

Community CPR & AED



Meets the most current
CPR and ECC Guidelines





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Chapter 1

Introduction to Emergency Care

Learning Outcomes

After reading this chapter and completing any related course work, you will be able to:

- Recognize the significance of injuries and medical emergencies.
- Define first aid.
- Describe basic life support.
- Identify legal considerations when providing emergency care.
- Provide examples of conditions when emergency medical services (EMS) should be called.
- Identify questions a dispatcher is likely to ask when you call 9-1-1.
- Describe steps you can take to prevent disease transmission during first aid.

Chapter Quick Look

- Knowing What to do Matters
- Basic Life Support
- Emergency Care and the Law
- Recognizing an Emergency
- Taking Action
- Staying Safe from Disease
- Chapter Review

Knowing What to do Matters

Emergencies can happen anywhere, and at any time. Knowing what to do can save lives and reduce the consequences of injuries and medical emergencies. Each year more than 800,000 people in the United States die from heart disease, making it the number one killer in America. More than 300,000 of these deaths occur from sudden cardiac death (arrest). Unintentional injury is another significant cause of death, claiming more than 130,000 lives annually.

First Aid is the immediate care provided to an ill or injured victim. This care may be as minimal as washing a wound and applying a bandage, with no further need for assistance. But it could also involve more extensive care for serious conditions requiring **Emergency Medical Services (EMS)** and hospital care.

In serious situations you need to know how to summon more advance medical personnel, what care to give immediately, and how to provide continued care until more qualified help arrives.

Basic Life Support

The care provided by laypersons in the first few minutes for those experiencing conditions such as breathing and heart emergencies is referred to as **basic life support (BLS)**. BLS is provided for adults, children, and infants, and involves 3 specific skills that you will learn in this course to help you save lives:

- Clearing an Airway Obstruction for a victim who is choking.
- Providing **Cardiopulmonary Resuscitation (CPR)** for a victim who is unresponsive and not breathing (or only gasping).
- Using an Automated External Defibrillator (AED) to automatically correct specific electrical disturbances within the heart (**Figure 1.1**).

Figure 1.1



CPR and AEDs save lives.

Emergency Care & the Law

Though laws vary somewhat from state to state, there are several basic legal considerations that you should be aware of when rendering emergency care:

Good Samaritan Laws. State laws enacted to protect responders from legal actions that might arise from emergency care provided while not in the line of duty. These laws vary from state to state.

Duty to act. Most laypersons do not have a legal duty to act. But this could apply to you in these situations:

- Your job requires you to render care, such as designated company responder established to meet Occupational Safety and Health Administration (OSHA) requirements for a safe workplace.
- A pre-existing relationship to others makes you responsible for their wellbeing, such as a parent's responsibility to his or her child.

Consent. To provide care you must first obtain consent from an ill or injured victim, either verbally or as a gesture. If a victim is unable to grant consent due to mental impairment, confusion, or loss of consciousness, then consent is implied. In this case, the law assumes that the victim would grant consent if he or she were able to do so.

Abandonment. Abandonment involves leaving a victim after you started to give care without ensuring the victim continues to receive care at an equal or higher level.

Negligence. Negligence is the failure to follow a reasonable standard of care, which causes or contributes to injury or damage.

Recognizing an Emergency

The EMS system is a network of local public safety professionals and community resources. Police, fire and medical personnel respond to calls for help, most often through a call to 9-1-1 from bystanders first on the scene. Calling promptly enables valuable resources to be brought to your aid; resources that can save lives if provided early. Some indications that an emergency exists include unusual sights, sounds, odors, appearances, and actions. Examples of possible emergencies include:

- Smoke or fire
- Screaming
- Screeching tires
- Sounds of a collision
- Collapsing structure
- Downed electrical wires
- Strong odors
- A victim collapsing

Taking Action

As a bystander, you will be the first person to encounter an emergency, so it will be up to you to take action. Everyone acts differently when confronted with an emergency, and training helps individuals act more appropriately.

Some people worry about taking action. They must first overcome concerns that may delay their actions. Common factors that keep people from acting include:

- Assuming others will act
- Fear of making a mistake / lawsuit
- Fear of disease transmission
- Uncertainty about the care to provide or need to call for professional help (e.g. 9-1-1)

Do not assume that other bystanders will help. You may be the best trained person at the scene of the emergency. While others may panic, you can keep a cooler head. Recruit others to assist you in providing care.

The care steps you will need to remember are few and simple. And providing first aid is also common sense. So do not fear doing anything wrong.

It is extremely unlikely that a disease will be transmitted while providing any type of first aid. Following a few standard precautions described later in this chapter will keep you safe while providing first aid.

If you are uncertain about the need for EMS or about the care to provide, it is still better to call. Dispatchers will provide you with instructions for care. Follow the steps of care that you learn in this manual and course and you will be providing appropriate care until higher level care can be provided.

When to Call for Medical Help

9-1-1 is the emergency number to call in most parts of the United States (**Figure 1.2**). Call for medical help if the victim is experiencing any of these conditions:

- Loss of consciousness
- Seizure
- Difficulty breathing
- Chest pain / pressure
- Abdominal pain/ pressure

Figure 1.2



Call 9-1-1 for police, fire, and emergency medical services.

- Serious bleeding
- Vomiting blood
- Serious burns
- Serious head, neck, or back injury
- Stroke
- Broken bones (e.g. fractured arm or leg)

When you call 9-1-1 the dispatcher will ask a few questions to gather important information or to confirm what information appears on the dispatcher's screen. Do not hang up the phone until the dispatcher advises to do so. Dispatchers can give specific instructions for care until EMS personnel arrive. When you call 9-1-1 dispatchers often ask:

- Your name
- Your phone number
- The location of the victim
- What happened
- How many people need help
- The condition of the victim(s)
- Whether any care is being provided / If you need instructions for providing care

Staying Safe from Disease

The risk to a first aider of acquiring an infectious disease is extremely low. But you can take **Standard Precautions** to further reduce the chance of contracting any disease. Diseases of concern include hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV), transmitted through bodily fluids. Diseases such as tuberculosis and measles are transmitted through the air. Some diseases, like the flu, can create some discomfort but are rarely serious for otherwise healthy adults.

Bodily fluids that might contain hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV) include blood, body fluids, secretions, and excretions excluding sweat. Blood contains the greatest threat of transmission when providing first aid. If blood is not visible, it is still likely that very small quantities of blood are present in other fluids, such as saliva, but the risk for transmitting HBV, HCV, or HIV is extremely low.

Measles, once thought to be eliminated in the United States, has unfortunately returned as a result of communities in the U.S. with unvaccinated people. It is considered a highly communicable disease. The disease resides in the nose and throat and is transmitted by air through coughing and sneezing.

See **Table 1.1** for information on more common diseases of concern.

Table 1.1 Diseases of Concern

| Disease | Overview | Vaccination |
|---|---|--|
| Hepatitis B | A bloodborne virus causing serious disease of the liver. Hepatitis B infection can lead to long term liver disease, including cirrhosis and cancer. | An effective vaccine is available and must be offered to employees within a few days following new employment. |
| Hepatitis C | A bloodborne virus causing serious disease of the liver. Hepatitis C infection can lead to long term liver disease, including cirrhosis and cancer. | None |
| Human Immunodeficiency Virus (HIV) | A bloodborne virus that attacks white blood cells, destroying the body's ability to fight infection, and leading to AIDS in most cases. | None |
| Tuberculosis | An airborne bacterial infection primarily affecting the lungs. | Bacille Calmette-Guérin (BCG) is a vaccine for tuberculosis, but is rarely needed. |
| Measles | A highly contagious airborne virus resulting in a high fever lasting numerous days, characteristic rash, cough, and conjunctivitis. | The measles vaccine is effective at preventing the disease. |

Standard Precautions

Standard Precautions are measures put in place to reduce the risk of disease transmission. Such measures include hygiene practices, such as proper hand washing. Other measures include the use of engineering controls in the workplace that isolate or remove a particular danger, reducing the risk of disease transmission.

Additional measures include work practice controls that involve proper storage, use, and cleaning of equipment, as well as clean up procedures in the event that a surface becomes contaminated.

The last of these measures involves the use of **personal protective equipment (PPE)** to ensure an effective barrier can be maintained between the first aider and an ill or injured victim (**Figure. 1.3**)

PPE includes:

- Medical exam gloves to avoid contact with bodily fluids.
- Breathing devices to avoid contact with bodily fluids and airborne disease.
- Goggles or eye glasses with side shields to protect against fluid splatter.
- Gowns that can cover the entire body.
- Antiseptic solution for washing immediately after providing care.

To prevent disease transmission when providing first aid:

- Use barriers, such as disposable gloves, to avoid contact with blood or body fluids.
- Use protective CPR breathing devices if available, and if needed.
- Do not eat, drink or touch your mouth, nose or eyes when giving care.
- Wash your hands thoroughly with warm water and soap, or use a hand sanitizer, after giving care.
- Do not touch any items soiled with bodily fluids.
- Clean and disinfect any surfaces where bodily fluids such as blood have spilled. The Centers for Disease Control (CDC) recommend a mixture of 1 part bleach to 9 parts cool water. Let this sit for 20 minutes and then wipe it up.

Figure 1.3



Personal protective equipment includes items such as gloves and breathing masks.

- Dispose of all soiled items properly (Figure 1.4).

If you come in contact with an injured or ill victim's bodily fluids while providing first aid in a workplace setting, follow your company's exposure control plan for reporting the incident and follow-up (post-exposure) evaluation (Figure 1.5).

Figure 1.5

Follow your employer's exposure control plan if you suffer an exposure at work.

Figure 1.4

Dispose of soiled items properly.

Chapter 1 REVIEW

Key Terms

- Abandonment
- Basic life support (BLS)
- Cardiopulmonary resuscitation (CPR)
- Consent
- Duty to act
- Emergency medical Services (EMS)
- First Aid
- Good Samaritan Laws
- Negligence
- Personal protective equipment (PPE)
- Standard Precautions

Key Points

- ✓ Bystanders are often the first on the scene capable of rendering basic care for a victim with a breathing or cardiac problem.
- ✓ All care begins by providing Basic Life Support (BLS)
- ✓ First aid providers should understand the risks of disease transmission when providing care, and take proper precautions at all times.
- ✓ Using personal protective equipment (PPE) ensures an effective barrier while providing care.

Check Your Progress

Now that you have read this chapter and completed any accompanying class activities, answer the following questions:

- ✓ Can you identify examples of emergency situations? (Pg 3)
- ✓ What are some basic legal considerations that apply to emergency care? (Pg 3)
- ✓ Can you name several diseases that pose a risk of transmission during first aid? (Pg 5-6)
- ✓ What precautions can you take to prevent disease transmission during first aid? (Pg 7-8)

Chapter 2

Assessing the Scene and the Victim

Learning Outcomes

After reading this chapter and completing any related course work, you will be able to:

- Identify dangers at the scene of an emergency.
- Describe the purpose of the primary check when assessing a victim.
- Describe the purpose of the secondary check when assessing a victim.
- Demonstrate how to assess a responsive and unresponsive victim using the primary and secondary check.

Chapter Quick Look

- Scene Check
- Primary Check
- Secondary Check

Scene Check

Before you can assess a victim and provide care you must make sure the scene is safe to enter. Check the scene for anything unsafe so that you do not become a victim while providing care (**Figure 2.1**). Unsafe scenes can include:

- Traffic
- Fire/Smoke
- Downed electrical wires
- Unsafe structures
- Chemical spills / Poisonous gas
- Active assailant

If you are unable to make the scene safe, stay at a safe distance and call 9-1-1. Advise other bystanders not to enter until the scene can be made safe.

Primary Check

With the scene safe, begin to assess the victim. The **primary check** is designed to quickly determine if the victim has any immediate life threats. The primary check is used to determine if a victim:

- Is responsive (conscious)
- Is breathing normally
- Has a heartbeat
- Is bleeding severely

Checking Responsive Victims

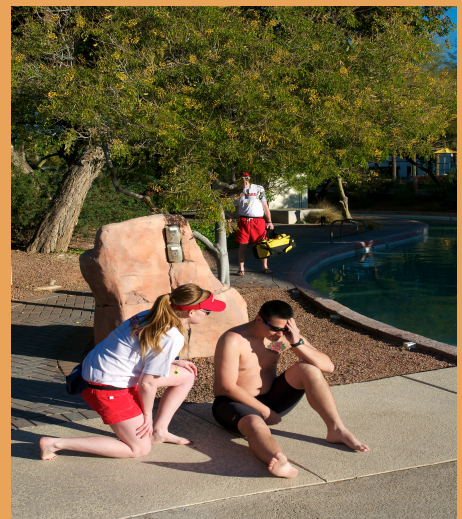
For an obviously responsive (conscious) victim, ask what is wrong (**Figure 2.2**). A victim who is able to answer questions is alert, breathing, has a heartbeat, and is not choking. Complete the primary check by quickly scanning up and down the victim's body to make sure there is no severe bleeding. Look for blood-soaked clothing and blood on the surrounding area. If serious bleeding is present, apply pressure directly over the wound with your hand and a barrier device, such as medical exam gloves, gauze pads or folded towel to stop the bleeding. Identify the problems and call 9-1-1 if needed.

Figure 2.1



Make sure the scene is safe before approaching the victim.

Figure 2.2



Speak with a responsive victim as part of the primary check.

Checking Unresponsive Victims

If you find a person motionless, you still begin with the primary check. The appropriate care is provided based on what is found during this assessment.

Check for responsiveness in a motionless person by tapping the shoulder of the victim, and asking, “Are you OK?” (**Figure 2.3**). If the victim does not respond, he or she is said to be unresponsive. This is an emergency that requires professional care. Have a bystander call 9-1-1, or call 9-1-1 yourself (cell phone or local phone).

Look at the chest for movement (rising and falling) that would indicate breathing. Listen for sounds such as gasping, gurgling, wheezing, or others that would indicate abnormal breathing (**Figure 2.4**). If the victim is unresponsive, but still breathing normally, keep monitoring the victim’s condition watching for any changes while awaiting EMS personnel.

If an unresponsive victim begins to vomit, roll the victim onto his or her side, a position known as the **recovery position** (**Figure 2.5**).

If the victim is not breathing (or only has occasional gasps), the victim needs CPR promptly. This is covered later in this manual.

Figure 2.3



Check for responsiveness in a motionless victim.

Figure 2.4



Check for breathing by looking for movement of the chest.

Figure 2.5



The recovery position helps keep the airway clear in an unresponsive victim.

Secondary Check

A secondary check should only be done once the primary check is completed and any immediate life-threatening conditions are cared for. The **secondary check** has two parts:

- Gathering information about the victim's condition that could help you provide care, including deciding about the need to call 9-1-1. Pass on any information you gather to arriving EMS personnel
- Quick physical exam of the body for conditions that could need care or become more serious if left uncared for.

During the secondary check, you will search for signs and symptoms. A **sign** is a condition that you can see or feel, such as a deformed limb or bleeding wound. A **symptom** is what the victim is able to describe to you, such as chest tightness, pain, and dizziness.

Gathering Information

Some people wear medical identification in the form of a bracelet or necklace that notes the wearer's medical conditions. It may also provide a phone number that can be called to get more information, or to alert a person, such as a parent, if needed. You can gather information directly from a responsive victim, bystanders who may have witnessed the incident, or family or friends who are present and know the medical background of the victim. The mnemonic **SAMPLE** can be used to help you remember what information to gather (**Table 2.1**).

Table 2.1 SAMPLE

| Letter Descriptions | Questions |
|--|--|
| <u>S</u> igns and Symptoms | "What is wrong?" |
| <u>A</u> llergies | "Are you allergic to anything?" |
| <u>M</u> edication | "Are you taking any medications for this condition?" |
| <u>P</u> ast medical history | "Do you have any medical problems?" |
| <u>L</u> ast intake | "When did you last eat or drink?" |
| <u>E</u> vents leading up to the problem | "What were you doing before the problem started?" or "How did you get hurt?" |

Physical Exam

A victim may have a condition that can be pointed out, so you can focus your attention on that area of the body. A victim may also have problems in multiple areas of the body, requiring a more thorough physical check of the entire body. The acronym **DOTS** can help you remember what signs and symptoms of injury or illness to look for as you check the victim. DOTS stands for:

- Deformity
- Open wound
- Tenderness (or pain)
- Swelling

Start your physical exam at the head and quickly work downward along the victim's body (**Figures 2.6-2.10**). Use DOTS, and look, feel, and listen as you progress. Speak with the victim. Ask what happened so that you can determine the cause of the incident. Ask the victim to describe any pain and the location of the pain and what makes it feel better or worse. See **Table 2.2** for detailed information on conducting a physical exam.

Figure 2.6



Conduct a physical exam of the head and neck.

Figure 2.7



Conduct a physical exam of the chest

Figure 2.8



Conduct a physical exam of the abdomen

Figure 2.9



Conduct a physical check of the pelvis.

Figure 2.10



Conduct a physical exam of the legs.

Table 2.2 Physical Exam

| Part of the Body to Check | What to Check For |
|---------------------------|---|
| Head | DOTS Skin temperature, color, moisture Pupils (should be the same size and both react to light) Clear or blood tinged fluid in the ears or nose Injury to the teeth or tongue |
| Neck | DOTS |
| Chest | DOTS Symmetry during breathing |
| Abdomen | DOTS (Push gently to determine tenderness) |
| Pelvis | DOTS (push inward on the sides of the hips for tenderness) |
| Limbs | DOTS (Check arms/hands and legs/feet) Have victim wiggle fingers and toes |
| Back | DOTS If the victim is lying on the back and you do not suspect a spine injury, roll the victim onto the side. Do not move the victim if already complaining of back pain. |

Skin Conditions

Skin should be normal in color, temperature and moisture. Flushed (red) skin can be an indication of conditions such as high blood pressure, excitement, or being overheated. Pale/blue/gray skin can result from blood loss, insufficient oxygen, and shock.

If skin is hot and moist or dry, it could be a high fever or exposure to heat. Cool and moist skin often reflects poor blood circulation and shock. Cold skin, especially areas such as the abdomen under clothing, could indicate hypothermia.

Medical ID

Some victims have conditions that are identified on medical identification bracelets or necklaces. In addition to the victim's medical condition, the item may also have a phone number to call for more information in the event the victim is unable to communicate. Look for medical ID tags as you conduct your physical exam. Pass this information on to arriving EMS personnel.

Chapter 2 REVIEW

Key Terms

- DOTS
- Physical exam
- Primary check
- Recovery position
- SAMPLE
- Secondary check
- Sign
- Symptom

Key Points

- ✓ Before you can assess a victim and provide care you must make sure the scene is safe to enter.
- ✓ The primary check is designed to quickly determine if the victim has any immediate life threats.
- ✓ Checking responsiveness in a motionless victim involves tapping and asking at the victim.
- ✓ Look at the chest for movement (rising and falling) that would indicate breathing. Listen for sounds such as gasping, gurgling, wheezing, or others that would indicate abnormal breathing.
- ✓ If an unresponsive victim begins to vomit, roll the victim onto his or her side (recovery position).
- ✓ A secondary check is done once the primary check is completed and any immediate life-threatening conditions are cared for.
- ✓ The secondary check involves gathering information and conducting a physical exam.
- ✓ A sign is a condition that you can see or feel, while a symptom is what the victim is able to describe to you.
- ✓ SAMPLE is used to gather information.
- ✓ DOTS is used to look for signs and symptoms of illness or injury.
- ✓ The physical exam involves a quick head to toe check of the victim's body.

Check Your Progress

Now that you have read this chapter and completed any accompanying class activities, answer the following questions:

- ✓ Can you identify dangers at the scene of an emergency? (Pg 11)
- ✓ What is the purpose of the primary check when assessing a victim? (Pg 11)
- ✓ How do you assess a responsive victim using the primary check? (Pg 11)
- ✓ How do you assess an unresponsive victim using the primary check? (Pg 12)
- ✓ Can you name the parts of the secondary check? (Pg 13)
- ✓ Can you identify what information to gather as part of the secondary check? (Pg 13)
- ✓ Can you describe the steps of a physical exam? (Pg 14)

Breathing Emergencies

Learning Outcomes

After reading this chapter and completing any related course work, you will be able to:

- Identify causes of breathing emergencies.
- Describe how to recognize someone having difficulty breathing.
- Describe how to care for someone who stops breathing.
- Demonstrate how to care for a responsive choking adult, child, and infant.
- Describe how to relieve airway obstruction for an unresponsive adult, child, and infant.

Chapter Quick Look

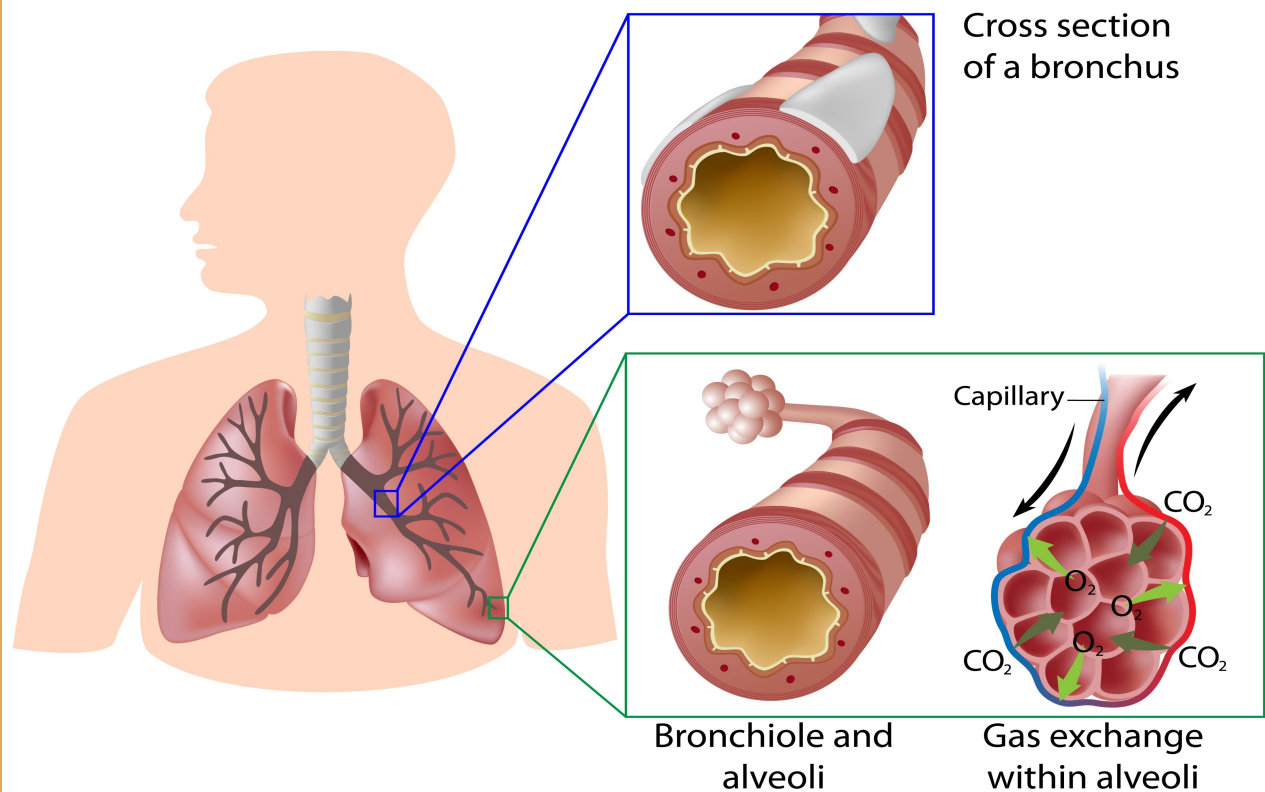
- The Breathing Process
- Causes of Breathing Problems
- Recognizing Breathing Problems
- Caring for Breathing Problems
- Airway Obstruction in a Responsive Adult or Child
- Airway Obstruction in a Responsive Infant
- Airway Obstruction in an Unresponsive Victim
- Chapter Review

The Breathing Process

Breathing is normally an effortless process. It involves inhaling **oxygen** from the air into the lungs, and exhaling bi-products such as **carbon dioxide**. Air entering the mouth and nose is filtered, warmed, and humidified before passing down the throat and entering the windpipe and the lungs. Deep within the lungs tiny air sacs (alveoli) exchange oxygen and carbon dioxide through small blood vessels known as capillaries (**Figure 3.1**). This continuous process is necessary to sustain life. Any interruption in this process can result in death within minutes.

Figure 3.1

Human Lung Anatomy and Function



Oxygen and carbon dioxide are exchanged during the breathing process.

Causes of Breathing Problems

There are numerous causes of breathing problems. These include:

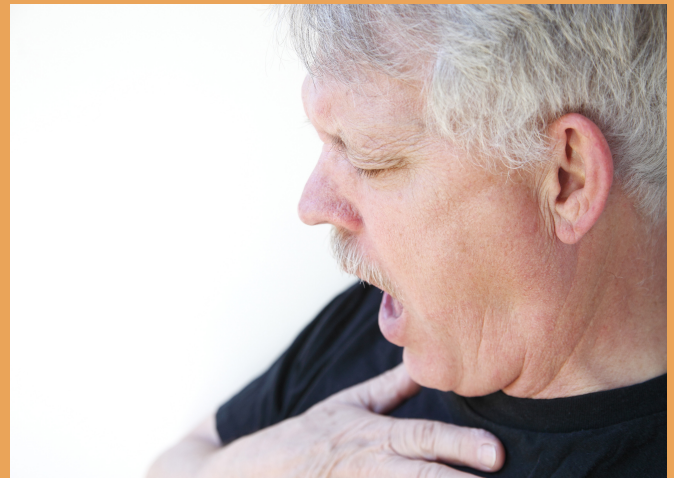
- Choking (Airway obstruction)
- Inhaling smoke or other poisonous chemicals
- Aspiration (inhaling stomach contents)
- Asthma attack
- Lung infections such as bronchitis or pneumonia.
- Drowning
- Suffocation
- Chest injury
- Drug overdose
- Electrocutation
- Heart attack / Cardiac arrest

Recognizing Breathing Problems

Breathing problems are not hard to identify. Look and listen to how a victim breathes. Ask a responsive victim how he or she feels when breathing. Signs of breathing problems can include: **(Figure 3.2)**.

- Labored breathing (struggling to breathe)
- Noisy breathing (wheezing, gurgling or high-pitched sounds)
- Unusually slow or fast breathing
- Unusually deep or shallow breathing
- Irregular breathing
- Gasping for breath
- Inability to speak in full sentences
- Excessive coughing
- Restlessness, anxiety, and confusion
- Changes in level of consciousness

Figure 3.2



A victim experiencing difficulty breathing needs immediate help.

- Flushed, pale, or bluish (cyanotic) skin
- Chest pain or discomfort when breathing
- Tingling sensations

Caring for Breathing Problems

Follow these guidelines to care for a conscious victim experiencing breathing problems:

- Help the victim rest in a position that makes breathing easier. This is often a seated position.
- Call 9-1-1
- Comfort and reassure the victim.
- Assist the victim with the use of his or her prescribed medication, such as an inhaler.
- Keep the victim's airway clear.

If the victim stops breathing as a result of prolonged difficulty breathing, the delivery of oxygen to the body, most importantly to the brain, will be interrupted. The victim will lose consciousness. Without adequate oxygen the heart will stop beating (cardiac arrest). Death is certain if left untreated, but is potentially reversible if cared for promptly. Any victim that is unresponsive and not breathing needs CPR. This is discussed in detail in the next chapter.

Airway Obstruction in a Responsive Adult or Child

An object blocking the airway is a common cause breathing problems. **Airway obstruction**, commonly called **choking** in a responsive (conscious) adult or child most often results from an object, such as food, becoming lodged in the throat (**Figure 3.3**). Young children also choke on small objects such as coins or toy parts. A choking victim may clutch the throat in what is commonly referred to as the universal distress sign of choking (**Figure 3.4**).

Figure 3.3



Children often choke as a result of foods such as grapes, nuts, meat, and hard candy.

Figure 3.4



Grasping the throat is a common distress sign of choking.

If the victim is able to cough, the airway is only partially obstructed. Encourage the victim to continue coughing. This often aids in dislodging the obstruction. If the victim cannot cough, speak, cry, or breathe, or is coughing weakly or making high pitched “crowing” sounds, the airway is severely obstructed, and immediate care is needed.

If the choking victim is an adult or child, use the **Heimlich Maneuver** to dislodge the obstruction. Follow these steps to relieve the obstruction:

1. Stand behind the victim.
2. Reach around the victim’s waist with one hand and locate the navel.
3. Make a fist with your other hand and place the fist just above the navel (**Figure 3.5**).
4. Grasp your fist and give quick inward and upward thrusts to force the object out (**Figure 3.6**). Repeat these thrusts until the object is dislodged or the victim becomes unresponsive. If the victim becomes unresponsive, begin CPR (Covered in the next chapter), and call 9-1-1.

If a choking victim is too large and you are unable to reach around the victim to give effective abdominal thrusts, or if the victim is obviously pregnant, give chest thrusts. Reach under the victim’s armpits and place the thumb side of your fist against the center of the victim’s chest. Grasp your fist with your other hand and give quick, inward thrusts (**Figure 3.7**).

Figure 3.5



Locate the navel and position your fist just above it.

Figure 3.6



Grasp your fist and provide inward and upward abdominal thrusts to relieve the obstruction.

Figure 3.7



Provide chest thrusts for a pregnant or large victim.

FYI: How the Heimlich Maneuver Works

The diaphragm is the largest muscle aiding breathing. When your hands are positioned just above the navel, they lie just below the diaphragm. When you pull inward and upward, the diaphragm is moved upward. This action forces air out of the lungs under pressure, which is often adequate to dislodge an object in a conscious choking adult or child.

Airway Obstruction in a Responsive Infant

If an infant (birth to 1 year) is conscious and choking, use a series of back slaps and chest compressions to relieve the obstruction. Follow these steps to relieve a severe airway obstruction in an infant:

1. Grasp the infant's jaw, position the infant face down on your forearm, and lower your forearm to your leg.
2. Use the heel of your free hand to give 5 back slaps between the infant's shoulder blades. **(Figure 3.8).**
3. Grasp the back of the infant's head, roll the infant face up on your forearm, and lower your forearm to your leg.
4. With your free hand, place 2 fingers on the breastbone, about a finger width below the nipples, and give 5 chest compressions. Each compression should be one third the depth of the chest (about 1.5 inches), and allow the chest to fully recoil after each compression. **(Figure 3.9).**

Figure 3.8



Provide 5 back slaps between the infant's shoulder blades.

Figure 3.9



Provide 5 chest thrusts to help relieve the obstruction

5. Look in the mouth of the infant and attempt to sweep out any visible object.
6. Repeat these steps until the obstruction is dislodged or the infant becomes unresponsive. If the infant becomes unresponsive, begin CPR (Covered in the next chapter), and call 9-1-1.

Caring for a Responsive Victim Who Becomes Unresponsive

Occasionally a responsive choking victim could become unresponsive (lose consciousness) due to insufficient oxygen. Follow these steps if a responsive choking victim becomes unresponsive:

1. Carefully lower the victim to the ground.
2. Open the victim's mouth and look for an object.
3. If you see an object, remove it with your finger.
4. If an object is not visible, open the victim's airway. This involves tilting the head back and lifting the chin. For adults the head is tilted back further than children or infants. Attempt 2 rescue breaths. Each breath should last 1 second and make the chest rise. If the chest does not rise when attempting breaths, the airway is likely still obstructed. Provide care as described in the next section.

Airway Obstruction in an Unresponsive Victim

If an adult or a child is unresponsive, not breathing, and the chest does not rise with rescue breaths, follow these steps:

1. Retilt the head and try another rescue breath. If the chest still does not rise, assume that the airway remains blocked.
2. Provide chest compressions to dislodge the object. Use the same technique that is described in detail in the next chapter to compress the chest at a rate of about 110 compressions per minute (range of 100 – 120) **(Figure 3.10).**

Figure 3.10



Chest compressions are used to dislodge airway obstructions in unresponsive victims.

- a. Use 2 hands to compress an adult's chest at least 2 inches deep, and 30 times
 - b. Use 1 or 2 hands to compress a child's chest $\frac{1}{3}$ the depth of the chest (about 2 inches), and 30 times.
 - c. Use 2 fingers to compress an infant's chest $\frac{1}{3}$ the depth of the chest (1.5 inches), and 30 times.
3. Open the mouth and look for an object. If you see an object, remove it with your finger.
4. Attempt rescue breaths. If the chest does not rise the airway is likely still obstructed. Repeat the steps until the obstruction is removed.

Chapter 3 REVIEW

Key Terms

- Airway Obstruction
- Carbon Dioxide
- Choking
- Heimlich Maneuver
- Oxygen

Key Points

- ✓ Breathing should be an effortless process.
- ✓ There are numerous causes of breathing emergencies, including choking.
- ✓ Recognizing breathing problems is not difficult. Labored breathing and noisy breathing are among the most common signs and symptoms.
- ✓ To care for breathing problems have the victim rest in the most comfortable position for breathing, which is normally seated upright. Call 9-1-1. Assist the victim with any prescribed medication for his or her condition.
- ✓ If the airway is obstructed in a responsive adult or child, provide abdominal thrusts, commonly called the Heimlich Maneuver. For responsive choking infants, back slaps and chest compressions are used to dislodge the object.
- ✓ If a victim is unresponsive with an airway obstruction, provide 30 chest compressions to dislodge the object.

Check Your Progress

Now that you have read this chapter and completed any accompanying class activities, answer the following questions:

- ✓ Can you describe the breathing process? (Pg 20)
- ✓ What are several causes of breathing emergencies? (Pg 21)
- ✓ What are several signs and symptoms that would indicate a breathing problem? (Pg 21-22)
- ✓ Can you describe how to care for a victim experiencing difficulty breathing? (Pg 22)
- ✓ How should you provide care for an airway obstruction in a responsive adult, child, or infant? (Pg 22-25)
- ✓ How should you provide care for an airway obstruction in an unresponsive adult, child, or infant? (Pg 25-26)

Chapter 4

Learning Outcomes

After reading this chapter and completing any related course work, you will be able to:

- Describe how the circulatory system works.
- Identify the risk factors of cardiovascular disease.
- Describe how to recognize a heart attack.
- Describe how to care for a person experiencing a heart attack.
- Describe how to recognize a stroke.
- Describe how to care for a person experiencing a stroke.
- Demonstrate how to provide cardiopulmonary resuscitation (CPR) for an adult, child, and infant in cardiac arrest.
- Demonstrate how to relieve airway obstruction for an unresponsive adult, child, and infant.

Chapter Quick Look

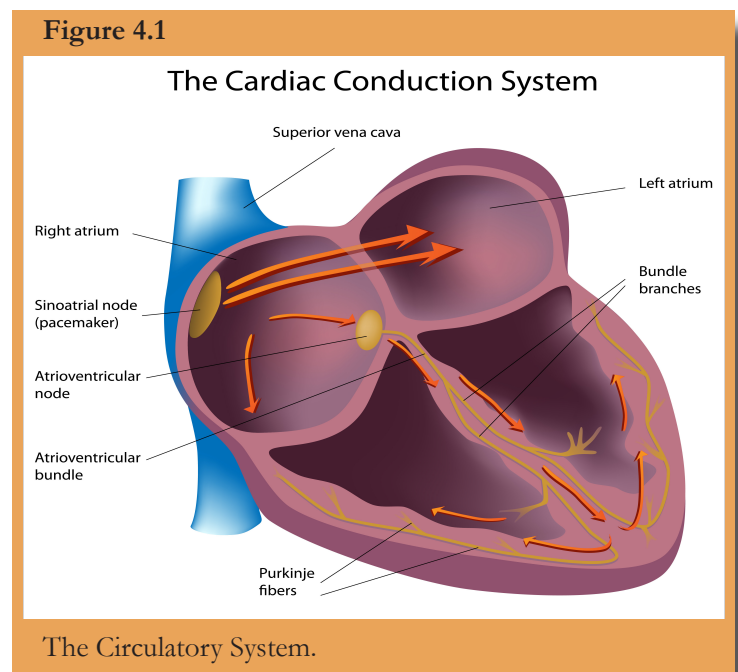
- The Circulatory System
- Understanding Cardiovascular Disease
- Heart Attack
- Stroke
- Cardiac Arrest
- Cardiopulmonary Resuscitation (CPR)
- Chapter Review

The Circulatory System

The circulatory system is made up of the heart and blood vessels. This system delivers oxygen and nutrients throughout the body, and removes waste products. The heart is an organ about the size of a person's fist, with four chambers through which blood moves in and out. The two upper chambers are the right and left atria. The two lower chambers are the right and left ventricles.

The two chambers on the right side of the heart are the right atrium (upper chamber) and right ventricle (lower chamber). These chambers receive oxygen-poor venous blood from the body and pump it to the lungs, where the waste products are removed and oxygen is picked up and returned to the left side of the heart. The two chambers on the left side of the heart are the left atrium (upper chamber) and left ventricle (lower chamber). These chambers accept the oxygen-rich blood and pump it out to all parts of the body through the arteries.

The heart muscle is very unique in that it automatically creates its own electrical impulses. These impulses, normally originating in the upper right side of the heart, move along an electrical conduction system in a wavelike pattern throughout the heart. When these impulses reach specialized muscle tissue, the chambers of the heart contract and then relax (**Figure 4.1**). This action moves blood throughout the body, generating a heartbeat that can be felt as a pulse. The electrical impulses in the heart are able to be viewed and interpreted through an electrocardiogram.



Understanding Cardiovascular Disease

Cardiovascular disease, also known as heart disease, involves diseases that affect the heart and blood vessels. More people die globally each year from cardiovascular disease than from any other cause.

Coronary heart disease (CHD) involves the narrowing of the coronary arteries, the blood vessels that supply oxygen and blood to the heart. This is usually caused by **atherosclerosis**,

which is the plaque (cholesterol substances) that accumulates on the inside walls of the arteries, causing them to narrow. This results in reduced blood flow to the heart. Diseases of the blood vessels can also affect other organs, such as the brain, resulting in a stroke.

Other types of cardiovascular disease include:

- Arrhythmias – electrical disturbance of the electrical conduction system in the heart.
- Heart valve problems – valves do not open or close properly; blood does not flow properly through the heart.
- Heart failure – when the heart fails to pump blood adequately.
- Stroke – a blockage or bursting of a blood vessel in the brain.

Many of the causes leading to heart disease can be prevented by adopting a heart healthy lifestyle that reduces the risk of heart disease. There are two types of risk factors; those that can be controlled, and those that cannot be controlled.

Risking Your Life

There are 8 risk factors commonly associated with cardiovascular disease. Five risk factors that can be controlled are:

1. High cholesterol - Total cholesterol level is a measure of all the cholesterol in the blood, including LDL (bad) cholesterol and HDL (good) cholesterol. The higher the LDL (bad) cholesterol number, the greater the risk of developing heart disease from cholesterol building up in the arteries.
2. High blood pressure - Blood pressure (BP) increases with each heartbeat and decreases when the heart relaxes. Blood pressure constantly changes as a result of exercise, stress, or sleep. For adults at rest, BP for adults should normally be less than 120/80 mm Hg (120 systolic and 80 diastolic).
3. Overweight - Body Mass Index (BMI) is a method used to determine if a person is overweight. It is calculated from a person's weight and height, and provides an indicator of body fatness, that can lead to health problems. Although BMI correlates with the amount of body fat, it does not directly measure body fat. So some people, such as athletes, may have a BMI that identifies them as being overweight even though they do not have excess body fat.
4. Smoking - Smoking is a major cause of heart disease. A person's risk of heart disease and heart attack greatly increases with the number of cigarettes smoked. People who smoke are 2-4 times more likely to suffer heart disease. Women who smoke are twice as likely to have a heart attack as male smokers.
5. Diabetes - Adults with diabetes are 2 - 4 times more likely to have cardiovascular disease than adults without diabetes. People with diabetes often have other risk factors that contribute to their risk for developing cardiovascular disease.

Risk factors that cannot be controlled are:

1. Gender – Coronary heart disease, the single biggest cause of death in the United States, claims men and women in nearly equal numbers each year.
2. Heredity - Certain inherited heart conditions can affect the physical structure of the heart and interfere with its ability to pump blood to the rest of the body. Hereditary electrical disturbances (dysrhythmias) can result in a heartbeat that is too fast, too slow or irregular. This can lead to dizziness, fainting, and sometimes death.
3. Age – As people age the risks of cardiovascular disease increase.

Take the Pledge to Reduce Your Risk

Reducing your odds of developing heart disease can begin with a personal pledge that involves five areas –

- *Achieve a healthy weight.* Being overweight or obese cause many preventable deaths.
- *Be active.* Commit to at least 30 minutes of moderate-intensity activity daily.
- *Eat smart.* Choose a diet that includes whole grains, vegetables and fruits, and one that is low in saturated fat, trans fat, and cholesterol.
- *Know your personal facts.* Have your physician check your blood pressure, cholesterol (total, HDL, LDL, triglycerides), and blood glucose, and establish a plan to improve these numbers.
- *Don't smoke, and if you already do, attempt to quit.* People who smoke are more likely to suffer a heart attack than non-smokers

Heart Attack

A **heart attack** occurs when blood flow to a part of the heart is blocked by a clot. This is often associated with atherosclerosis. If the damage to the heart muscle is too great, the heart can stop beating, a condition known as **cardiac arrest**.

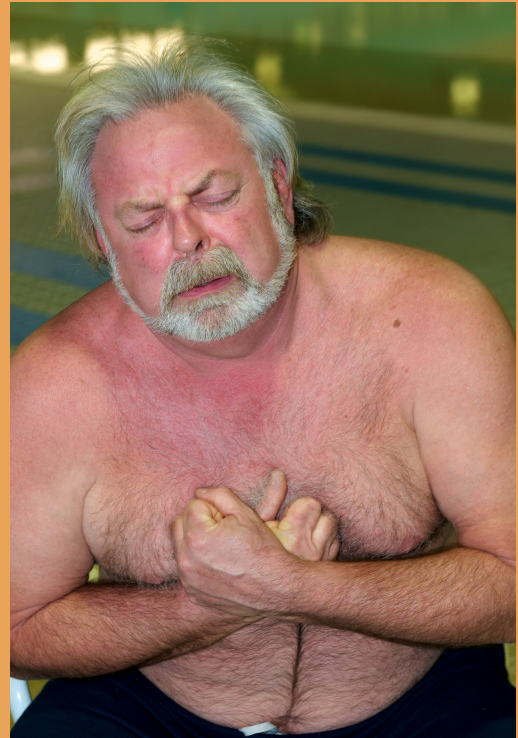
Recognizing a Heart Attack

The signs and symptoms of a heart attack can include:

- Chest pain or discomfort that lasts longer than 15 minutes, and can radiate to the arms, neck, jaw, or back (**Figure 4.2**)
- Difficulty breathing
- Profuse sweating
- Nausea and vomiting
- Cool, pale skin
- Unusual weakness / fatigue
- Dizziness / fainting
- Irregular heart beat

Not everyone presents with all these signs and symptoms. Some people have little or no chest discomfort. This is often referred to as a “silent heart attack,” and occurs most frequently in women, elderly, or those with diabetes.

Figure 4.2



Chest pain is a primary symptom of a heart attack.

Women and the Atypical Heart Attack

During a heart attack women can also experience the same heavy chest pressure that men feel, but many women don't. Unlike men, a large portion of women can experience a heart attack without chest pressure. Other atypical signs of a heart attack in women include pressure or pain in the lower chest or upper abdomen, upper back pressure, and unusual, extreme fatigue.

Caring for a Heart Attack

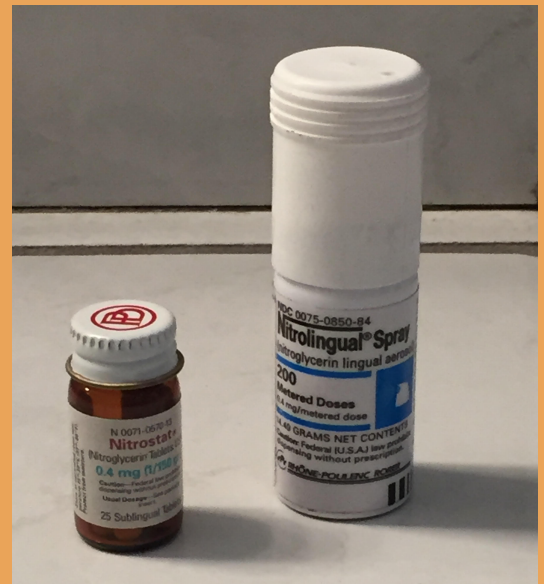
Follow these steps to care for a heart attack:

- Call 9-1-1.
- Have the victim stop all activity and rest in a comfortable position.
- Loosen any restrictive clothing.

- If the victim has a prescribed heart medication such as nitroglycerin, you can assist with its use. Because nitroglycerin lowers a person's blood pressure, it should not be given if the person is dizzy or feels faint (**Figure 4.3**).
- Provide low dose aspirin if the person is not allergic, not on a blood thinner, and does not have stomach disease. Provide 1-2 chewable aspirin (81mg each) (**Figure 4.4**).

Figure 4.4

Low dose aspirin can help victims of heart attack.

Figure 4.3

Nitroglycerin is a medication prescribed for select heart problems.

- Be prepared to provide cardiopulmonary resuscitation (CPR).
- Get an automated external defibrillator (AED) if available.

FYI: Chances of Heart Attack

Studies show that heart attacks are more likely to occur in the morning hours than any other time of day. Mondays are the most likely day of the week for a heart attack to occur. People are far more likely to experience a heart attack in the winter months than at any other time.

Why this happens is not exactly known. But it is believed that stress plays an important part. Cortisol is a hormone produced by the adrenal gland. It is often called the “stress hormone” because it is involved in response to stress. Elevated cortisol levels, and increased heart rates (also in response to stress) normally occurring during these times can lead to the rupture of plaque in coronary arteries.

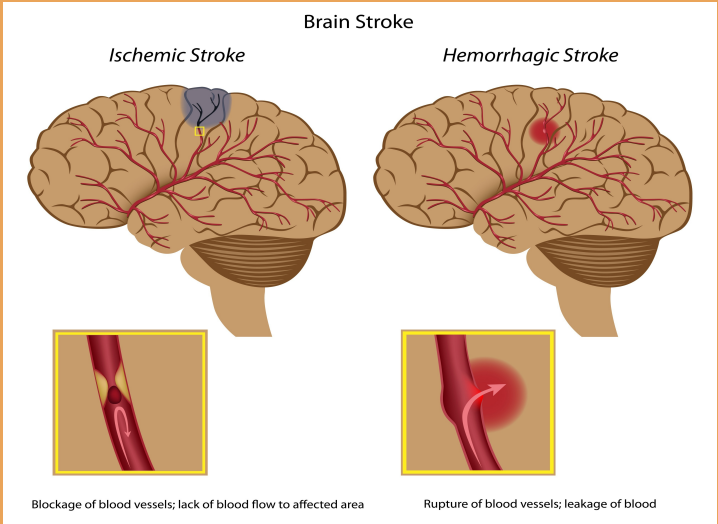
Stroke

Stroke, also called brain attack, occurs when a blood vessel in the brain becomes blocked (ischemic) or ruptures (hemorrhagic) (**Figure 4.5**). Most strokes are ischemic. Without adequate oxygen brain cells will die. Stroke and heart disease share many of the same risk factors.

As brain cells die, a person can show signs and symptoms of a stroke (**Table 4.1**), including:

- Numbness, weakness, or paralysis of the face, arm, or leg on one side
- Difficulty speaking
- Difficulty understanding
- Dizziness
- Blurred or decreased vision in one eye
- Sudden, severe headache
- Unequal pupils

Figure 4.5



There are two types of stroke.

Table 4.1 F.A.S.T. Stroke Action Plan

| Stroke Sign / Symptom | Questions |
|---------------------------|--|
| F acial Droop | Is one side of the face numb or drooping? If the person can smile, is it uneven? |
| A rm Weakness | Is one arm numb or weak? Can the person raise both arms equally? |
| S peech Difficulty | Is the person unable to speak or hard to understand? Can the person repeat a simple sentence correctly? |
| T ime to Get Help | Note the time the signs and symptoms first appeared and call 9-1-1 or summon more advanced care. |

Stroke Facts: Did You Know?

Strokes do not just affect older people. One in 10 strokes happen to people less than 45 years of age. One-fourth of all strokes occur among people less than age 65. And more women die from strokes each year than breast cancer.

Caring for Stroke

To care for stroke:

- Call 9-1-1. Getting the victim the necessary advanced medical care needed as soon as possible can save the victim's life or reduce the amount of injury to the brain.
- Have the victim rest in the most comfortable position, which is often lying on the back with the head and shoulders elevated.
- Loosen any restrictive clothing.
- Do NOT give the victim any medication that he or she might have been using for heart conditions, such as nitroglycerin or aspirin.

Cardiac Arrest

If the heart muscle is damaged severely, a person's heart can cease to function, a condition previously described as cardiac arrest. The person will become unresponsive, and stop breathing (or with only occasional gasps). The victim will not have a heartbeat. The immediate care for a person in cardiac arrest involves:

- Calling 9-1-1
- Providing cardiopulmonary resuscitation (CPR)
- Using an AED if it is available

A Closer Look: Agonal (Gasping) Breaths

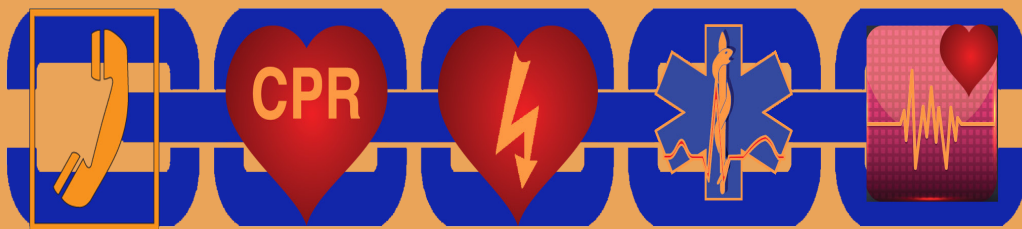
An unresponsive guest may have occasional gasping breaths called agonal breaths, which occur in the first few minutes of cardiac arrest. These are ineffective breaths and should not be confused with adequate breathing. Agonal breaths occur in about half of all guests experiencing cardiac arrest outside of a hospital. If agonal breaths are present, CPR should be performed.

The Chain of Survival: Taking Action

The **Chain of Survival** refers to a series of actions that must be linked together to provide the best care and chance of survival for a person in cardiac arrest (**Figure 4.6**). The five links are:

- Rapid recognition and activation of the emergency response system
- Immediate high quality CPR
- Rapid defibrillation
- Care by basic and advanced EMS personnel
- Advanced life support and post arrest care

Figure 4.6



The Chain of Survival is a series of actions that are initiated by laypersons.

Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) involves providing chest compressions and breaths that help circulate blood and oxygen to vital organs throughout the body (**Figure 4.7**). Once you have completed the primary check, verifying that the victim is unresponsive and not breathing, and 9-1-1 has been called, begin CPR starting with chest compressions.

Figure 4.7



CPR helps circulate blood and oxygen to vital organs during cardiac arrest.

Providing Chest Compressions

Chest compressions are a critical part of high quality CPR, and require rescuers to:

- Position the victim on his or her back, on a hard surface.
- Compress on the center of chest repeatedly.
- Push at a rate of about 110 compressions per minute (Range 100-120 per min).
- Push deep (at least 2 inches for adults).
- Push rhythmically.
- Allow for complete recoil of the chest following each compression.
- Minimize interruptions.

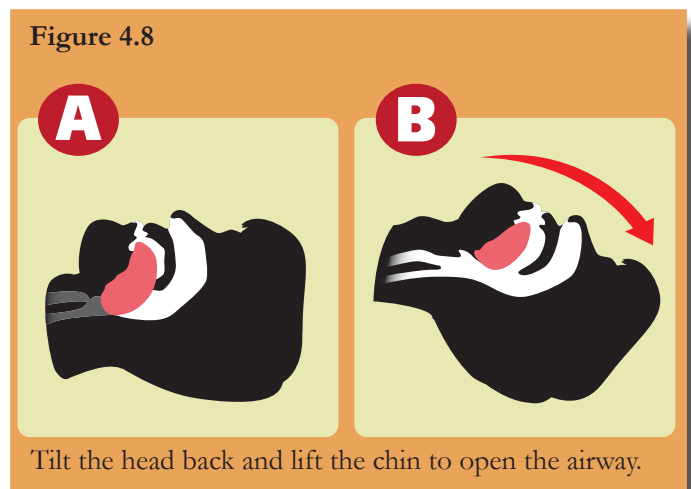
Opening the Airway

Breaths are the second part of CPR. But before breaths can be given, the victim's airway must be opened. To open the airway, place one hand on the victim's forehead and 2 fingers of the other hand under the chin. Tilt the head back while lifting the chin. This action moves the tongue away from the back of the throat to open the airway (**Figure 4.8**). Opening the airway of an adult requires you to tilt the head back farther than you would for children or infants. Do not over extend the neck of a child or infant, as this could cause narrowing of the trachea (windpipe).

If the victim suffered a serious injury to the head or neck, it is best to avoid movement of the head. In this situation, try to open the airway by just lifting the chin. If you cannot get your breaths to go in, tilt the head back gently.

Providing Rescue Breaths

With the airway open, give two **rescue breaths** after every 30 compressions. Each breath should be given over 1 second duration, and be enough to make the victim's chest rise. Breaths must be provided in a manner that does not overinflate the lungs or end up in the stomach. Breathing too rapidly or forcefully can damage the lungs of a young child or infant. It can also cause distention



(swelling) of the abdomen that can result in vomiting, inability of the lungs to fully inflate, and a decrease in the amount of blood that returns to the heart.

While rescue breaths can be performed by making a tight seal directly against the victim's mouth, you may feel more comfortable providing rescue breaths in a manner that minimizes the risk of disease transmission. A breathing device, such as a face shield, can be used to provide a barrier between you and victim during rescue breathing. This device is tiny and easily portable. Position the face shield on the victim's face, keep the airway open, pinch the nose, and provide breaths through the one-way port in the mask (**Figure 4.9**).

Figure 4.9



Breathing devices.

Special Situation: Laryngectomy

A victim who has had a laryngectomy has had his or her larynx surgically removed. This victim breathes through a small surgical opening in the front of the neck called a **stoma** (**Figure 4.10**). To provide rescue breathing for a victim with a laryngectomy, close the victim's mouth and nose, place the face shield over the stoma, and give breaths.

Figure 4.10



A victim with a laryngectomy breathes through a stoma.

If Breaths Do Not Make the Chest Rise

Occasionally rescue breaths may not make the chest rise. This is often because the airway has not been adequately opened. If your breath fails to make the chest rise, re-tilt the victim's head and try another breath. If the breath still does not go in, the airway may be obstructed. Follow these steps to provide care for an airway obstruction in any unresponsive victim:

1. Provide 30 chest compressions as described in the upcoming sections of this chapter.
2. Open the victim's mouth and look for any object. If an object is visible, sweep it out with your finger.
3. Reattempt your breaths.
4. Repeat these steps if your breaths fail to make the chest rise.

Compression - Only CPR

There may be times when you are unable or unwilling to provide rescue breaths for a victim of cardiac arrest. Examples include a victim who has blood or vomit in the mouth. Compression-only CPR is an acceptable alternative in these situations. Just provide the same compressions you normally give, but do not stop after 30 compressions. Instead, provide non-stop compressions for as long as you can, until others relieve you, or until the victim shows signs of life.

Stopping CPR

CPR is necessary for anyone found unresponsive and not breathing (or only gasping). Continue CPR until:

- An AED is available
- The victim shows signs of life (e.g. coughing, moaning, normal breathing, regains consciousness).
- You are too exhausted to continue.
- You are replaced by another rescuer able to perform CPR.
- The scene is no longer safe.
- Medical professionals (EMS/physician) advise to stop resuscitative efforts.
- Cardiac arrest lasts longer than 30 minutes, except in situations involving hypothermia or cold water drowning

Adult CPR

For the purpose of layperson CPR, adults are considered to be those older than age 8. Provide CPR to an adult by following these steps:

1. Position the victim on his or her back on a hard surface.
2. Tap and shout to check for responsiveness.

3. If the victim is unresponsive, make sure 9-1-1 has been called.
4. Check for breathing.
5. If unresponsive and not breathing (or only gasping), begin CPR.
6. Kneel alongside victim's chest.
7. Place the heel of one hand on the center of the chest (breastbone) between the nipples. Place your other hand on top of the first hand. Straighten your arms and lock your elbows.
8. With your shoulders over your hands compress the chest at least 2 inches and allow the chest to return to its normal position. Give 30 chest compressions at a rate of about 110 compressions per minute (range of 100-120) **(Figure 4.11)**.
9. Tilt the head back and lift the chin to open the victim's airway.
10. Give 2 breaths. Each breath should last about 1 second and make the chest rise **(Figure 4.12)**.
11. Repeat cycles of 30 compressions and 2 breaths until a defibrillator is available or the victim shows signs of life.

Figure 4.11

Use 2 hands to compress the chest of an adult in cardiac arrest.

Figure 4.12

Open the airway and give 2 rescue breaths after each set of 30 chest compressions.

Child CPR

For the purpose of layperson CPR, children are considered to be those 1-8 years of age. Provide CPR to a child by following these steps:

1. Position the child on his or her back on a hard surface.
2. Tap and shout to check for responsiveness.
3. If the child is unresponsive, make sure 9-1-1 has been called.

4. Check for breathing.
5. If unresponsive and not breathing (or only gasping), begin CPR.
6. Kneel alongside the child's chest.
7. You can use 1 or 2 hands when providing chest compressions for a child. If using 1 hand, place the heel of your hand on the center of the chest (breastbone) between the nipples. Straighten your arm and lock your elbow. If using 2 hands, place your hands as you would for an adult.
8. Compress the chest at least one third the depth of the chest (about 2 inches) and allow the chest to return to its normal position. Give 30 chest compressions at a rate of about 110 compressions per minute (range of 100-120) (**Figure 4.13**).
9. Tilt the head back slightly and lift the chin to open the child's airway.
10. Give 2 breaths. Each breath should last about 1 second and make the chest rise (**Figure 4.14**).
11. Repeat cycles of 30 compressions and 2 breaths until a defibrillator is available or the child shows signs of life.

Figure 4.13

Use 1 or 2 hands to compress the chest of a child in cardiac arrest.

Figure 4.14

Open the airway and give 2 rescue breaths after each set of 30 chest compressions.

Infant CPR

For the purpose of layperson CPR, infants are considered to be those up to 1 year of age. Provide CPR to an infant by following these steps:

1. Position the infant on his or her back on a hard surface.
2. Tap and shout to check for responsiveness.

3. If the infant is unresponsive, make sure 9-1-1 has been called.
4. Check for breathing.
5. If unresponsive and not breathing (or only gasping), begin CPR.
6. Kneel alongside the infant's chest.
7. Place 2 fingers on the center of the chest (breastbone) slightly below the nipples.
8. Use your fingers to compress the chest at least one third the depth of the chest (about 1.5 inches) and allow the chest to return to its normal position. Give 30 chest compressions at a rate of about 110 compressions per minute (range of 100-120) **(Figure 4.15)**.
9. Tilt the head back slightly and lift the chin to open the infant's airway.
10. Give 2 breaths. Each breath should last about 1 second and make the chest rise **(Figure 4.16)**.
11. Repeat cycles of 30 compressions and 2 breaths until a defibrillator is available or the infant shows signs of life.

Figure 4.15

Use 2 fingers to compress the chest of an infant in cardiac arrest.

Figure 4.16

Open the airway and give 2 rescue breaths after each set of 30 chest compressions.

Key Terms

- Atherosclerosis
- Automated External Defibrillator (AED)
- Cardiac arrest
- Cardiopulmonary resuscitation (CPR)
- Cardiovascular disease
- Chain of survival

Key Points

- ✓ Laypersons are often the first on the scene, and are capable of rendering appropriate initial care for a victim with a heart problem.
- ✓ Care begins by checking responsiveness, breathing, and circulation.
- ✓ An unresponsive, non-breathing person needs CPR, an AED, and more advanced care.
- ✓ Regardless of whether the person is an adult, child, or infant, the general steps of CPR are
- ✓ the same.
- ✓ Begin CPR with chest compressions. Compressions should be deep, fast, and with minimal interruptions.
- ✓ When performing CPR, provide 30 compressions and 2 breaths.
- ✓ Repeat cycles of compressions and breaths until a defibrillator is available, you are too
- ✓ Continue CPR until you are too exhausted to continue, the victim shows signs of life, or EMS personnel take over care.

Check Your Progress

Now that you have read this chapter and completed any accompanying class activities you should be able to answer the following questions:

- ✓ Can you explain how the circulatory system works? (Pg 30)
- ✓ What are the risk factors of cardiovascular disease? (Pg 30-32)
- ✓ How does a heart attack occur? (Pg 32)
- ✓ What are the signs and symptoms of a heart attack? (Pg 33)
- ✓ Can you describe how to care for a person experiencing a heart attack? (Pg 33-34)
- ✓ Can you identify the signs and symptoms of a person experiencing a stroke? (Pg 35)
- ✓ Can you describe how to care for a person experiencing a stroke? (Pg 36)
- ✓ What are the links in the Chain of Survival? (Pg 37)
- ✓ How should you provide CPR for an adult, child, or infant in cardiac arrest? (Pg 37-43)

Chapter 5

Automated External Defibrillation

Learning Outcomes

After reading this chapter and completing any related course work, you will be able to:

- Explain the electrical conduction system of the heart.
- Explain the two abnormal heart rhythms that the AED can correct.
- Identify the elements common to all AEDs.
- Describe how an AED works to help a victim in cardiac arrest.
- Describe special considerations when using an AED.
- Describe how to maintain an AED in proper working condition.
- Demonstrate how to use an AED.

Chapter Quick Look

- The Heart's Electrical Conduction System
- About AEDs
- Using an AED
- Special Considerations
- Maintenance
- Chapter Review

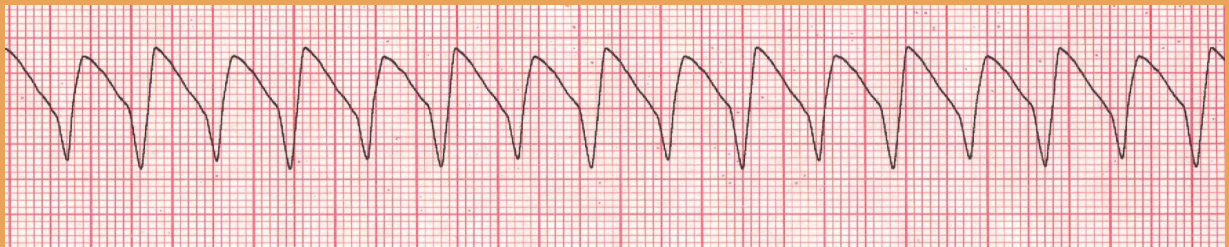
The Heart's Electrical Conduction System

The electrical conduction system of the heart sends the signal that results in the contraction of the chambers of the heart and the pulse that can be felt. The normal electrical impulse in the heart originates in the upper right side, occurs about once every second, and travels along pathways within the heart. When the electrical impulse causes the heart muscle to contract, it forces blood to move throughout the body.

When the normal electrical activity of the heart is interrupted, electrical disturbances known as **dysrhythmias** will occur. These dysrhythmias are able to be viewed as tracings on an **electrocardiogram (ECG)**. Two of the most common life-threatening dysrhythmias seen in the first few minutes of sudden cardiac arrest are ventricular tachycardia (V-tach) and ventricular fibrillation (V-fib).

Ventricular tachycardia causes the ventricles to beat far too fast. The chambers cannot fill properly or pump blood effectively (**Figure 5.1**).

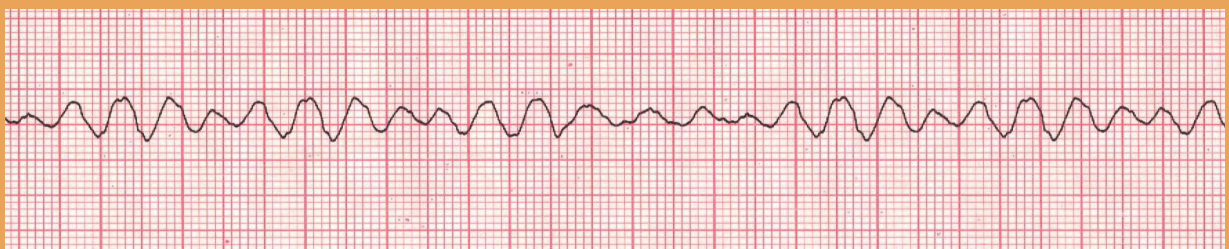
Figure 5.1



Electrocardiogram (ECG) showing Ventricular Tachycardia.

Ventricular fibrillation is disorganized, chaotic electrical activity that results in quivering of the ventricles. Blood cannot be pumped out of the heart so the victim will be pulseless (**Figure 5.2**).

Figure 5.2



Electrocardiogram (ECG) showing Ventricular Fibrillation.

About AEDs

An **automated external defibrillator (AED)** is a portable electronic device applied to a victim in cardiac arrest. It is capable of analyzing the heart rhythm and delivering an electric shock, known as **defibrillation**, to the heart of a victim to correct ventricular fibrillation or ventricular tachycardia. The goal of defibrillation is to reestablish a viable heart rhythm by shutting down the heart (asystole), enabling the heart to restart with normal electrical and mechanical function. Besides analyzing the heart rhythm and delivering a shock if needed, an AED also records data such as the number of shocks delivered, changes in the ECG, the date, and the time of use. (**Figure 5.3**).

There are several different AED manufacturers. Beyond the minor differences in device appearance (color, size, buttons), all AEDs have the following commonalities (**Figure 5.4**):

- Battery operated
- Self – maintained internal diagnostics
- Power on/off
- Voice prompts to guide users
- Cable and electrode pads to attach to the chest
- ECG Analysis capability
- Defibrillation capability

Figure 5.3



AEDs can quickly analyze the heart rhythm and provide a shock if needed.

Figure 5.4



Though there are different devices, all devices have common features.

FYI: “Rebooting” the Heart

It may help you to think of an AED restarting the heart in a manner similar to a computer being “rebooted,” when it becomes locked and must be shut down completely and then restarted.

Using an AED

The initial care for a victim in cardiac arrest involves giving CPR until a defibrillator is available. For every minute that defibrillation is delayed, the chance that a victim in cardiac arrest will survive decreases 7% - 10%.

Once an AED is available, turn the device on and follow the prompts. Expose and prepare the victim's chest. This involves removing any clothing, as well as drying the chest and shaving any excessive hair (where the electrodes will be placed) if needed. A "Ready Kit" is part of the AED, and normally includes scissors, razor, and a drying cloth (**Figure 5.5**).

With the chest prepared, remove the two **electrode pads** from the package. Peel the protective backing off the pads, and place the pads on the chest according to the diagram on the packaging. For adults, one pad is placed just below the right collarbone. The other pad is placed on the lower left side of the chest (**Figure 5.6**). Pad placement varies for children and infants. Follow the manufacturer's instructions for use of pediatric pads if available.

With the cable attached to the AED the device will immediately begin analysis of the heart's electrical activity once the second electrode pad is attached. Stand clear and allow the device to analyze the rhythm. The AED will advise of the need to administer a shock. Some AED's are fully automated and will administer the shock automatically. Others are semi-automatic requiring the operator to push a flashing "shock" button (**Figure 5.7**).

Figure 5.5



A "Ready Kit" has necessary AED supplies.

Figure 5.6



Place electrode pads on the upper right side and lower left side of an adult victim's chest.

Figure 5.7



AEDs can deliver the shock automatically, or require the user to press a button to deliver the shock.

If advised to shock, make sure no one is in contact with the victim before the shock is administered. If no shock is advised, it means that the AED did not find a shockable rhythm (V-fib or v-tach) (Figure 5.8).

Figure 5.9

Provide 2 minutes of CPR after delivering any shock.

Figure 5.8

Make sure everyone is standing clear before the shock is delivered.

Regardless of whether a “shock” or a “no shock” advisory is given, follow with 2 minutes of CPR as long as the victim is in cardiac arrest. In some cases more than one shock will be needed to correct the dysrhythmia. Two minutes of CPR should be given following every analysis or shock. If the shock is successful the victim may begin to show signs of life (Figure 5.9).

A Survivor's Perspective

Dennis Burstein is an accomplished athlete, coach, educator, and administrator. He is a spouse, parent, and grandparent. But he is far more than this. He is a survivor of sudden cardiac arrest. Dennis is not unique because he survived cardiac arrest, but rather, the way in which he survived it.

Dennis suffered two heart attacks! The first heart attack happened when he was a young man, just 40 years of age. The second occurred 12 years later. Here is his remarkable story of survival.



It was early morning in mid-September. I had just completed a vigorous 2 hour swimming workout. When I arrived home just before 7:00 a.m., I told one of my children and my wife that I was not feeling well and just wanted to lie down for a few minutes.

Minutes later I felt my chest suddenly compress three times, going “pa-thump, pa-thump, pa-thump.” I knew I was having a heart attack. Just as suddenly, my chest felt fine, there was no pain, only a sudden awareness that I had to get to the hospital right away. I knew if I asked my wife to take me that she would need a few minutes to get dressed, and if I called 9-1-1 I feared it would be a longer delay. Since I lived a half mile from the hospital, I grabbed the car keys, said I was going to the hospital, and drove away.

How fortunate that I made it to the hospital. It was even more fortunate that when I arrived at the hospital there were no other patients present! As I registered and sat down in the triage area my chest compressed again, four more times. Simultaneously, I felt like an entire swimming pool of water was flowing over my head and down my body, as I slid off the chair toward the floor.

The next thing I remembered was waking up and realizing I had been defibrillated. What I found out later is that it was the third shock that brought me back. When I opened my eyes my wife was at my side asking how I was feeling. Just then my heart stopped again, and I was defibrillated several more times. The next time I awoke was after the sixth defibrillation. I felt my body pop up off the table and I shouted out “that hurt.” Collapsing again, a seventh shock was provided. I again felt my body pop off the table and I shouted out again. Though things were hazy, I saw a group of people standing around me. A group of interns had just arrived, and my condition caused everyone to observe. Each time following defibrillation my heart would recover, but then I would go back into cardiac arrest. The 8th, 9th, and 10th shocks were administered when I arrested in the cardiac cath lab where I had emergency surgery.

After celebrating my 40th birthday in the hospital, things were fine for 12 more years until I had a second heart attack at age 52. This was the same age that my father died of a heart attack. After being successfully defibrillated (this time by an AED), and surviving that event, it was suggested that I put in an internal cardiac defibrillator (ICD). I was in no hurry to return to the hospital, and delayed having this procedure for several more years. Finally I was ready. Three stents were installed along with an ICD.

Although it was very noticeable to me when it was first implanted, after a while it seemed hardly noticeable. Even when I am swimming most people never even noticed. I know my ICD is there just in case I experience another event. It is like an insurance policy for my heart. My first ICD lasted more than the six years of its expected battery life.

I am now on my second ICD, which is expected to last more than 10 years. I am anxious to see what new technology will be out there when it needs to be replaced. At this point in my life, I continue to eat relatively well, take my medicine, and exercise on a regular basis. Exercising regularly helps me feel good, reduce stress, stay fit, look better, and live a longer, healthier life. And right now my blood lipids are the best they have ever been. The more I am with my family and friends the more fulfilling my life becomes.



Special Considerations

There are several special considerations to be aware of when using an AED:

- Medication patches
- Children and infants
- Water
- Implanted devices
- Jewelry and body piercings
- Metal Surfaces

Medication Patches

Medication patches such as nitroglycerin, pain medication, or nicotine are worn on the skin and absorbed into the body. If a patch is worn on the chest and it is in the way of where an electrode pad will be placed, remove the patch, dry the chest, and apply the electrode pads (**Figure 5.10**).

Figure 5.10



Remove any medication patches in the way of the electrode pads.

Children and Infants

Cardiac arrest in children and infants is usually secondary to airway and breathing problems that ultimately lead to cardiac arrest. AEDs can be used on adults, children, or infants. Special pediatric electrodes pads or a pediatric “key,” reduce the energy for use on those 8 years of age or less (**Figure 5.11**). Pediatric pads are to be placed according to the manufacturer’s instructions. For infants this means placement of one pad on the chest and the other on the back. If pediatric pads are not available, adult pads can be used. The pediatric “key” turns a specific AED into a pediatric AED, adjusting the voice instructions and decreasing the energy during defibrillation of children and infants using the same set of electrode pads for adults.

Figure 5.11



Use pediatric pads or “key” if available for those 8 years of age or younger.

Water

Water is a conductor of electricity, which could provide a pathway for electricity between the AED and rescuers. Common practice is to remove the victim from any free-standing water. This might involve moving a victim from a pool to at least 6 feet away from the pool edge. It could also include placing the victim on a backboard to further ensure separation from the water. Dry the victim's chest and then attach the electrode pads. Taking these precautions greatly reduces any risks to rescuers (**Figure 5.12**).

Figure 5.12



Move the victim from standing water and dry the chest before applying electrode pads.

Implanted Devices

Implanted devices include internal **pacemakers** and **cardioverter defibrillators (ICD)** (**Figure 5.13**). These devices are placed under the skin and attached to the heart in people with specific heart conditions. They can often be seen or felt once clothing is removed from the chest. They are often placed under the skin on the top left side of the chest, so AED electrode pads should not normally be in contact with these implanted devices. If the device has been placed in an area where the pad is normally positioned, avoid placing the AED electrode pad over top of the implanted device.

Figure 5.13



Implanted Cardioverter Defibrillator (ICD).

Since an ICD shocks the heart directly, a shock from an ICD is less powerful than a shock given externally through an AED. Though the victim will feel a jolt, the energy that escapes to the surface, where a rescuer might be contact with the victim, is hard to detect and harmless.

Jewelry and Body Piercings

In most cases there is no need to remove body piercings and jewelry when using an AED. Place the electrode pads so that are not directly over metallic jewelry or body piercings. This may require you to position the pads slightly different than normal. Remove jewelry or body piercings if there is no other way to safely place the electrode pads.

Metal Surfaces

It is safe to deliver a shock when a guest is on a metal surface, as long as the AED electrode pads do not contact the metal surface and no one is touching the guest during defibrillation.

Maintenance

AEDs require very little maintenance. Devices run their own internal checks to verify proper operation. AEDs have warning lights that signal users that the device is functioning properly or that it is malfunctioning. If a device has a problem, such as a low battery, it can inform users by changing to a red light instead of its normal light, and chirping the same way a smoke alarm does. This signals those responsible for the maintenance of the device that attention is needed immediately (**Figure 5.14**).

Periodic inspection of the AED will also ensure that the proper supplies, such as unexpired electrode pads are in place, as well as items such as a razor, scissors, and drying cloth (**Figure 5.15**).

Figure 5.14



AEDs run internal diagnostics to ensure proper working condition. Warning lights verify that the device is functioning properly or needs attention.

Figure 5.15



Periodic inspection of the AED will ensure it is proper function and that the necessary supplies are available and up-to-date.

Chapter 5 REVIEW

Key Terms

- Automated External Defibrillator (AED)
- Defibrillation
- Dysrhythmia
- Electrocardiogram (ECG)
- Electrode pads
- Internal cardioverter defibrillator (ICD)
- Pacemaker
- Ventricular fibrillation
- Ventricular tachycardia

Key Points

- ✓ The electrical conduction system of the heart is responsible for coordinating the rhythmic pumping action of the heart.
- ✓ Ventricular fibrillation (V-fib) and ventricular tachycardia (V-tach) are two of the most common electrical disturbances present at the time of cardiac arrest. Both of these rhythms interrupt normal blood flow. Both respond to defibrillation.
- ✓ The earlier an AED can be used the greater the chance the victim will survive. Chances decrease 7% -10% for each minute that defibrillation is delayed.
- ✓ Provide high quality CPR until an AED is available. Once available, turn on the device and follow the prompts of the device.
- ✓ An AED will give one of two commands – “Shock” or “No shock advised.” Provide CPR for two minutes after receiving the command.
- ✓ After two minutes of CPR the AED will advise to stand clear so that it can reanalyze the heart and advise how to continue with care.
- ✓ There are a few special considerations when using an AED: water, medication patches, children and infants, implanted devices, metal surfaces, jewelry and body piercings.
- ✓ An AED requires little maintenance other than regular inspection to verify that the device is functioning properly and has the necessary supplies.

Check Your Progress

Now that you have read this chapter and completed any accompanying class activities answer the following questions:

- ✓ Can you explain the electrical conduction system of the heart? (Pg 47)
- ✓ What are the two abnormal heart rhythms that an AED can correct? (Pg 48)
- ✓ What elements are common to all AEDs? (Pg 48)
- ✓ What are several special considerations to be aware of when using an AED? (Pg 52)
- ✓ Can you explain how to use an AED for an adult, child, and infant in cardiac arrest? (Pg 49-50)
- ✓ How should an AED be maintained to insure proper working condition? (Pg 54)

APPENDICES

SKILL PERFORMANCE SHEET: ADULT CPR

Name:

Date:

Instructor:

| Task | Practice Prompts | Satisfactory | Unsatisfactory |
|---|--|--------------|----------------|
| Check responsiveness. | <i>Adult is unresponsive.</i> | | |
| Make sure 9-1-1 has been called. | <i>EMS system has been activated.</i> | | |
| Check breathing. | <i>Breathing is absent or only gasping sounds are heard.</i> | | |
| Use 2 hands to provide 30 chest compressions at a rate of about 110/min (range 100-120), at least 2 inches in depth and with proper recoil. | | | |
| Tilt the head and lift the chin to open the airway. | <i>Airway is open</i> | | |
| Give 2 breaths (each 1 second in duration) to achieve chest rise. | <i>Chest rise is noted</i> | | |
| Continue CPR cycles until an AED is available. | <i>It has been 2 minutes. An AED is available.</i> | | |

Notes: _____

SKILL PERFORMANCE SHEET: CHILD CPR

Name:

Date:

Instructor:

| Task | <i>Practice Prompts</i> | Satisfactory | Unsatisfactory |
|--|--|---------------------|-----------------------|
| Check responsiveness. | <i>Child is unresponsive.</i> | | |
| Make sure 9-1-1 has been called. | <i>EMS system has been activated.</i> | | |
| Check breathing. | <i>Breathing is absent or only gasping sounds are heard.</i> | | |
| Use 1 or 2 hands to provide 30 chest compressions at a rate of about 110/min (range 100-120), about 2 inches in depth, and with proper recoil. | | | |
| Tilt the head and lift the chin to open the airway. | <i>Airway is open</i> | | |
| Give 2 breaths (each 1 second in duration) to achieve chest rise. | <i>Chest rise is noted</i> | | |
| Continue CPR cycles until an AED is available. | <i>It has been 2 minutes. An AED is available.</i> | | |

Notes: _____

SKILL PERFORMANCE SHEET: INFANT CPR

Name:

Date:

Instructor:

| Task | <i>Practice Prompts</i> | Satisfactory | Unsatisfactory |
|---|--|---------------------|-----------------------|
| Check responsiveness. | <i>Infant is unresponsive.</i> | | |
| Make sure 9-1-1 has been called. | <i>EMS system has been activated.</i> | | |
| Check breathing. | <i>Breathing is absent or only gasping sounds are heard.</i> | | |
| Use 2 fingers to provide 30 chest compressions at a rate of about 110/min (range 100-120), about 1.5 inches in depth, and with proper recoil. | | | |
| Tilt the head slightly and lift the chin to open the airway. | <i>Airway is open</i> | | |
| Give 2 breaths (each 1 second in duration) to achieve chest rise. | <i>Chest rise is noted</i> | | |
| Continue CPR cycles until an AED is available. | <i>It has been 2 minutes. An AED is available.</i> | | |

Notes: _____

PERFORMANCE SKILL SHEET: AED

Name:

Date:

Instructor:

| Task | Practice Prompts | Satisfactory | Unsatisfactory |
|---|--|---------------------|-----------------------|
| Provide CPR until an AED is available. | <i>An AED is now available.</i> | | |
| Turn on the Device. | <i>Device is on.</i> | | |
| Ensure chest is bare and dry. | | | |
| Apply electrode pads to chest according to manufacturer design. | <i>Pads are applied.</i> | | |
| Stand clear. | | | |
| Initiate analysis. | <i>Shock advised.</i> | | |
| Deliver shock. | <i>Shock delivered.</i> | | |
| Provide CPR, starting with chest compressions. | | | |
| Reanalyze rhythm after 2 minutes. | <i>No shock advised.</i> | | |
| Resume CPR if still needed, and reanalyze every 2 minutes. | <i>Victim is unresponsive, but breathing normally.</i> | | |

Notes: _____

SKILL PERFORMANCE SHEET: ADULT / CHILD AIRWAY OBSTRUCTION

Name:

Date

Instructor:

| Task | Practice Prompts | Satisfactory | Unsatisfactory |
|--|---|--------------|----------------|
| <i>Responsive Adult / Child</i> | | | |
| Determine that the adult/child is choking. | <i>Adult/child is unable to speak, cough, or cry.</i> | | |
| Provide abdominal thrusts (Heimlich Maneuver) until the obstruction is relieved or the adult/child becomes unresponsive. | <i>Object is expelled.</i> | | |
| | | | |
| <i>Unresponsive Adult/Child</i> | | | |
| Position the adult/child on the back on the ground. | | | |
| Make sure 9-1-1 has been called. | <i>EMS system has been activated.</i> | | |
| Provide 30 chest compressions in the same manner as CPR. | | | |
| Open the airway and look in the mouth. Remove any object that is visible. | <i>No object is visible.</i> | | |
| Attempt 2 breaths. | <i>First breath is unsuccessful.</i> | | |
| If breath is unsuccessful, reposition the head and reattempt breath. | <i>Second breath is unsuccessful.</i> | | |
| Repeat chest compressions, object check, and breaths until the obstruction is relieved or EMS personnel arrive. | <i>Obstruction is relieved and adult/child is breathing normally.</i> | | |

Notes: _____

SKILL PERFORMANCE SHEET: INFANT AIRWAY OBSTRUCTION

Name:

Date:

Instructor:

| Task | Instructor Prompts | Satisfactory | Unsatisfactory |
|---|--|--------------|----------------|
| Responsive Infant | | | |
| Determine that the infant is choking. | <i>Infant is unable to speak, cough, or cry.</i> | | |
| Provide 5 back slaps and 5 chest compressions. Check mouth for object and remove if visible. | <i>Obstruction is not relieved.</i> | | |
| Repeat procedures until the obstruction is relieved or the infant becomes unresponsive. | <i>Object is expelled.</i> | | |
| | | | |
| Unresponsive Infant | | | |
| Position the infant on the back on the ground. | | | |
| Make sure 9-1-1 has been called. | <i>EMS system has been activated.</i> | | |
| Provide 30 chest compressions in the same manner as CPR. | | | |
| Open the airway and look in the mouth. Remove any object that is visible. | <i>No object is visible.</i> | | |
| Attempt 2 breaths. | <i>First breath is unsuccessful.</i> | | |
| If breath is unsuccessful, reposition the head and reattempt breath. | <i>Second breath is unsuccessful.</i> | | |
| Repeat chest compressions, object check, and breaths until the obstruction is relieved or EMS personnel arrive. | <i>Obstruction is relieved and infant is breathing normally.</i> | | |

Notes: _____

GLOSSARY

Abandonment Abandoning a person after you started to give care without ensuring the person continues to receive care at an equal or higher level.

Advanced cardiac life support (ACLS) Specialized care procedures initiated by paramedics and EMTs in the prehospital setting, and physicians and nurses in the hospital setting.

Airway Obstruction Choking

Atherosclerosis Plaque accumulates on the walls of the arteries of the heart, narrowing the arteries and restricting blood flow.

Atria The two upper chambers of the heart.

Automated External Defibrillator (AED) Battery powered device used to correct certain types of electrical disturbances within the heart.

Basic Life Support (BLS) The initial care provided for those experiencing respiratory and cardiac emergencies.

Bronchi Two main branches off the trachea which allow air to enter into each of the two lungs.

Bronchioles The division of the bronchi into smaller branches.

Capillaries Tiny blood vessels involved in the exchange of oxygen and carbon dioxide.

Carbon dioxide Waste product produced by the body and exhaled.

Cardiac arrest Absence of responsiveness, breathing, and pulse.

Cardiopulmonary resuscitation (CPR) Providing chest compressions and breaths to a person in cardiac arrest (unresponsive and not breathing).

Chain of Survival A series of actions that must be linked together to provide the best care and chance of survival for a person in cardiac arrest.

Choking blockage of the airway

Cardiovascular Disease (CVD) Also known as heart disease, CVD involves diseases that affect the heart and blood vessels.

Coronary heart disease (CHD) Involves the narrowing of the coronary arteries; the blood vessels that supply oxygen and blood to the heart.

Consent Approval given by an ill or injured person, either verbally or as a gesture. If a person is unable to grant consent due to mental impairment, confusion, or loss of consciousness, then consent is implied.

Defibrillation A process in which an electronic device sends an electric shock to the heart to stop an extremely rapid/ irregular heartbeat and restore normal heart rhythm.

Duty to Act Legal duty to respond to emergency situations and provide care.

Dysrhythmia Disturbance of the electrical conduction system in the heart.

Electrocardiogram (ECG) An assessment of the function of the heart's electrical activity.

Electrode pads Pads placed on the chest of a person in cardiac arrest to determine the ECG and administer a shock if needed.

Emergency Medical Services Community resources including EMTs and paramedics

First Aid The immediate care provided to an ill or injured victim.

Good Samaritan Laws State laws enacted to protect responders from legal actions that might arise from emergency care provided while not in the line of duty. These laws vary from state to state.

Head Tilt – Chin Lift Technique used to open a person's airway so that the tongue does not restrict the back of the throat.

Heart Attack Resulting damage that occurs when blood flow to a part of the heart is blocked.

Heimlich Maneuver Care procedure for a conscious choking adult or child.

Hepatitis A bloodborne virus causing serious disease of the liver.

Human Immunodeficiency Syndrome A bloodborne virus that attacks white blood cells, destroying the body's ability to fight infection, and leading to AIDS in most cases.

Implanted Cardioverter defibrillator (ICD) a device placed within the body, designed to recognize and correct certain types of abnormal heart rhythms, such as ventricular fibrillation and ventricular tachycardia.

Laryngectomy A person who has had his or her larynx surgically removed.

Negligence Failure to follow a reasonable standard of care, which causes or contributes to injury or damage.

Oxygen Chemical in the air breathed; essential for life.

Pacemaker A device placed within the body, designed to recognize and correct certain types of abnormal heart rhythms, such as very slow rhythms.

Personal Protective Equipment (PPE) Standard precautions used to ensure that health care providers have an effective barrier between themselves and an ill or injured person.

Primary Check The initial process of checking for immediate threats to life.

Rescue breathing The process of manually providing oxygen to the lungs of a non-breathing person during CPR.

Respiratory arrest Stoppage of breathing.

Respiratory distress Difficulty breathing.

Standard Precautions Measures used to reduce the risk of disease transmission.

Stoma A small opening in the front of the neck through which a person who has had a laryngectomy breathes.

Stroke A blockage of blood flow or rupture of an artery to the brain resulting in death of brain cells.

Trachea The windpipe.

Tuberculosis (TB) A communicable airborne disease.

Ventricles The two lower chambers of the heart.

Ventricular fibrillation Condition of disorganized, chaotic electrical activity in the heart.

Ventricular tachycardia Electrical disturbance that causes the ventricles of the heart to beat far too fast.

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