A heart attack occurs when heart muscle tissue dies because its blood supply is severely reduced or stopped. This often occurs because of a clot in one or more coronary arteries. The signs of a heart attack and the steps for caring for a heart attack are discussed in detail in chapter 12. If damage to the heart muscle is too severe, the victim's heart can stop beating—a condition known as cardiac arrest. Sudden cardiac arrest is a leading cause of death in the United States, affecting about 250,000 people yearly in out-of-hospital locations.

Chain of Survival

Few victims experiencing sudden cardiac arrest outside of a hospital survive unless a rapid sequence of events takes place. The chain of survival is a way of describing the ideal sequence of care that should take place when a cardiac arrest occurs.

The four links in the chain of survival are as follows:

1. Early access: Recognizing the emergency and immediately calling 9-1-1 to activate emergency medical services (EMS).
2. Early CPR: Cardiopulmonary resuscitation (CPR) supplies a minimal amount of blood to the heart and brain. It buys time until a defibrillator and EMS personnel are available. It can double or triple the victim's chances of survival.
3. **Early defibrillation:** Administering a shock to the heart can restore the heartbeat in some victims. It can produce survival rates as high as 50–75%.

4. **Early advanced care:** Health care providers give advanced cardiac life support to victims of sudden cardiac arrest. This includes providing IV fluids, medications, and advanced airway devices. If any one of these links in the chain is broken (absent), the chance that the victim will survive is greatly decreased. If all links in the chain are strong, the victim has the best possible chance of survival.

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**FYI**

Defibrillation

Most adults in cardiac arrest need defibrillation. Early defibrillation is the single most important factor in surviving cardiac arrest. Chapter 6 provides information on automated external defibrillators (AEDs).

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**Performing CPR**

When a person’s heart stops beating, he or she needs CPR, an AED, and EMS professionals quickly. CPR consists of breathing oxygen into a victim’s lungs and moving blood to the heart and brain by giving *chest compressions*. CPR techniques are very similar for infants (birth to 1 year), children (ages 1–8), and adults (age 8 and older), with just a few slight variations.

**Check for Responsiveness**

When the scene is safe, check for responsiveness by tapping the victim’s shoulder and asking if he or she is okay. If the victim does not respond, ask a bystander to call 9-1-1. If you are alone with an adult and a phone is nearby, call 9-1-1. If you are alone with an unresponsive child or infant, give CPR for 2 minutes (five cycles), and then call 9-1-1.

**Open the Airway and Check for Breathing**

Before starting CPR, open the victim’s airway and check to see if the victim is breathing. Open the airway by tilting the head back and lifting the chin (**Figure 5-1**). This moves the tongue away from the back of the throat, allowing air to enter and escape the lungs. The procedure can be done for injured or uninjured victims.

While performing the head tilt-chin lift maneuver, check for breathing by placing your ear next to the victim’s mouth and looking at the victim’s chest. Look, listen, and feel for signs of normal breathing for 5 to 10 seconds (**Figure 5-2**).

**Rescue Breaths**

If the victim is not breathing, you must provide rescue breaths. With the airway open, pinch the victim’s nose and make a tight seal over the victim’s mouth with your mouth. Give one breath lasting 1 second, take a normal breath for yourself (not a deep breath), and then give another breath like the first one. Each rescue breath should make the victim’s chest rise. Other methods of rescue breathing are as follows:

- Mouth-to-barrier device
- Mouth-to-nose method
- Mouth-to-stoma method
Mouth-to-Barrier Device
A barrier device is placed in the victim's mouth or over the victim's mouth and nose as a precaution against infection. There are several different types of barrier devices (for example, face shields and face masks), and all are easy to use with little modification to the mouth-to-mouth method (Figure 5-3).

Mouth-to-Nose Method
If you cannot open the victim's mouth, the teeth are clenched shut, the mouth is severely injured, or you cannot make a good seal with the victim's mouth (for example, because there are no teeth), use the mouth-to-nose method. With the head tilted back, push up on the victim's chin to close the mouth. Make a seal with your mouth over the victim's nose and provide rescue breaths.

Mouth-to-Stoma Method
Some diseases of the vocal cords result in surgical removal of the larynx. People who have this surgery breathe through a small, permanent opening in the neck called a stoma. To perform mouth-to-stoma breathing, close the victim's mouth and nose and breathe through the opening in the neck.

Chest Compressions
Chest compressions move a small but critical amount of blood to the heart and brain. Perform chest compressions with two hands for an adult, one or two hands for a child, and two fingers for an infant. Effective compressions require rescuers to push hard and fast. The chest of an adult should be compressed 1.5 to 2 inches, and the chest of a child or infant should be compressed one third to one half the depth of the chest. The chest should be allowed to return to its normal depth after each compression. The desired position for adult and child chest compressions is in the center of the chest between the nipples; for infants, it is just below the nipple line (Figure 5-4). The victim should be on a hard, flat surface (for example, the floor) and on his or her back.

FYI
Avoiding Stomach Distention
Rescue breaths can cause stomach distention. Minimize this problem by limiting the breaths to the amount needed to make the chest rise. Avoid overinflating the victim's lungs by just taking a normal breath yourself before breathing into the victim. Gastric distention can cause regurgitation of stomach contents and complicate care.

CAUTION
First aiders do not:
Check for a pulse or other signs of circulation (for example, movement)
Give rescue breaths without chest compressions
Use a jaw thrust to open the airway—only health care providers use this maneuver.
Immediately after giving the first two breaths, give 30 compressions at a rate of 100 compressions a minute for all victims (adults, children, and infants). After 30 compressions, give two rescue breaths. Repeat the cycles of 30 compressions and two breaths for 2 minutes (five total cycles). Continue the cycles of CPR until an AED becomes available, the victim shows signs of life, EMS takes over, or you are too tired to continue.

Over the years, CPR procedures have changed, becoming easier for people to learn and remember. To perform adult CPR, follow the steps in **Skill Drill 5-1**:

1. Check responsiveness by tapping the victim and asking, “Are you okay?” If the victim is unresponsive, roll him or her onto his or her back (Skill Drill Step 1).
2. Have someone call 9-1-1 and retrieve an AED if available (Skill Drill Step 2).
3. Open the airway using the head tilt-chin lift method (Skill Drill Step 3).
4. Check for breathing for 5 to 10 seconds by looking for chest rise and fall and listening and feeling for breathing (Skill Drill Step 4). If the victim is breathing, place him or her in the recovery position. If the victim is not breathing, go to the next step.
5. Give two rescue breaths (1 second each), making the chest rise (Skill Drill Step 5). If the first breath does not cause the chest to rise, retilt the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step.
6. Perform CPR.
   - Place one or two hands on the center of the chest between the nipples (Skill Drill Step 6). If two hands are used, place one hand on top of the other as in adult CPR.
   - Depress chest one third to one half the depth of the chest.
   - Give 30 chest compressions at a rate of about 100 per minute.
   - Open the airway and give two breaths (1 second each).
7. Continue cycles of 30 chest compressions and two breaths for 2 minutes (about four more cycles), or until an AED is available, the victim is breathing, EMS takes over, or you are too tired to continue (Skill Drill Step 7).

To perform CPR on a child, follow the steps in **Skill Drill 5-2**:

1. Check responsiveness by tapping the victim and shouting, “Are you okay?” If the victim is unresponsive, roll him onto his or her back (Skill Drill Step 1).
2. Have someone call 9-1-1 and retrieve an AED if available (Skill Drill Step 2).
3. Open the airway using the head tilt-chin lift method (Skill Drill Step 3).
4. Check for breathing for 5 to 10 seconds by looking for chest rise and fall and listening and feeling for breathing (Skill Drill Step 4). If the victim is breathing, place him or her in the recovery position. If the victim is not breathing, go to the next step.
5. Give two rescue breaths (1 second each), making the chest rise (Skill Drill Step 5). If the first breath does not cause the chest to rise, retilt the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step.

To perform CPR on an infant, follow the steps in **Skill Drill 5-3**:

1. Check responsiveness by tapping the victim and shouting, “Are you okay?” If the victim is unresponsive, roll him onto his or her back (Skill Drill Step 1).
2. Have someone call 9-1-1 (Skill Drill Step 2).
3. Open the airway by tilting the head back slightly and lifting the chin (Skill Drill Step 3).
4. Check breathing for 5 to 10 seconds by looking for chest rise and fall and listening and feeling for breathing (Skill Drill Step 4). If the victim is breathing, place him or her in the recovery position. If the victim is not breathing, go on to the next step.
5. Give two rescue breaths (1 second each), making the chest rise (Skill Drill Step 5). If the first breath does not cause the chest to rise, retilt the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step.
Check responsiveness. If the victim is unresponsive, roll him onto his back. Have someone call 9-1-1 and retrieve an AED if available.

Open the airway using the head tilt-chin lift method. Check for breathing for 5 to 10 seconds. If the victim is breathing, place him or her in the recovery position. If the victim is not breathing, go to the next step.

Give two rescue breaths (1 second each). If the first breath does not cause the chest to rise, retilt the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step. Perform CPR.

Continue cycles of chest compressions and breaths for 2 minutes (about four more cycles), or until an AED is available, the victim is breathing, EMS takes over, or you are too tired to continue.
Check responsiveness. If the victim is unresponsive, roll her onto her back. Have someone call 9-1-1 and retrieve an AED if available.

Open the airway using the head tilt-chin lift method.

Check for breathing for 5 to 10 seconds. If the victim is breathing, place him or her in the recovery position. If the victim is not breathing, go to the next step.

Give two rescue breaths (1 second each), making the chest rise. If the first breath does not cause the chest to rise, retight the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step. Perform CPR.

Continue cycles of chest compressions and breaths for 2 minutes (about four more cycles), or until an AED is available, the victim is breathing, EMS takes over, or you are too tired to continue.
Chapter 5  CPR

Check responsiveness. If the victim is unresponsive, roll him onto his back. Have someone call 9-1-1.

Open the airway by tilting the head back slightly and lifting the chin. Check breathing for 5 to 10 seconds. If the victim is breathing, place him in the recovery position. If the victim is not breathing, go on to the next step.

Give two rescue breaths (1 second each). If the first breath does not cause the chest to rise, retilt the head and try the breath again and then proceed to the next step. If both breaths cause the chest to rise, go to the next step.

Perform CPR.

Continue cycles of chest compressions and breaths for 2 minutes (about four more cycles) until the infant starts breathing, EMS arrives, or you are too tired to continue.
6. Perform CPR.
   - Place two fingers on the breastbone just below the nipple line (one finger even with the line) (Skill Drill Step 4).
   - Depress chest one third to one half the depth of the chest.
   - Give 30 chest compressions at a rate of about 100 per minute.
   - Open the airway and give two breaths (1 second each).

7. Continue cycles of 30 chest compressions and two breaths for 2 minutes (about four more cycles) until the infant starts breathing, EMS arrives, or you are too tired to continue (Skill Drill Step 7).

**FYI**

**Compression-Only CPR**

Mouth-to-mouth rescue breathing has a long safety record for victims and rescuers. But fear of infectious diseases causes some to be reluctant to give mouth-to-mouth rescue breaths to strangers. To avoid the chance that the victim will not receive any care, compression-only CPR can be considered in these circumstances:
- Rescuer is unwilling or unable to perform mouth-to-mouth rescue breathing.
- Untrained bystander is following dispatcher-assisted CPR instructions.

**Airway Obstruction**

People can choke on all kinds of objects. Foods such as candy, peanuts, and grapes are major offenders because of their shapes and consistencies. Nonfood choking deaths are often caused by balloons, balls and marbles, toys, and coins inhaled by children and infants.

**Recognizing Airway Obstruction**

An object lodged in the airway can cause a mild or severe airway obstruction. In a mild airway obstruction, good air exchange is present. The victim is able to make forceful coughing efforts in an attempt to relieve the obstruction. The victim should be encouraged to cough. A victim with a severe airway obstruction will have poor air exchange. The signs of a severe airway obstruction include the following:
- Breathing becoming more difficult
- Weak and ineffective cough

- Inability to speak or breathe
- Skin, fingernail beds, and the inside of the mouth appear bluish gray (indicating cyanosis)

Choking victims sometimes clutch their necks to communicate that they are choking. This motion is known as the universal distress signal for choking. The victim becomes panicked and desperate (Figure 5-5).

**Caring for a Person with an Airway Obstruction**

For a responsive adult or child with a severe airway obstruction, ask the victim “Are you choking?” If the victim is unable to respond verbally, but nods yes, provide care for the victim. Move behind the victim and reach around the victim’s waist with both arms. Place a fist with the thumb side against the victim’s abdomen, just above the navel. Grasp the fist with your other hand and press into the abdomen with quick inward and upward thrusts (this is the Heimlich maneuver) (Figure 5-6). Continue thrusts until the object is removed or the victim becomes unresponsive.

For a responsive infant with a severe airway obstruction, give back blows and chest thrusts instead of abdominal thrusts to relieve the obstruction. Support the infant’s head and neck and lay the infant face down on your forearm, then lower your arm to your leg. Give up to five back blows between the infant’s shoulder blades with the heel of your hand (Figure 5-7). While supporting the back of the infant’s head, roll the infant face up and give up to five chest thrusts with two fingers on the infant’s sternum in the same location used for CPR (Figure 5-8). Repeat these steps until the object is removed or the infant becomes unresponsive.
Unresponsive Victim?

Have someone call 9-1-1 and get an AED if available (for adults and children).

Age of Victim?

Adult (> 8 years), Child (1–8 years), or Infant (Birth–1 Year)

- Open the airway using the head tilt-chin lift maneuver.
- Check breathing for 5 to 10 seconds.
- If the victim is not breathing, give two breaths (1 second for each breath)
- Perform CPR for 2 minutes (five cycles)

- 30 chest compressions
- Two breaths

- Recheck breathing for 5 to 10 seconds.
- If victim still not breathing, continue CPR.
If you are caring for an unresponsive, nonbreathing victim of any age and your first breath does not cause the chest to rise, retilt the head and try a second breath. Whether the second breath is successful or not, perform CPR—30 compressions and two breaths for five cycles (2 minutes). Since the victim might have had a foreign body airway obstruction, look for an object in the victim’s mouth and, if you see it, remove it before giving the two breaths during the cycles of CPR. To relieve airway obstruction in a responsive adult or child who cannot speak, breathe, or cough, follow the steps in Skill Drill 5-4:

1. Check victim for choking by asking, “Are you choking?” (Skill Drill Step 1)
2. Have someone call 9-1-1 (Skill Drill Step 2).
3. If the victim is choking, give abdominal thrusts (Heimlich maneuver). Place a fist with thumb side against the victim’s abdomen just above the navel, grasp it with the other hand, and press into victim’s abdomen with quick inward and upward thrusts (Skill Drill Step 3). Continue thrusts until the object is removed or the victim becomes unresponsive.
4. If the victim becomes unresponsive, assess breathing and give CPR if needed. Each time you open the airway to give a breath, look for an object in the mouth or throat, and if you see one, remove it (Skill Drill Step 4).
**Check victim for choking.**

2. **Have someone call 9-1-1.**

3. **If the victim is choking, give abdominal thrusts (Heimlich maneuver). Continue thrusts until object is removed or victim becomes unresponsive.**

4. **If the victim becomes unresponsive, assess breathing and give CPR if needed. Each time you open the airway to give a breath, look for an object in the mouth or throat, and if you see one, remove it.**
To relieve airway obstruction in a responsive infant who cannot cry, breathe, or cough, follow the steps in **Skill Drill 5-5**:  
1. Have someone call 9-1-1 (Skill Drill Step 1).  
2. Support the infant’s head and neck and lay the infant face down on your forearm, then lower your arm to your leg. Give five back blows between the infant’s shoulder blades with the heel of your hand (Skill Drill Step 2).  
3. While supporting the back of the infant’s head, roll the infant face up and give five chest thrusts on the infant’s sternum in the same location used in CPR (Skill Drill Step 3).  
4. Repeat these steps until the object is removed. If the infant becomes unresponsive, begin CPR. Each time you open the airway to give a breath, look for an object in the mouth or throat, and if you see it, remove it (Skill Drill Step 4).  

**FYI**  
The Tongue and Airway Obstruction  
Airway obstruction in an unresponsive victim lying on his or her back is usually the result of the tongue relaxing in the back of the mouth, restricting air movement. Opening the airway with the head tilt-chin lift method could be all that is needed to correct this problem.

Table 5-1 provides a review of CPR and the steps to take in the event of an airway obstruction for victims of all ages.
These eight steps are the same for all motionless victims regardless of age:

1. **Check responsiveness:** Tap a shoulder and ask if the victim is okay. If the victim is unresponsive, have someone call 9-1-1.
2. **Open airway:** Head tilt-chin lift maneuver.
3. **Check breathing:** Look at the chest to see it rise and fall, and listen and feel for breathing for 5-10 seconds.
4. **Place victim in recovery position:** If victim is breathing but unresponsive, place him or her in recovery position.
5. **Give breaths:** If victim is not breathing, give two breaths (1 second per breath).
6. **Perform CPR:** If breaths cause the chest to rise, begin CPR—cycles of 30 chest compressions and two breaths for five cycles (2 minutes). Rate should be 100 compressions per minute. Recheck breathing after every five cycles.
7. **Retilt and retry:** If first breath does not cause the chest to rise, retilt victim’s head and try a second breath.
8. **Perform CPR:** Whether the second breath is successful or not, perform CPR—30 compressions and 2 breaths for five cycles (2 minutes). In the case of an unresponsive victim with an airway obstruction, look for an object in the victim’s mouth before giving the two breaths, and remove it if you see it.

### Table 5-1 CPR and Airway Obstruction Review

<table>
<thead>
<tr>
<th>Action</th>
<th>Adult (≥ 8 years)</th>
<th>Child (1-8 years)</th>
<th>Infant (&lt; 1 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Breathing methods</td>
<td>Mouth-to-barrier device</td>
<td>Mouth-to-barrier device</td>
<td>Mouth-to-mouth and nose</td>
</tr>
<tr>
<td></td>
<td>Mouth-to-mouth</td>
<td>Mouth-to-nose</td>
<td>Mouth-to-barrier device</td>
</tr>
<tr>
<td></td>
<td>Mouth-to-stoma</td>
<td></td>
<td>Mouth-to-nose</td>
</tr>
<tr>
<td>2. Chest compressions</td>
<td>On the breastbone, between nipples</td>
<td>On the breastbone, between nipples</td>
<td>On the breastbone, just below nipple line</td>
</tr>
<tr>
<td>Locations</td>
<td>Two hands: Heel of one hand on breastbone between nipples; other hand on top</td>
<td>One or two hands</td>
<td>Two fingers</td>
</tr>
<tr>
<td>Method</td>
<td>1.5 to 2 inches</td>
<td>One third to one half the depth of the chest</td>
<td>One third to one half the depth of the chest</td>
</tr>
<tr>
<td>Depth</td>
<td>100 per minute</td>
<td>100 per minute</td>
<td>100 per minute</td>
</tr>
<tr>
<td>Rate</td>
<td>30:2</td>
<td>30:2</td>
<td>30:2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. When to activate EMS when alone</th>
<th>Immediately after determining unresponsiveness</th>
<th>After 2 minutes of CPR</th>
<th>After 2 minutes of CPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Use of AED</td>
<td>Yes; deliver one shock as soon as possible, followed by 2 minutes of CPR</td>
<td>Yes; use special electrode pads if available</td>
<td>No</td>
</tr>
<tr>
<td>5. Responsive victim and airway obstruction</td>
<td>Heimlich maneuver</td>
<td>Heimlich maneuver</td>
<td>Back blows and chest thrusts</td>
</tr>
</tbody>
</table>
A heart attack occurs when heart muscle tissue dies because the blood supply is severely reduced or stopped.

The four links in the chain of survival are early access, early CPR, early defibrillation, and early advanced care.

CPR consists of breathing oxygen into a victim’s lungs and moving blood to the heart and brain by giving chest compressions.

The signs of a severe airway obstruction include difficult breathing, weak and ineffective cough, inability to speak or breathe, and signs of cyanosis.

**Vital Vocabulary**

*Airway obstruction* A blockage, often the result of a foreign body, in which air flow to the lungs is reduced or completely blocked.

*Cardiac arrest* Stoppage of the heartbeat.

*Chain of survival* A four-step concept to help improve survival from cardiac arrest: early access, early CPR, early defibrillation, and early advanced care.

*Chest compressions* Depressing the chest and allowing it to return to its normal position as part of CPR.

*CPR* Cardiopulmonary resuscitation; the act of providing rescue breaths and chest compressions for a victim in cardiac arrest.

*Heart attack* Death of a part of the heart muscle.

*Rescue breaths* Breathing for a person who is not breathing.

**Assessment in Action**

You are at a local health club when you overhear someone in the weight room nearby shouting for help. You enter the room and see a person lying motionless on the floor. You quickly confirm that he is unresponsive.

*Directions:* Circle Yes if you agree with the statement, and circle No if you disagree.

1. The next thing to do is to start chest compressions.
2. The ratio of chest compressions to rescue breaths is 15 to 2.
3. Compression depth for an adult is one third the depth of the chest.
4. Open the airway using the head tilt-chin lift method.
5. Continue CPR until an AED becomes available or EMS personnel arrive.

**Answers:** 1. No; 2. No; 3. Yes; 4. Yes; 5. Yes

**Check Your Knowledge**

*Directions:* Circle Yes if you agree with the statement, and circle No if you disagree.

1. Take 5 to 10 seconds when checking for breathing.
2. After you determine that an adult victim is unresponsive, the next step is to call 9-1-1.
3. Tilting the head back and lifting the chin helps move the tongue and open the airway.
4. If you determine that a victim is not breathing, begin chest compressions.
5. Do not start chest compressions until you have checked for a pulse.
6. For all victims (adult, child, infant) needing CPR, give 30 compressions followed by two breaths.
7. Use two fingers when performing CPR on an infant.
8. A sign of choking is that the victim is unable to speak or cough.
9. To give abdominal thrusts to a responsive choking victim, place your fist below the victim’s navel.
10. When giving abdominal thrusts to a responsive choking victim, repeat the thrusts until the object is removed or the victim becomes unresponsive.