters the body.

rule of nines A system that assigns percentages to sections of the body, allowing calculation of the amount of skin surface involved in the burn area.

sacroiliac joint The connection point between the pelvis and the vertebral column.

sacrum One of three bones (sacrum and two pelvic bones) that make up the pelvic ring; consists of five fused sacral vertebrae.

safe zone An area of protection providing safety from the danger zone (hot zone).

safety officer In incident command, the person who monitors the scene for conditions or operations that may present a hazard to responders and patients; he or she may stop an operation when responder safety is an issue.

sagittal (lateral) plane An imaginary line where the body is divided into left and right parts.

saline locks (buff caps) Special types of intravenous devices filled with a small amount of normal saline to keep blood from clotting at the end of the catheter, allowing an IV site to be maintained without running fluids through the vein; also called heparin caps and heparin locks.

salivary glands The glands that produce saliva to keep the mouth and pharynx moist.

SAMPLE history A brief history of a patient’s condition to determine signs and symptoms, allergies, medications, pertinent past history, last oral intake, and events leading to the injury or illness.

sarin (GB) A nerve agent that is one of the G agents; a highly volatile colorless and odorless liquid that turns from liquid to gas within seconds to minutes at room temperature.

scald burn A burn caused by hot liquids.

scalp The thick skin covering the cranium, which usually bears hair.

scanner A radio receiver that searches or “scans” across several frequencies until the message is completed; the process is then repeated.

scapula The shoulder blade.

scene size-up A step within the patient assessment process that involves a quick assessment of the scene and the surroundings to provide information about scene safety and the mechanism of injury or nature of illness before you enter and begin patient care.

schizophrenia A complex, difficult-to-identify mental disorder whose onset typically occurs during early adulthood. Symptoms typically become more prominent over time and include delusions, hallucinations, a lack of interest in pleasure, and erratic speech.

school-age A person who is 6 to 12 years of age.

sciatic nerve The major nerve to the lower extremities; controls much of muscle function in the leg and sensation in most of the leg and foot.

sclera The tough, fibrous, white portion of the eye that protects the more delicate inner structures.

scoop stretcher A stretcher that is designed to be split into two or four sections that can be fitted around a patient who is lying on the ground or other relatively flat surface; also called an orthopedic stretcher.

scope of practice Most commonly defined by state law; outlines the care that the EMT is able to provide for the patient.

scuba gear A system that delivers air to the mouth and lungs at various atmospheric pressures, increasing with the depth of the dive; stands for self-contained underwater breathing apparatus.

sebaceous glands Glands that produce an oily substance called sebum, which discharges along the shafts of the hairs.

secondary assessment A step within the patient assessment process in which a systematic physical examination of the patient is performed. The examination may be a systematic exam or an assessment that focuses on a certain area or region of the body, often determined through the chief complaint.

secondary blast injury A penetrating or nonpenetrating injury caused by ordnance projectiles or secondary missiles.

secondary containment An engineered method to control spilled or released product if the main containment vessel fails.

secondary device A secondary explosive used by terrorists, set to explode after the initial bomb.

secondary (indirect) injury The after effects of the primary injury; includes abnormal processes such as cerebral edema, increased intracranial pressure, cerebral ischemia and hypoxia, and infection; onset is often delayed following the primary brain injury.

secondary prevention Efforts to limit the effects of an injury or illness that you cannot completely prevent.

secondary triage A type of patient sorting used in the treatment area that involves retriage of patients.

sedative A substance that decreases activity and excitement.

seizure A neurologic episode caused by a surge of electrical activity in the brain; can be a convulsion characterized by generalized, uncoordinated muscular activity, and can be associated with loss of consciousness.

self-contained breathing apparatus (SCBA) Respirator with independent air supply used by firefighters to enter toxic and otherwise dangerous atmospheres.

semen Fluid ejaculated from the penis and containing sperm.

seminal vesicles Storage sacs for sperm and seminal fluid, which empty into the urethra at the prostate.

sensitization Developing a sensitivity to a substance that initially caused no allergic reaction.

sensorineural deafness A permanent lack of hearing caused by a lesion or damage of the inner ear.

sensory nerves The nerves that carry sensations such as touch, taste, smell, heat, cold, and pain from the body to the central nervous system.

septic shock Shock caused by severe infection, usually a bacterial infection.

severe airway obstruction Occurs when a foreign body completely obstructs the patient’s airway. The patient cannot breathe, talk, or cough.

sexual assault An attack against a person that is sexual in nature, the most common of which is rape.

shaken baby syndrome A syndrome seen in abused infants and children; the patient has been subjected to violent, whiplash-type shaking injuries inflicted by the abusing individual that may cause coma, seizures, and increased intracranial pressure due to tearing of the cerebral veins with consequent bleeding into the brain.

shallow respirations Respirations characterized by little movement of the chest wall (reduced tidal volume) or poor chest excursion.

shock A condition in which the circulatory system fails to provide sufficient circulation, and therefore inadequate oxygen and nutrient delivery, to maintain normal cellular functions; also called hypoperfusion.

shoulder girdle The proximal portion of the upper extremities, made up of the clavicle, the scapula, and the humerus.

shunts Tubes that drain excess cerebrospinal fluid (CSF) from the brain to another part of the body outside of the brain, such as the abdomen; lowers pressure in the brain.

sickle cell disease A hereditary disease that causes normal, round red blood cells to become oblong, or sickle shaped.

side effects Any effects of a medication other than the desired ones.

sign Objective findings that can be seen, heard, felt, smelled, or measured.

simple access Access that is easily achieved without the use of tools or force.

simple pneumothorax Any pneumothorax that is free from significant physiologic changes and does not cause drastic changes in the vital signs of the patient.

simplex Single-frequency radio; transmissions can occur in either direction but not simultaneously in both; when one party transmits, the other can only receive, and the party that is transmitting is unable to receive.

single command system A command system in which one person is in charge, generally used with small incidents that involve only one responding agency or one jurisdiction.

situational awareness Knowledge and understanding of one’s surroundings and the ability to recognize potential risks to the safety of the patient or EMS team.

size-up The ongoing process of information gathering and scene evaluation to determine appropriate strategies and tactics to manage an emergency.

skeletal muscle Muscle that is attached to bones and usually crosses at least one joint; striated, or voluntary, muscle.

skeleton The framework that gives the body its recognizable form; also designed to allow motion of the body and protection of vital organs.

slander False and damaging information about a person that is communicated by the spoken word.

sling A bandage or material that helps to support the weight of an injured upper extremity.

small intestine The portion of the digestive tube between the stomach and the cecum, consisting of the duodenum, jejunum, and ileum.

smallpox A highly contagious disease; it is most contagious when blisters begin to form.

small-volume nebulizer A respiratory device that holds liquid medicine that is turned into a fine mist. The patient inhales the medication into the airways and lungs as a treatment for conditions such as asthma.

smooth muscle Involuntary muscle; it constitutes the bulk of the gastrointestinal tract and is present in nearly every organ to regulate automatic activity.

sniffing position An upright position in which the patient's head and chin are thrust slightly forward to keep the airway open; the optimum position for the uninjured child who requires airway management.

solid organs Solid masses of tissue where much of the chemical work of the body takes place (eg, the liver, spleen, pancreas, and kidneys).

solution A liquid mixture that cannot be separated by filtering or allowing the mixture to stand.

soman (GD) A nerve agent that is one of the G agents; twice as persistent as sarin and five times as lethal; it has a fruity odor, as a result of the type of alcohol used in the agent, and is a contact and an inhalation hazard that can enter the body through skin absorption and through the respiratory tract.

somatic nervous system The part of the nervous system that regulates activities over which there is voluntary control.

span of control In incident command, the subordinate positions under the commander's direction to which the workload is distributed; the ideal supervisor/worker ratio is one supervisor for three to seven workers.

Special Atomic Demolition Munitions (SADM) Small suitcase-sized nuclear weapons that were designed to destroy individual targets, such as important buildings, bridges, tunnels, and large ships.

special weapons and tactics team (SWAT) A specialized law enforcement tactical unit.

sphincters Circular muscles that encircle and, by contracting, constrict a duct, tube, or opening. Examples are found within the rectum, bladder, and blood vessels.

sphygmomanometer A device used to measure blood pressure.

spina bifida A developmental defect in which a portion of the spinal cord or meninges may protrude outside of the vertebrae and possibly even outside of the body, usually at the lower third of the spine in the lumbar area.

spinal cord An extension of the brain, composed of virtually all the nerves carrying messages between the brain and the rest of the body. It lies inside of and is protected by the spinal canal.

splint A flexible or rigid device used to protect and maintain the position of an injured extremity.

spontaneous pneumothorax A pneumothorax that occurs when a weak area on the lung ruptures in the absence of major injury, allowing air to leak into the pleural space.

spontaneous respirations Breathing that occurs without assistance.

spotter A person who assists a driver in backing up an ambulance to help adjust for blind spots at the back of the vehicle.

sprain A joint injury involving damage to supporting ligaments, and sometimes partial or temporary dislocation of bone ends.

staging supervisor In incident command, the person who locates an area to stage equipment and personnel and tracks unit arrival and deployment from the staging area.

stair chair A lightweight folding device that is used to carry a conscious, seated patient up or down stairs.

standard of care Written, accepted levels of emergency care expected by reason of training and profession; written by legal or professional organizations so that patients are not exposed to unreasonable risk or harm.

standard precautions Protective measures that have traditionally been developed by the Centers for Disease Control and Prevention for use in dealing with objects, blood, body fluids, and other potential exposure risks of communicable disease.

standing orders Written documents, signed by the EMS system's medical director, that outline specific directions, permissions, and sometimes prohibitions regarding patient care; also called protocols.

Star of Life The six-pointed star emblem that identifies vehicles that meet federal specifications as licensed or certified ambulances.

START triage A patient sorting process that stands for Simple Triage And Rapid Treatment and uses a limited assessment of the patient's ability to walk, respiratory status, hemodynamic status, and neurologic status.

state-sponsored terrorism Terrorism that is funded and/or supported by nations that hold close ties with terrorist groups.

status epilepticus A condition in which seizures recur every few minutes or last longer than 30 minutes.

statute of limitations The time within which a case must be commenced.

steam burn A burn caused by exposure to hot steam.

sterilization A process, such as heating, that removes microbial contamination.

sterile technique A technique that involves thorough decontamination, as well as the use of sterile fields around the procedure and full-scale, sterile PPE; often used during long, highly invasive surgical procedures.

sternocleidomastoid muscles The muscles on either side of the neck that allow movement of the head.

sternum The breast bone.

stimulant An agent that produces an excited state.

stoma An opening through the skin and into an organ or other structure; for example, in the neck, it connects the trachea directly to the skin.

strain Stretching or tearing of a muscle; also called a muscle pull.

strangulation Complete obstruction of blood circulation in a given organ as a result of compression or entrapment; an emergency situation causing death of tissue.

stratum corneal layer The outermost or dead layer of the skin.

stridor A harsh, high-pitched respiratory sound, generally heard during inspiration, that is caused by partial blockage or narrowing of the upper airway; may be audible without a stethoscope.

stroke An interruption of blood flow to the brain that results in the loss of brain function; also called a cerebrovascular accident (CVA).

stroke volume (SV) The volume of blood ejected with each ventricular contraction.

structure fire A fire in a house, apartment building, office, school, plant, warehouse, or other building.

subarachnoid hemorrhage Bleeding into the subarachnoid space, where the cerebrospinal fluid circulates.

subcutaneous emphysema A characteristic crackling sensation felt on palpation of the skin, caused by the presence of air in soft tissues.

subcutaneous (SC) injection Injection into the fatty tissue between the skin and muscle; a medication delivery route.

subcutaneous tissue Tissue, largely fat, that lies directly under the dermis and serves as an insulator of the body.

subdural hematoma An accumulation of blood beneath the dura mater but outside the brain.

sublingual (SL) Under the tongue; a medication delivery route.

substance abuse The misuse of any substance to produce a desired effect.

sucking chest wound An open or penetrating chest wall wound through which air passes during inspiration and expiration, creating a sucking sound. See also *open pneumothorax*.

sucking reflex An infant reflex in which the infant starts sucking when his or her lips are stroked.

suction catheter A hollow, cylindrical device used to remove fluid from the patient's airway.

sudden infant death syndrome (SIDS) Death of an infant or young child that remains unexplained after a complete autopsy.

suffix The part of a term that comes after the root word, at the end of the term.

sulfur mustard (H) A vesicant; it is a brownish, yellowish oily substance that is generally considered very persistent; has the distinct smell of garlic or mustard and, when released, is quickly absorbed into the skin and/or mucous membranes and begins an irreversible process of damaging the cells. Also called mustard gas.

superficial Closer to or on the skin.

superficial (first-degree) burns Burns that affect only the epidermis, characterized by skin that is red but not blistered or actually burned through.

superior Above a body part or nearer to the head.

superior vena cava One of the two largest veins in the body; carries blood from the upper extremities, head, neck, and chest into the heart.

supine Lying face up.

supine hypotensive syndrome Low blood pressure resulting from compression of the inferior vena cava by the weight of the pregnant uterus when the woman is supine.

surfactant A liquid protein substance that coats the alveoli in the lungs, decreases alveolar surface tension, and keeps the alveoli expanded; a low level in a premature infant contributes to respiratory distress syndrome.

suspension A mixture of ground particles that are distributed evenly throughout a liquid but do not dissolve.

swathe A bandage that passes around the chest to secure an injured arm to the chest.

sweat glands The glands that secrete sweat, located in the dermal layer of the skin.

sympathetic nervous system The part of the autonomic nervous system that controls active functions such as responding to fear (also known as the "fight-or-flight" system).

symphysis A type of joint that has grown together to form a very stable connection.

symptom Subjective findings that the patient feels but that can be identified only by the patient.

symptomatic hyperglycemia A state of unconsciousness resulting from several problems, including ketoacidosis, dehydration because of excessive urination, and hyperglycemia.

symptomatic hypoglycemia Severe hypoglycemia resulting in changes in mental status.

syncope A fainting spell or transient loss of consciousness, often caused by an interruption of blood flow to the brain.

syndromic surveillance The monitoring, usually by local or state health departments, of patients presenting to emergency departments and alternative care facilities, the recording of EMS call volume, and the use of over-the-counter medications.

synovial fluid The small amount of liquid within a joint used as lubrication.

synovial membrane The lining of a joint that secretes synovial fluid into the joint space.

systemic circulation The portion of the circulatory system outside of the heart and lungs.

systemic vascular resistance (SVR) The resistance that blood must overcome to be able to move within the blood vessels; related to the amount of dilation or constriction in the blood vessel.

systole The contraction, or period of contraction, of the heart, especially that of the ventricles.

systolic pressure The increased pressure in an artery with each contraction of the ventricles (systole).

tabun (GA) A nerve agent that is one of the G agents; is 36 times more persistent than sarin and approximately half as lethal; has a fruity smell and is unique because the components used to manufacture the agent are easy to acquire and the agent is easy to manufacture.

tachycardia A rapid heart rate, more than 100 beats/min.

tachypnea Increased respiratory rate.

tactical situation A hostage, robbery, or other situation in which armed conflict is threatened or shots have been fired and the threat of violence remains.

team In the context of EMS, a collection of health care providers who have been assigned specific roles, working interdependently in a coordinated manner under a designated leader.

team leader The team member who provides a combination of role-assignment, coordination, oversight, centralized decision making, and support for the team to accomplish its goals and achieve desired results.

technical rescue group A team of emergency responders from one or more departments in a region who are trained and on call for certain types of technical rescue.

technical rescue situation A rescue that requires special technical skills and equipment in one of many specialized rescue areas, such as technical rope rescue, cave rescue, and dive rescue.

telemetry A process in which electronic signals are converted into coded, audible signals; these signals can then be transmitted by radio or telephone to a receiver with a decoder at the hospital.

temporal bones The lateral bones on each side of the cranium; the temples.

temporomandibular joint The joint formed where the mandible and cranium meet, just in front of the ear.

tendon The fibrous connective tissue that attaches muscle to bone.

tension pneumothorax An accumulation of air or gas in the pleural space that progressively increases pressure in the chest that interferes with cardiac function with potentially fatal results.

termination of command The end of the incident command structure when an incident draws to a close.

tertiary blast injury An injury from whole-body displacement and subsequent traumatic impact with environmental objects.

testicle A male genital gland that contains specialized cells that produce hormones and sperm.

therapeutic communication Verbal and nonverbal communication techniques that encourage patients to express their feelings and to achieve a positive relationship.

therapeutic effect The desired or intended effect a medication is expected to have on the body.

thermal burns Burns caused by heat.

thoracic cage The chest or rib cage.

thoracic spine The 12 vertebrae that lie between the cervical vertebrae and the lumbar vertebrae. One pair of ribs is attached to each of these vertebrae.

thorax The chest cavity that contains the heart, lungs, esophagus, and great vessels.

thromboembolism A blood clot that has formed within a blood vessel and is floating within the bloodstream.

thrombophilia A tendency toward the development of blood clots as a result of an abnormality of the system of coagulation.

thrombosis A blood clot, either in the arterial or venous system. When the clot occurs in a cerebral artery, it may result in the interruption of cerebral blood flow and subsequent stroke.

thyroid cartilage A firm prominence of cartilage that forms the upper part of the larynx; the Adam's apple.

tibia The shinbone; the larger of the two bones of the lower leg, responsible for supporting the major weight-bearing surface of the knee and the ankle.

tidal volume The amount of air (in milliliters) that is moved in or out of the lungs during one relaxed breath; about 500 mL for an adult.

toddler A child age 1 to 3 years.

tolerance The need for increasing amounts of a drug to obtain the same effect.

tonsil tips Large, semirigid suction tips recommended for suctioning the pharynx; also called Yankauer tips.

topical medications Lotions, creams, and ointments that are applied to the surface of the skin and affect only that area; a medication delivery route.

topographic anatomy The superficial landmarks of the body that serve as guides to the structures that lie beneath them.

tort A wrongful act that gives rise to a civil lawsuit.

tourniquet The bleeding control method used when a wound continues to bleed despite the use of direct pressure; useful if a patient is bleeding severely from a partial or complete amputation.

toxicity levels Indicates the risk that a hazardous material poses to the health of an individual who comes into contact with it.

toxicology The study of toxic or poisonous substances.

toxin A poison or harmful substance produced by bacteria, animals, or plants.

trachea The windpipe; the main trunk for air passing to and from the lungs.

tracheitis Inflammation of the trachea.

tracheostomy A surgical procedure to create an opening (stoma) into the trachea; a stoma in the neck connects the trachea directly to the skin.

tracheostomy tube A plastic tube placed within the tracheostomy site (stoma).

traction Longitudinal force applied to a structure.

trade name The brand name that a manufacturer gives a medication; the name is capitalized.

tragus The small, rounded, fleshy bulge that lies immediately anterior to the ear canal.

trajectory The path a projectile takes once it is propelled.

transcutaneous (transdermal) Through the skin; a medication delivery route.

transient ischemic attack (TIA) A disorder of the brain in which brain cells temporarily stop functioning because of insufficient oxygen, causing stroke-like symptoms that resolve completely within 24 hours of onset.

transmission The way in which an infectious disease is spread: contact, airborne, by vehicles, or by vectors.

transportation area The area in a mass-casualty incident where ambulances and crews are organized to transport patients from the treatment area to receiving hospitals.

transportation supervisor In incident command, the person in charge of the transportation sector in a mass-casualty incident who assigns patients from the treatment area to awaiting ambulances in the transportation area.

transverse (axial) plane An imaginary line where the body is divided into top and bottom parts.

trauma emergencies Emergencies that are the result of physical forces applied to the body; injuries.

trauma score A score calculated from 1 to 16, with 16 being the best possible score. It relates to the likelihood of patient survival with the exception of a severe head injury. It takes into account the Glasgow Coma Scale (GCS) score, respiratory rate, respiratory expansion, systolic blood pressure, and capillary refill.

traumatic asphyxia A pattern of injuries seen after a severe force is applied to the chest, forcing blood from the great vessels back into the head and neck.

traumatic brain injury (TBI) A traumatic insult to the brain capable of producing physical, intellectual, emotional, social, and vocational changes.

treatment area The location in a mass-casualty incident where patients are brought after being triaged and assigned a priority, where they are reassessed, treated, and monitored until transport to the hospital.

treatment supervisor In incident command, the person, usually a physician, who is in charge of and directs EMS providers at the treatment area in a mass-casualty incident.

triage The process of sorting patients based on the severity of injury and medical need to establish treatment and transportation priorities.

triage supervisor In incident command, the person in charge of the incident command triage sector who directs the sorting of patients into triage categories in a mass-casualty incident.

triceps The muscle in the back of the upper arm.

tripod position An upright position in which the patient leans forward onto outstretched arms with the head and chin thrust slightly forward.

trunking Telecommunication systems that allow a computer to maximize utilization of a group of frequencies.

trust and mistrust Refers to a stage of development from birth to approximately 18 months of age, during which infants gain trust of their parents or caregivers if their world is planned, organized, and routine.

tuberculosis (TB) A chronic bacterial disease, caused by *Mycobacterium tuberculosis*, that usually affects the lungs but can also affect other organs such as the brain and kidneys; it is spread by cough and can lie dormant in a person's lungs for decades and then reactivate.

tunica media The middle and thickest layer of tissue of a blood vessel wall, composed of elastic tissue and smooth muscle cells that allow the vessel to expand or contract in response to changes in blood pressure and tissue demand.

turbinates Layers of bone within the nasal cavity.

turgor The ability of the skin to resist deformation; tested by gently pinching skin on the forehead or back of the hand.

two- to three-word dyspnea A severe breathing problem in which a patient can speak only two to three words at a time without pausing to take a breath.

tympanic membrane The eardrum; a thin, semitransparent membrane in the middle ear that transmits sound vibrations to the internal ear by means of auditory ossicles.

type 1 diabetes An autoimmune disorder in which the individual's immune system produces antibodies to the pancreatic beta cells, and therefore the pancreas cannot produce insulin; onset in early childhood is common.

type 2 diabetes A condition in which insulin resistance develops in response to increased blood glucose levels; can be managed by exercise and diet modification, but is often managed by medications.

UHF (*ultra high frequency*) Radio frequencies between 300 and 3,000 MHz.

ulna The inner bone of the forearm, on the side opposite the thumb.

umbilical cord The structure that connects the pregnant woman to the fetus via the placenta; contains two arteries and one vein.

unified command system A command system used in larger incidents in which there is a multiagency response or multiple jurisdictions are involved.

unintended effects Actions that are undesirable but pose little risk to the patient.

untoward effects Actions that can be harmful to the patient.

uremia Severe kidney failure resulting in the buildup of waste products within the blood. Eventually brain functions will be impaired.

ureter A small, hollow tube that carries urine from the kidneys to the bladder.

urethra The canal that conveys urine from the bladder to outside the body.

urinary bladder A sac behind the pubic symphysis made of smooth muscle that collects and stores urine.

urinary system The organs that control the discharge of certain waste materials filtered from the blood and excreted as urine.

urinary tract infection (UTI) A bacterial infection, usually of the lower urinary tract (urethra and bladder) that occurs when normal flora bacteria enter the urethra and grow.

urostomy A surgical procedure to create an opening (stoma) that connects the urinary system to the surface of the skin and allows urine to drain through the abdominal wall.

urticaria Small areas of generalized itching and/or burning that appear as multiple raised areas on the skin; hives.

uterus The muscular organ where the fetus grows, also called the womb; responsible for contractions during labor.

V agent (VX) One of the G agents; it is a clear, oily agent that has no odor and looks like baby oil; more than 100 times more lethal than sarin and is extremely persistent.

vagina The outermost cavity of a woman’s reproductive tract that connects the uterus with the vulva (the external female genitalia); the lower part of the birth canal.

vancomycin-resistant *enterococci* (VRE) A bacterium that is normally present in the human intestines and the female reproductive tract, but which can cause infection and which is resistant to the antibiotic vancomycin.

vapor hazard The term used to describe danger posed by an agent that enters the body through the respiratory tract.

vasa deferentia The spermatic duct of the testicles; also called vas deferens.

vascular access A procedure that gains access to a patient’s circulatory system in order to inject or remove fluids, medicines, or blood products, usually obtained through an intravenous catheter placed in a vein, but sometimes through a needle or catheter placed in an artery or a needle placed into bone.

vasoconstriction The narrowing of a blood vessel, such as with hypoperfusion or cold extremities.

vasoocclusive crisis Ischemia and pain caused by sickleshaped red blood cells that obstruct blood flow to a portion of the body.

vector-borne transmission The use of an animal to spread an organism from one person or place to another.

veins The blood vessels that carry blood from the tissues to the heart.

ventilation Exchange of air between the lungs and the environment, spontaneously by the patient or with assistance from another person, such as an EMT.

ventral The anterior surface of the body.

ventricle One of two (right and left) lower chambers of the heart. The left chamber receives blood from the left atrium (upper chamber) and delivers blood to the aorta. The right chamber receives blood from the right atrium and pumps it into the pulmonary artery.

ventricular fibrillation Disorganized, ineffective quivering of the ventricles, resulting in no blood flow and a state of cardiac arrest.

ventricular tachycardia A rapid heart rhythm in which the electrical impulse begins in the ventricle (instead of the atrium), which may result in inadequate blood flow and eventually deteriorate into cardiac arrest.

venules Very small, thin-walled blood vessels.

vernix caseosa A white, cheesy substance that covers the body of the fetus.

vertebrae The 33 bones that make up the spinal column.

vertex presentation A delivery in which the head of the newborn comes out first.

vesicants Blister agents; the primary route of entry for this agent is through the skin.

vesicular breath sounds Normal breath sounds made by air moving in and out of the alveoli.

VHF (very high frequency) Radio frequencies between 30 and 300 MHz; the VHF spectrum is further divided into "high" and "low" bands.

video laryngoscopy Visualization of the vocal cords, and thereby placement of the endotracheal tube, that is facilitated by use of a video camera and monitor.

viral hemorrhagic fevers (VHF) A group of diseases caused by viruses that include the Ebola, Rift Valley, and yellow fevers, among others. This group of viruses causes the blood in the body to seep out from the tissues and blood vessels.

virulence The strength or ability of a pathogen to produce disease.

viruses Germs that require a living host to multiply and survive.

visceral pleura Thin membrane that covers the lungs.

vital capacity The amount of air that can be forcibly expelled from the lungs after breathing in as deeply as possible.

vital signs The key signs that are used to evaluate the patient's overall condition, including respirations, pulse, blood pressure, level of consciousness, and skin characteristics.

vocal cords Thin white bands of tough muscular tissue that are lateral borders of the glottis and serve as the primary center for speech production.

volatility How long a chemical agent will stay on a surface before it evaporates.

voluntary activities Actions that we consciously perform, in which sensory input or conscious thought determines a specific muscular activity.

voluntary muscle Muscle that is under direct voluntary control of the brain and can be contracted or relaxed at will; skeletal, or striated, muscle.

$\dot{V}/\dot{Q}$ ratio A measurement that examines how much gas is being moved effectively and how much blood is flowing around the alveoli where gas exchange (perfusion) occurs.

warm zone The area located between the hot zone and the cold zone at a hazardous materials incident. The decontamination corridor is located in this zone.

weapon of mass casualty (WMC) Any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports); also known as a weapon of mass destruction (WMD).

weapon of mass destruction (WMD) Any agent designed to bring about mass death, casualties, and/or massive damage to property and infrastructure (bridges, tunnels, airports, and seaports); also known as a weapon of mass casualty (WMC).

weaponization The creation of a weapon from a biologic agent generally found in nature and that causes disease; the agent is cultivated, synthesized, and/or mutated to maximize the target population's exposure to the germ.

wheal A raised, swollen, well-defined area on the skin resulting from an insect bite or allergic reaction.

wheeled ambulance stretcher A specially designed stretcher that can be rolled along the ground. A collapsible undercarriage allows it to be loaded into the ambulance; also called an ambulance stretcher.

wheezing A high-pitched, whistling breath sound that is most prominent on expiration, and which suggests an obstruction or narrowing of the lower airways; occurs in asthma, bronchiolitis, and chronic obstructive pulmonary disease.

white blood cells Blood cells that have a role in the body's immune defense mechanisms against infection; also called leukocytes.

word root The main part of a term that contains the primary meaning.

work The measure of force over distance.

work of breathing An indicator of oxygenation and ventilation; reflects the patient's attempt to compensate for hypoxia.

xiphoid process The narrow, cartilaginous lower tip of the sternum.

zone of injury The area of potentially damaged soft tissue, adjacent nerves, and blood vessels surrounding an injury to a bone or a joint.

zygomas The quadrangular bones of the cheek, articulating with the frontal bone, the maxillae, the zygomatic processes of the temporal bone, and the great wings of the sphenoid bone.

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