



# 3 Cardiac Emergencies

**A cardiac emergency is life-threatening.** It can happen at any time to a victim of any age, on land or in the water. You may be called on to care for a victim of a cardiac emergency, including non-specific chest pain, a heart attack or cardiac arrest. Cardiac arrest care includes performing CPR and using an automated external defibrillator (AED)—two of the links in the Cardiac Chain of Survival. By following the Cardiac Chain of Survival, you can greatly increase a victim's chance of survival from cardiac arrest.

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# 3-1 CARDIAC CHAIN OF SURVIVAL

To effectively respond to cardiac arrest, it is important to understand the Cardiac Chain of Survival (Figure 3-1). The Cardiac Chain of Survival for adults consists of five links:

- Recognition of cardiac arrest and activation of the emergency response system
- Early CPR to keep oxygen-rich blood flowing and to help delay brain damage and death
- Early defibrillation to help restore an effective heart rhythm and significantly increase the victim's chance for survival
- Advanced life support using advanced medical personnel who can provide the proper tools and medication needed to continue the lifesaving care
- Integrated post-cardiac arrest care to optimize ventilation and oxygenation and treat hypotension immediately after the return of spontaneous circulation

The pediatric Cardiac Chain of Survival is similar to the adult Cardiac Chain of Survival (Figure 3-2). The five links include the following:

- Injury prevention and safety
- Early, high-quality CPR
- Rapid activation of the emergency medical services (EMS) system or response team to get help on the way quickly—no matter the victim's age
- Effective, advanced life support
- Integrated post-cardiac arrest care

For each minute CPR and defibrillation are delayed, the victim's chance for survival is reduced by about 10 percent.



Figure 3-1 | The Cardiac Chain of Survival



## 3-2 HEART ATTACK

When the muscle of the heart suffers a loss of oxygenated blood, the result is a myocardial infarction (MI), or heart attack. A heart attack is not the same as a cardiac arrest, but it can cause a

cardiac arrest. Heart attacks usually result from cardiovascular disease, but can be caused by a myocardial contusion or bruising to the heart caused by a traumatic event.

### Recognizing a Heart Attack

A heart attack refers to the necrosis (death) of heart tissue as a result of a loss of oxygenated blood. The sooner the signs and symptoms are recognized and treated, the better the victim's chance of survival. Even victims who have had a heart attack may not recognize the signs because each heart attack may have different signs and symptoms.

Summon EMS personnel and provide prompt care if the victim shows or reports any of the signs and symptoms listed below. Ask open-ended questions, such as, "How are you feeling?" to hear the symptoms described in the victim's own words.

- Chest discomfort or pain that is severe, lasts longer than 3 to 5 minutes, goes away and comes back, or persists even during rest.

- Discomfort, pressure or pain that is persistent and ranges from discomfort to an unbearable crushing sensation in the center of the chest, possibly spreading to the shoulder, arm, neck, jaw, stomach or back, and usually not relieved by resting, changing position or taking medication.
- Chest pain that comes and goes.
- Difficulty breathing, such as at a faster rate than normal or noisy breathing.
- Pale or ashen skin, especially around the face.
- Sweating, especially on the face.
- Dizziness or light-headedness.
- Nausea or vomiting.
- Fatigue, lightheadedness or loss of consciousness.

These warning signs may occur with or without chest pain. When women experience chest pain, it may be atypical—sudden, sharp but short-lived pain outside the breastbone. Like women, other individuals—such as older adults or those with diabetes—are somewhat more likely to experience

some of the other warning signs, such as:

- Shortness of breath
- Nausea or vomiting
- Back or jaw pain
- Unexplained fatigue or malaise

## Caring for a Heart Attack

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If you think someone is having a heart attack:

- Take immediate action and summon EMS personnel.
- Have the victim stop any activity and rest in a comfortable position.
- Loosen tight or uncomfortable clothing.
- Closely monitor the victim until EMS personnel take over
- Note any changes in the victim's appearance or behavior.
- Comfort the victim.
- Be prepared to perform CPR and use an AED.

### Administering Aspirin for a Heart Attack

You may be able to help a victim that is awake and alert who is showing signs of a heart attack by offering an appropriate dose of aspirin, if local protocols allow or medical direction permits. Aspirin never should replace advanced medical care, and you should never delay calling EMS to find or offer aspirin.

If the victim is awake and alert and able to take medicine by mouth, ask:

- Are you allergic to aspirin?
- Do you have a stomach ulcer or stomach disease?
- Are you taking any blood thinners, such as Coumadin® (warfarin)?
- Have you been told by a healthcare provider not to take aspirin?

If the victim answers “no” to all of these questions, and if local protocols allow, consider administering two 81-mg, low-dose aspirins (162-mg total), or up to one 5-grain, 325-mg aspirin tablet, based on what is available. (It is not necessary to give more than two low dose aspirin.) The aspirin must be chewed before swallowing.

Be sure that you only give aspirin and not acetaminophen (e.g., Tylenol®) or nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen (e.g., Motrin® or Advil®) or naproxen (e.g., Aleve®). These medications do not work the same way aspirin does and are not beneficial for a person who is experiencing a heart attack. Enteric-coated aspirin is fine to administer as long as it is chewed.

# 3-3 CARDIAC ARREST

Cardiac arrest is a life-threatening emergency that may be caused by a heart attack, drowning, electrocution, respiratory arrest or other conditions. Cardiac arrest occurs when the heart stops beating or beats too irregularly or weakly to circulate blood effectively. Cardiac arrest can occur suddenly and without warning. In many cases, the

victim has already been experiencing the signs and symptoms of a heart attack. However, sudden cardiac arrest is often the first sign of sudden death. The signs of a cardiac arrest include:

- Sudden collapse
- Unresponsiveness
- Abnormal breathing
- No pulse

# 3-4 CPR

A victim who is unresponsive, not breathing normally and has no pulse is in cardiac arrest and needs CPR (Figure 3-3). The objective of CPR is to perform a combination of effective chest compressions and ventilations to circulate blood that contains oxygen to the victim's brain and other vital organs. In most cases, CPR is performed in cycles of 30 chest compressions followed by 2 ventilations.

Summoning EMS personnel immediately is critical for the victim's survival. If an AED is available, it should be used in combination with CPR and according to local protocols until EMS personnel take over.

One component of CPR is chest compressions. To ensure optimal victim outcomes, high-quality CPR must be performed. You can ensure high-quality CPR by providing high-quality chest compressions, making sure that the:

- Victim is on a firm, flat surface to allow for adequate compression, such as the floor or ground.
- Chest is exposed to ensure proper hand placement and the ability to visualize chest recoil.
- Hands are correctly positioned with the heel of one hand in the center of the chest on the lower half of the victim's sternum, with the other hand on top. Most responders find that interlacing their fingers makes it easier to provide compressions while keeping the fingers off the chest.



Figure 3-3 | CPR is delivered in cycles of chest compressions and ventilations.

- Arms are as straight as possible, with the shoulders directly over the hands to promote effective compressions. Locking elbows will help maintain straight arms.
- Compressions are given at the correct rate—at least 100 per minute to a maximum of 120 per minute—and at the proper depth to ensure adequate circulation:
  - For an adult, compress the chest at least 2 inches, but no more than 2.4 inches.
  - For a child, compress the chest about 2 inches.
  - For an infant, compress the chest about 1½ inches.
- Chest must be allowed to fully recoil between each compression to allow blood to flow back into the heart following the compression.
- Interruptions to chest compressions are minimized.

For more details, see Table 3-1.

## Chest Compression Fraction

**Chest compression fraction**, or CCF, is the term used to denote the proportion of time that chest compressions are performed. It represents the fraction of time spent performing compressions; that is, the time that the responders are in contact with the victim's chest, divided by the total time of the resuscitation, beginning with the start of CPR until CPR is stopped, for whatever reason. Expert consensus identifies a CCF of at least 60 percent to promote optimal outcomes, with a goal of 80 percent.

To achieve the best CCF percentage, a coordinated team approach is needed, with each member assuming specific roles, anticipating the next action steps for yourself and other team members. This coordinated team approach also includes integrating and assimilating additional safety members and EMS personnel who arrive on the scene.

Keep in mind that there are no national protocols in place for high-performance CPR. How you function within a team

setting, including how additional personnel assimilate into the team, may vary depending on your local protocols or practice.

Remember that when giving ventilations to a victim during CPR, you should:

- Maintain an open airway by keeping the head tilted back in the proper position.
- Seal the mask over the victim's mouth and nose.
- Blow into the one-way valve, ensuring that you can see the chest begin to rise and fall. Each ventilation should last about 1 second, with a brief pause between breaths to let the chest fall.

After ventilations, quickly reposition your hands on the center of the chest and start another cycle of 30 compressions and 2 ventilations.

## Two-Rescuer CPR

When an additional rescuer is available, you should provide two-rescuer CPR. One rescuer gives chest compressions and the other gives ventilations (Figure 3-4). Rescuers should change positions (alternate giving compressions and ventilations) at least every 2 minutes (5 cycles of 30 compressions and 2 ventilations) to reduce rescuer fatigue, or during the analysis of the AED. Changing positions should take less than 5 seconds.

When CPR is in progress by one rescuer and a second rescuer arrives, the second rescuer should confirm whether EMS personnel have been summoned. If EMS personnel have not been summoned, the second rescuer should do so before getting the AED or assisting with care. If EMS personnel have been summoned, the second rescuer should get the AED, or if an AED is not available, help perform two-rescuer CPR.

When performing two-rescuer CPR on a child or infant, rescuers should change the compression-to-ventilation ratio from 30 compressions for every 2 ventilations (30:2) to 15 compressions for every 2 ventilations (15:2). This provides more frequent ventilations for children and infants. When providing two-rescuer CPR to an infant, rescuers should also perform a different technique, called the encircling thumbs technique.

Once you begin CPR, do not stop. Continue CPR until:

- You see an obvious sign of life, such as normal breathing or victim movement.

- An AED is ready to analyze the victim's heart rhythm.
- Other trained responders, such as a member of your safety team or EMS personnel, take over and relieve you from compression and ventilation responsibilities.
- You are alone and too exhausted to continue.
- The scene becomes unsafe.


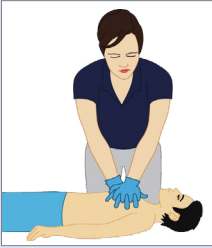
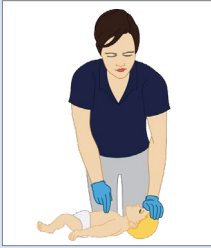
When performing CPR, the victim may vomit, there may be frothing at the nose and mouth, and the scene may be chaotic. The victim also may produce agonal breaths. Remember that agonal breaths are not normal breathing—this victim needs CPR.

Understand that, despite your best efforts, not all victims of cardiac arrest survive.



Figure 3-4 | During two-rescuer CPR, one rescuer gives ventilations and the other gives chest compressions.

**Table 3-1: Summary of Techniques for CPR—Adult, Child and Infant**

	Adult	Child	Infant
Hand position	Heel of one hand in center of chest (on lower half of sternum) with the other hand on top 		Two fingers on the center of the chest (just below the nipple line) 
Compression depth	At least 2 inches (Try to avoid greater than 2.4 inches if using a feedback device.)	About 2 inches	About 1 1/2 inches
Ventilations	Until chest begins to rise (about 1 second per ventilation)		
Cycles (one rescuer)	30 chest compressions and 2 ventilations		
Cycles (two rescuers)	30 chest compressions and 2 ventilations	15 chest compressions and 2 ventilations	
Rate	Between 100 and 120 compressions per minute		

## 3-5 AEDs

An automated external defibrillator (AED) is a portable electronic device that analyzes the heart's rhythm and provides an electrical shock (Figure 3-5). Defibrillation is the delivery of an electrical shock that may help re-establish an effective rhythm. CPR can help by supplying blood that contains oxygen to the brain and other vital organs. However, the sooner an AED is used, the greater the likelihood of survival. You must assess victims quickly and be prepared to use an AED in cases of cardiac arrest.



Figure 3-5 | An AED

## Did You Know?

*For each minute CPR and defibrillation are delayed, the victim's chance for survival is reduced by about 10 percent.*

## When the Heart Stops

Any damage to the heart from disease or injury can disrupt the heart's electrical system, which normally triggers the contraction—or pumping action—of the heart muscle. This disruption can result in an abnormal heart rhythm, possibly stopping circulation. Two common treatable abnormal rhythms that cause sudden cardiac arrest are **ventricular fibrillation (VF)** and pulseless **ventricular tachycardia (VT)**. In VF, the ventricles quiver, or fibrillate, without any organized rhythm, and the electrical impulses fire at random, creating chaos and preventing the heart from pumping and circulating blood. There is no normal breathing and no pulse. In pulseless VT, an abnormal electrical impulse controls

the heart. This abnormal impulse fires so fast that the heart's chambers do not have time to fill, and the heart is unable to pump blood effectively. As with V-fib, there is no normal breathing or pulse with pulseless VT.

In many cases, VF and VT can be corrected by early defibrillation. If VF or VT is not corrected, all electrical activity will eventually cease, a condition called **asystole**. Asystole cannot be corrected by defibrillation. You cannot tell what, if any, rhythm the heart has by feeling for a pulse. An AED will analyze the heart's rhythm and advise if shock should be applied.

## Using an AED on Adults

When cardiac arrest occurs, use an AED as soon as it is available and ready. First, turn on the AED and follow the audible and visual prompts. Apply the AED pads as instructed and allow the AED to analyze the heart rhythm. Ensure that no one is touching the victim during the analysis. Continue to follow the prompts of the AED. If CPR is in progress when the AED arrives, do not interrupt chest compressions and ventilations until the AED is turned on, the AED pads are applied and the AED is ready to analyze the heart rhythm, unless you are the only rescuer able to operate the AED and perform CPR.

After a shock is delivered, or if no shock is advised, immediately resume chest compressions and continue performing about 2 minutes of CPR before the AED re-analyzes the heart rhythm. If there are 2 or more rescuers, you should change positions (alternate performing compressions and operating the AED) about every 2 minutes, or as the AED is analyzing the heart rhythm, in order to reduce rescuer fatigue. If at any time you notice an obvious sign of life, such as normal breathing or movement, stop CPR and monitor the victim's condition. Administer emergency oxygen, if available and you are trained and authorized to do so.

# Using an AED on Children and Infants

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While the incidence of cardiac arrest in children and infants is relatively low compared with that of adults, cardiac arrest does happen to young children. Causes of cardiac arrests in children include:

- Airway and breathing problems
- Traumatic injuries or accidents (e.g., drowning, motor-vehicle collision, electrocution and poisoning)
- A hard blow to the chest
- Congenital heart disease
- Sudden infant death syndrome (SIDS)

AEDs equipped with pediatric AED pads are capable of delivering the lower levels of energy considered appropriate for infants and children up to 8 years old or weighing less than 55 pounds.

Use pediatric AED pads and/or equipment for a pediatric victim, if available. If pediatric-specific equipment is not available, an AED designed for adults can be used on children and infants. Pediatric pads should not be used on adults.

Always follow local protocols, medical direction and the manufacturer's instructions. For a child or infant in cardiac arrest, follow the same general steps and precautions as when using an AED on an adult. If the pads risk touching each other because of the victim's smaller chest size, place one pad on the child's chest and the other on the back. For an infant, always place one pad on the chest and the other on the back.

## DO'S AND DON'TS FOR AED USE

### Do's

- **Do** make sure that no one is touching or is in contact with the victim or the resuscitation equipment before shocking a victim with an AED.
- **Do** use an AED if a victim is experiencing cardiac arrest as a result of traumatic injuries. Follow local protocols or practice.
- **Do** use an AED for a victim who is pregnant. The mother's survival is paramount to the infant's survival. Follow local protocols and medical direction.
- **Do** use an AED on a victim who has a pacemaker, other implantable cardioverter defibrillators or metal body piercings. To maintain safety, avoid placing the AED pads directly over these items. Position the pads so they are at least an inch away.

### Don'ts

- **Do not** use alcohol to wipe the victim's chest dry. Alcohol is flammable.
- **Do not** touch the victim while the AED is analyzing. Touching or moving the victim could affect the analysis.
- **Do not** touch the victim while the device is defibrillating. You or someone else could be shocked.
- **Do not** defibrillate a victim when around flammable or combustible materials, such as gasoline or free-flowing oxygen. (If oxygen is begin administered to a victim when an AED is ready to be used, make sure to close the tank before shocking.)
- **Do not** use an AED on a victim wearing a medication patch on the chest until the patch and medication are removed. With a gloved hand, remove any patches from the chest and wipe away any residual medication before applying the pads.

# Special AED Situations

Some situations require special precautions when using an AED. These include using AEDs around water, on victims of trauma or hypothermia, or when confronted with AED protocols that differ than those discussed here. Be familiar with these situations, and know how to respond appropriately. Always follow manufacturer's recommendations.

## AEDs Around Water

A shock delivered in water could harm rescuers or bystanders; however, AEDs are safe to use on victims who have been removed from the water. If the victim is in water:

- Remove the victim from the water before defibrillation. A shock delivered in water could harm rescuers or bystanders.
- Be sure that there are no deep puddles of water around you, the victim or the AED.
- Remove the victim's wet clothing to place the AED pads properly, if necessary.
- Dry the victim's chest and attach the AED pads (Figure 3-6).

If it is raining, take steps to make sure that the victim is as dry as possible and sheltered from the rain. Ensure that the victim's chest is wiped dry.

Do not delay defibrillation when taking steps to create a dry environment. AEDs are safe, even in rain and snow, when all precautions and manufacturer's operating instructions are followed. Avoid getting the AED or AED pads wet, and keep them out of any deep puddles of water, if possible.

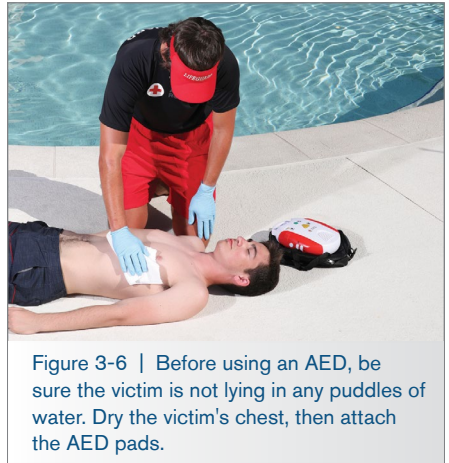


Figure 3-6 | Before using an AED, be sure the victim is not lying in any puddles of water. Dry the victim's chest, then attach the AED pads.

## Pacemakers and Implantable Cardioverter-Defibrillators

Pacemakers are small, implantable devices sometimes located in the area below the left collarbone. There may be a small lump that can be felt under the skin (Figure 3-7). An implantable cardioverter-defibrillator (ICD) is a miniature version of an AED that automatically prevents or corrects irregular heart rhythms. Sometimes, a victim's heart beats irregularly, even if the victim has a pacemaker or an ICD.

- If the implanted device is visible, or you know that the victim has one, do not place the AED pad directly over the device. This may interfere with the delivery of the shock. Adjust AED pad placement, if necessary, and continue to follow the AED instructions.
- If you are not sure whether the victim has an implanted device, use the AED as needed. It will not harm the victim or rescuer.
- Follow any special precautions associated with ICDs, but do not delay CPR or defibrillation.

It is possible to receive a mild shock if an implantable ICD delivers a shock to the victim while CPR is performed. This risk of injury to rescuers is minimal, and the amount of electrical energy involved is much lower than an AED.



Figure 3-7 | Scars or a small lump may indicate that the person has had some sort of device implanted.

## Transdermal Medication Patches

A transdermal medication patch administers medication through the skin. The most common of these patches is the nitroglycerin patch, used by those with a history of cardiac disease. Since you might absorb nitroglycerin or other medications, remove the patch from the victim's chest with a gloved hand before defibrillation (Figure 3-8). Never place AED electrode pads directly on top of medication patches.



Figure 3-8 | Remove any type of transdermal medication patch from the victim's chest with a gloved hand before defibrillation.

## Hypothermia

Hypothermia is a life-threatening condition in which the entire body cools because of its inability to keep itself warm. Some people who have experienced hypothermia have been resuscitated successfully, even after prolonged exposure to the cold.

If the victim is not breathing and does not have a pulse, begin CPR until an AED becomes available. Follow local protocols regarding whether you should use an AED in this situation.

If the victim is wet, follow these steps:

- Remove wet clothing, dry the victim's chest and protect the victim from further heat loss.
- Attach the AED pads.
- If a shock is indicated, deliver it, following the instructions of the AED.
- Follow local protocols regarding whether additional shocks should be delivered.
- Do not withhold CPR or defibrillation to re-warm the victim.
- Be careful not to unnecessarily shake a victim who has experienced hypothermia, as this could result in an irregular heart rhythm.

## Chest Hair

Some victims may have excessive chest hair that may cause difficulty with pad-to-skin contact. Since the time it takes to deliver the first shock is critical, and chest hair rarely interferes with pad adhesion, attach the pads and analyze the heart's rhythm as soon as possible.

- Press firmly on the pads to attach them to the victim's chest. If you get a "Check pads" or similar message from the AED, remove the pads and replace them with new ones if available. The pad adhesive may pull out some of the chest hair, which may solve the problem, but most AED cases contain a safety razor to assist in hair removal.
- If you continue to get the "Check pads" message, remove the pads, quickly shave the victim's chest and attach new pads to the victim's chest.
  - When in doubt, or in a situation when only one set of pads is available, shave the chest first.

## Trauma

If a victim is in cardiac arrest resulting from traumatic injuries, you should still use an AED. Administer defibrillation according to local protocols.

## Metal Surfaces

It is safe to deliver a shock to a victim in cardiac arrest on a metal surface, such as bleachers, as long as appropriate safety precautions are taken. Care should be taken that defibrillation electrode pads do not contact the conductive (metal) surface and that no one is touching the victim when the shock button is pressed.

## Jewelry and Body Piercings

You do not need to remove jewelry and body piercings when using an AED. Leaving them on the victim will do no harm. However, do **not** place the AED pad directly over metallic jewelry or body piercings. Adjust pad placement at least an inch away, if necessary, and continue to follow established protocols.

## Pregnancy

The best way to care for a pregnant woman in cardiac arrest is the same for all victims, including CPR and use of an AED. The fetus has the best chance of survival if the mother survives the event, and care should not be altered for fear that the electrical shock from an AED may harm the fetus. Follow local protocols and medical direction.

# AED Maintenance

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For defibrillators to perform optimally, they must be maintained. AEDs require minimal maintenance. These devices have various self-testing features. Familiarize yourself with any visual or audible prompts the AED may have that warn of malfunction or a low battery. Read the operator's manual thoroughly, and check with the manufacturer to obtain all necessary information regarding maintenance.

If the machine detects any malfunction, you should inform management, who will contact the manufacturer. The device may need to be returned to the manufacturer for service. While AEDs require minimal maintenance, it is important to remember the following:

- Follow the manufacturer's specific recommendations for periodic equipment checks.

- Make sure that the batteries have enough energy for one complete rescue. (A fully charged backup battery should be readily available.)
- Make sure that the correct defibrillator pads are in the package and are properly sealed.
- Check any expiration dates on AED pads and batteries, and replace as necessary.
- After use, make sure that all accessories are replaced and that the machine is in proper working order before placing the unit back in service.
- If at any time the machine fails to work properly, or you recognize any warning indicators, discontinue use, place the unit out of service and contact the manufacturer immediately.

## 3-6 MULTIPLE-RESCUER RESPONSE

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In the professional environment, more than two rescuers often respond to an emergency. In many cases, three or more rescuers provide care for an unresponsive victim. When an unresponsive victim has been removed from the water and needs CPR, care might begin with one rescuer until other rescuers arrive on the scene with additional equipment and begin assisting in providing care.

Roles for multiple-rescuer response for an unresponsive victim may include (Figure 3-9):

- **Circulation:** The rescuer provides compressions and also may operate the AED if giving care alone. If an additional rescuer is available, they should place the pads and operate the AED.
- **Airway:** The rescuer is positioned behind the victim's head to maintain an open airway and ensure the mask is positioned and sealed to provide effective ventilations.

**Breathing:** Two rescuers provide ventilations using a bag-valve-mask (BVM) resuscitator. Emergency oxygen may be attached to the BVM if rescuers are trained to administer emergency oxygen. If the victim vomits during CPR, the rescuer pauses CPR, rolls the victim on their side and clears the vomit from the victim's mouth by using a finger sweep or a suction device. After clearing the vomit, resume CPR starting with compressions.

Practice multiple-rescuer response drills regularly with your team. Each member of the team should be able to arrive on the scene and perform any of the roles necessary in providing the appropriate care.



Figure 3-9 | In a multiple-rescuer response for an unresponsive victim, professional rescuers work together to provide care.

## High Performance CPR

High-performance CPR refers to providing high-quality chest compressions as part of a well-organized team response to a cardiac arrest. Coordinated, efficient, effective teamwork is essential to minimize the time not spent in contact with the chest to improve victim outcomes. Think about all of the activities performed during resuscitation, for example:

- AED pads are applied
- AED must charge
- Pocket mask or BVM may need to be repositioned
- Airway may need to be reopened
- Other personnel arrive on scene

- Responders switch positions
- Advanced airway may need to be inserted
- Pulse checks may be done

All of these activities could affect your ability to maintain contact with the victim's chest.

# 3-7 WRAP-UP

As a professional rescuer, you should be able to recognize and respond to cardiac emergencies, including heart attacks and cardiac arrest. To do this, you must understand the importance of the five links of the Cardiac Chain of Survival: early recognition of the emergency and early access to EMS, early CPR, early defibrillation, early advanced medical care and integrated post-cardiac arrest care.

When using an AED, always follow local protocols. AEDs are relatively easy to operate and generally require minimal training and retraining. Remember that AEDs are safe to use on victims who have been removed from the water, but you must first make sure you, the victim and the AED are not in deep puddles.

## BENCHMARKS FOR PROFESSIONAL RESCUERS

Professional rescuers should:

- Minimize interruptions of high-quality chest compressions.
- Use the appropriate compression depth based on the victim's age.
- Maintain a chest compression fraction (CCF) of at least 60 percent, with a goal of 80 percent.
- Use the appropriate compression rate.
- Allow for a full chest recoil to allow blood to flow into the heart.
- Avoid rescuer fatigue by changing positions at least every 2 minutes.



## One-Rescuer CPR

### Notes:

- Size up the scene while forming an initial impression, use PPE, perform primary assessment and get an AED on the scene as soon as possible.
- Ensure the victim is on a firm, flat surface, such as the floor or a table.
- Expose the victim's chest to ensure proper hand placement and the ability to visualize chest recoil.

### If the victim is not breathing and has no pulse:

**1** Give **30** chest compressions.

- **Adult or child:** Place the heel of one hand in the center of the chest on the lower half of sternum with the other hand on top.
  - Keep your arms as straight as possible and shoulders directly over your hands.
- **Infant:** Place one hand on the infant's forehead. Place two or three fingers from your hand closest to the infant's feet on the center of the chest just below the nipple line. The fingers should be oriented so they are parallel not perpendicular to the sternum.
- Push hard, push fast.
  - Compress the chest at a depth of:
    - **Adult:** At least 2 inches but not more than 2.4 inches.
    - **Child:** About 2 inches.
    - **Infant:** 1½ inches.
  - Compress the chest at a rate of at least **100** per minute but no more than **120** per minute.
    - Let the chest fully recoil between each compression.





## CPR

### One-Rescuer CPR *continued*

**2** Give **2** ventilations.

**3** Perform cycles of **30** compressions and **2** ventilations.



#### **Do not stop CPR except in one of the following situations:**

- You see an obvious sign of life, such as normal breathing or victim movement.
- An AED is ready to analyze the victim's heart rhythm.
- Another trained responder or responders take over, such as a member of your safety team or EMS personnel, and relieve you from giving compressions or ventilations.
- You are alone and too exhausted to continue.
- The scene becomes unsafe.

#### **Notes:**

- *Keep your fingers off the chest when performing compressions on an adult or child by interlacing your fingers.*
- *Use your body weight, not your arms, to compress the chest.*
- *Count out loud or to yourself to help keep an even pace.*



## Two-Rescuer CPR—Adult and Child

### Notes:

- *Size up the scene while forming an initial impression, use PPE, perform primary assessment and get an AED on the scene as soon as possible.*
- *Ensure the victim is on a firm, flat surface, such as the floor or a table.*
- *Expose the victim's chest to ensure proper hand placement and the ability to visualize chest recoil.*

### If the victim is not breathing and has no pulse:

1

Rescuer 2 finds the correct hand position to give chest compressions.

- Place two hands on the center of the chest.

2

Rescuer 2 gives chest compressions.

- Push hard, push fast.
  - Compress the chest at a depth of:
    - **Adult:** At least 2 inches but not more than 2.4 inches.
    - **Child:** About 2 inches.
  - Compress the chest at a rate of at least **100** per minute but no more than **120** per minute.

3

Rescuer 1 gives **2** ventilations.

4

Perform about **2** minutes of compressions and ventilations.

- **Adult:** Perform cycles of **30** compressions and **2** ventilations.
- **Child:** Perform cycles of **15** compressions and **2** ventilations.

5

Rescuers change positions at least every **2** minutes (**5** cycles of **30** compressions and **2** ventilations) and/or while the AED is analyzing the heart rhythm.





## Two-Rescuer CPR—Adult and Child *continued*

- Rescuer 2 calls for a position change by using the word “change” at the end of the last compression cycle:
  - **Adult:** Use the word “change” in place of the word “thirty.”
  - **Child:** Use the word “change” in place of the word “fifteen.”
- Rescuer 1 gives **2** ventilations.
- Rescuer 2 quickly moves to the victim’s head with their own mask.
- Rescuer 1 quickly moves into position at the victim’s chest and locates correct hand position on the chest.
- Changing positions should take less than **5** seconds.



**6**

- Rescuer 1 begins chest compressions.
- Continue cycles of compressions and ventilations.

### Continue CPR until:

- You see an obvious sign of life, such as normal breathing or victim movement.
- An AED is ready to analyze the victim’s heart rhythm.
- Another trained responder or responders take over, such as a member of your safety team or EMS personnel, and relieve you from giving compressions or ventilations.
- You are alone and too exhausted to continue.
- The scene becomes unsafe.

### Notes:

- *Keep your fingers off the chest when performing compressions on an adult or child by interlacing your fingers.*
- *Use your body weight, not your arms, to compress the chest.*
- *Count out loud to help keep an even pace.*



## Two-Rescuer CPR—Infant

### Notes:

- *Size up the scene while forming an initial impression, use PPE, perform primary assessment and get an AED on the scene as soon as possible.*
- *Ensure the victim is on a firm, flat surface, such as the floor or a table.*
- *Expose the victim's chest to ensure proper hand placement and the ability to visualize chest recoil.*

### If the victim is not breathing and has no pulse:

1

Rescuer 2 finds the correct hand position to give chest compressions.

- Use the encircling thumbs technique to give chest compressions.
  - Place thumbs next to each other on the center of the chest just below the nipple line.
  - Place both hands underneath the infant's back and support the infant's back with your fingers.
  - Ensure that your hands do not compress or squeeze the side of the ribs.
- If available, a towel or padding can be placed underneath the infant's shoulders to help maintain the head in the neutral position.



2

Rescuer 2 gives chest compressions.

- Push hard, push fast.
  - Compress the chest about 1½ inches at a rate of at least **100** compressions per minute but no more than **120** per minute.

3

Rescuer 1 gives **2** ventilations.





## CPR

### Two-Rescuer CPR—Infant *continued*

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- 4** Perform cycles of **15** compressions and **2** ventilations for about **2** minutes.
- 5** Rescuers change positions at least every **2** minutes and/or during the analysis of the AED.
  - Rescuer 2 calls for a position change by using the word “change” in place of saying “fifteen” at the end of the last compression cycle.
  - Rescuer 1 gives **2** ventilations.
  - Rescuer 2 quickly moves to the victim’s head with their own mask.
  - Rescuer 1 quickly moves into position at the victim’s chest and locates correct hand position on the chest.
  - Changing positions should take less than **5** seconds.
- 6** Rescuer 1 begins chest compressions.
  - Continue cycles of compressions and ventilations.

#### Continue CPR until:

- You see an obvious sign of life, such as normal breathing or victim movement.
- An AED is ready to analyze the victim’s heart rhythm.
- Another trained responder or responders take over, such as a member of your safety team or EMS personnel, and relieve you from giving compressions and ventilations.
- You are alone and too exhausted to continue.
- The scene becomes unsafe.

#### *Note:*

- *Count out loud to help keep an even pace.*



## USING AN AED

### Using an AED

#### Notes:

- Size up the scene while forming an initial impression, use PPE, perform primary assessment and get an AED on the scene as soon as possible.
- Ensure the victim is on a firm, flat surface, such as the floor or a table.

#### If the victim is not breathing and has no pulse:

**1** Turn on the AED and follow the audible and/or visual prompts.

**2** Expose the victim's chest and wipe it dry if necessary.

*Tip:* Remove any medication patches with a gloved hand and wipe away any remaining medication residue.

**3** Attach the AED pads to the victim's bare, dry chest.

- Place one pad on the victim's upper right chest and the other pad on the left side of the chest.
  - Child: Use pediatric AED pads, if available. If the pads risk touching each other, place one pad in the middle of the child's chest and the other pad on the child's back, between the shoulder blades.
  - Infant: Always place one pad on the chest and the other on the back.





## USING AN AED

### Using an AED *continued*

**4** Plug in the connector, if necessary.

**5** Stand clear.

- Make sure that no one, including you, is touching the victim.
- Say, “Everyone, stand clear!”

**6** Analyze the heart rhythm.

- Push the “Analyze” button, if necessary. Let the AED analyze the heart rhythm.

**7** Deliver a shock or perform CPR based on the AED recommendation.

- If a shock is advised:
  - Make sure no one, including you, is touching the victim.
  - Say, “Everyone clear” in a loud commanding voice.
  - Deliver the shock by pushing the “Shock” button, if necessary.
  - After delivering the shock, perform about **2** minutes of CPR, starting with chest compressions.
- If no shock is advised:
  - Perform about **2** minutes of CPR, starting with chest compressions.
  - Continue to follow the prompts of the AED.





## USING AN AED

### Using an AED *continued*

#### Notes:

- *If at any time you notice an obvious sign of life, such as normal breathing or victim movement, stop CPR and monitor the victim's condition.*
- *The AED will not advise a shock for normal or absent heart rhythms.*
- *If two trained rescuers are present, one should perform CPR while the second rescuer operates the AED.*
- *Do not interrupt CPR (chest compressions and ventilations) until the AED pads are applied and the AED is turned on and ready to analyze unless you are the only rescuer able to operate the AED and perform CPR.*
- *If there are multiple responders, they should:*
  - *Hover with their hands a few inches above the chest during the AED analysis and the shock (if indicated) to minimize interruptions to resuming CPR.*
  - *Resume compressions immediately following the delivery of a shock or after the AED determines that no shock is advised.*
  - *Switch responsibility for compressions each time the AED performs an analysis to limit their fatigue.*
  - *Do not wait for the AED to deliver a "resume CPR" prompt before resuming compressions.*

# GLOSSARY

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**Abandonment** – Ending care of an ill or injured person without that person’s consent or without ensuring that someone with equal or greater training will continue that care.

**Abdomen** – The middle part of the trunk (torso) containing the stomach, liver and other organs.

**Abrasion** – A wound in which skin is rubbed or scraped away.

**Agonal breaths** – Isolated or infrequent breaths in the absence of normal breathing in an unresponsive person.

**AIDS** – When an infected person has a significant drop in a certain type of white blood cells or shows signs of having certain infections or cancers caused by an HIV infection.

**Airway adjunct** – A mechanical device to keep a victim’s airway clear.

**Anaphylactic shock** – A severe allergic reaction in which air passages may swell and restrict breathing; a form of shock. See also anaphylaxis.

**Anaphylaxis** – A severe allergic reaction; a form of shock. See also anaphylactic shock.

**Anatomical airway obstruction** – Complete or partial blockage of the airway by the tongue or swollen tissues of the mouth or throat.

**Antihistamine** – Drug used to treat the signals of allergic reactions.

**Aquatic environment** – An environment in which recreational water activities are played or performed.

**Ashen** – A grayish color; darker skin often looks ashen instead of pale.

**Assess** – To examine and evaluate a situation carefully.

**Asthma** – A condition that narrows the air passages and makes breathing difficult.

**Asystole** – A condition in which the heart has stopped generating electrical activity.

**Automated external defibrillator (AED)** – An automatic device used to recognize a heart rhythm that requires an electric shock and either delivers the shock or prompts the rescuer to deliver it.

**Bag-valve-mask (BVM) resuscitator** – A handheld breathing device used on a victim in respiratory distress or respiratory arrest. It consists of a self-inflating bag, a one-way valve and a mask; can be used with or without supplemental oxygen.

**Bandage** – Material used to wrap or cover an injured body part; often used to hold a dressing in place.

**Benchmarks** – A set of standards used as a point of reference for evaluating performance or level of quality.

**Bloodborne pathogens** – Bacteria and viruses present in blood and body fluids that can cause disease in humans.

**Bloodborne pathogens standard** – A federal regulation designed to protect employees from exposure to bodily fluids that might contain a disease-causing agent.

**Body substance isolation (BSI) precautions** – An approach to infection control that considers all body fluids and substances to be infectious.

**Bone** – A dense, hard tissue that forms the skeleton.

**Bystanders** – People at the scene of an emergency who do not have a duty to provide care.

**Carbon monoxide** – A clear, odorless, poisonous gas produced when carbon or other fuel is burned, as in gasoline engines.

**Cardiac arrest** – A condition in which the heart has stopped or beats too ineffectively to generate a pulse.

**Chest** – The upper part of the trunk (torso) containing the heart, major blood vessels and lungs.

**Chronic** – Persistent over a long period of time.

**Confidentiality** – Protecting a victim's privacy by not revealing any personal information learned about a victim except to law enforcement personnel or emergency medical services personnel caring for the victim.

**Consent** – Permission to provide care given by an ill or injured person to a rescuer.

**CPR** – A technique that combines chest compressions and rescue breaths for a victim whose heart and breathing have stopped.

**Cyanosis** – A blue discoloration of the skin around the mouth and fingertips resulting from a lack of oxygen in the blood.

**Defibrillation** – An electrical shock that disrupts the electrical activity of the heart long enough to allow the heart to spontaneously develop an effective rhythm on its own.

**Diabetes** – A condition in which the body does not produce enough insulin or does not use insulin effectively enough to regulate the amount of sugar (glucose) in the bloodstream.

**Direct contact transmission** – Occurs when infected blood or body fluids from one person enter another person's body at a correct entry site.

**Droplet transmission** – Transmission of disease through the inhalation of droplets from an infected person's cough or sneeze.

**Drowning** – Death by suffocation in water.

**Drug** – Any substance other than food intended to affect the functions of the body.

**Duty to act** – A legal responsibility of certain people to provide a reasonable standard of emergency care; may be required by case law, statute or job description.

**Emergency** – A sudden, unexpected incident demanding immediate action.

**Emergency medical services (EMS) personnel** – Trained and equipped community-based personnel dispatched through a local emergency number to provide emergency care for injured or ill people.

**Emphysema** – A disease in which the lungs lose their ability to exchange carbon dioxide and oxygen effectively.

**Engineering controls** – Safeguards intended to isolate or remove a hazard from the workplace.

**Epinephrine** – A form of adrenaline medication prescribed to treat the symptoms of severe allergic reactions.

**Fibrillation** – A quivering of the heart's ventricles.

**Forearm** – The upper extremity from the elbow to the wrist.

**Fracture** – A chip, crack or complete break in bone tissue.

**Hepatitis B** – A liver infection caused by the hepatitis B virus; may be severe or even fatal and can be in the body up to 6 months before symptoms appear.

**Hepatitis C** – A liver disease caused by the hepatitis C virus; it is the most common chronic bloodborne infection in the United States.

**HIV** – A virus that destroys the body's ability to fight infection. A result of HIV infection is referred to as AIDS.

**Hypothermia** – A life-threatening condition in which cold or cool temperatures cause the body to lose heat faster than it can produce it.

**Hypoxia** – A condition in which insufficient oxygen reaches the cells, resulting in cyanosis and changes in responsiveness, breathing and heart rates.

**Incident** – An occurrence or event that interrupts normal procedure or brings about a crisis.

**Indirect contact transmission** – Occurs when a person touches objects that have blood or body fluid of an infected person, and that infected blood or body fluid enters the body through a correct entry site.

**Injury** – The physical harm from an external force on the body.

**Jaundice** – Yellowing of the skin and eyes.

**Joint** – A structure where two or more bones are joined.

**Mechanical obstruction** – Complete or partial blockage of the airway by a foreign object, such as a piece of food or a small toy, or by fluids, such as vomit or blood.

**Muscle** – Tissue in the body that lengthens and shortens to create movement.

**Myocardial infarction** – A heart attack.

**Nasal cannula** – A device used to deliver oxygen to a breathing person; used mostly for victims with minor breathing problems.

**Negligence** – The failure to follow the standard of care or to act, thereby causing injury or further harm to another.

**Non-rebreather mask** – A mask used to deliver high concentrations of oxygen to breathing victims.

**Occupational Safety and Health Administration (OSHA)** – A government agency that helps protect the health and safety of employees in the workplace.

**Opportunistic infections** – Infections that strike people whose immune systems are weakened by HIV or other infections.

**Oxygen** – A tasteless, colorless, odorless gas necessary to sustain life.

**Oxygen delivery device** – Equipment used to supply oxygen to a victim of a breathing emergency.

**Pathogen** – A disease-causing agent. Also called a microorganism or germ.

**Poison** – Any substance that causes injury, illness or death when introduced into the body.

**Professional rescuers** – Paid or volunteer personnel, including lifeguards, who have a legal duty to act in an emergency.

**Refusal of care** – The declination of care by a victim; the victim has the right to refuse the care of anyone who responds to an emergency.

**Respiratory arrest** – A condition in which breathing has stopped.

**Respiratory distress** – A condition in which breathing is difficult.

**Respiratory failure** – Breathing difficult that begins to shut down the respiratory system and may lead to respiratory arrest.

**Resuscitation mask** – A pliable, dome-shaped device that fits over a person's mouth and nose; used to assist with rescue breathing.

**Seizure** – A disorder in the brain's electrical activity, marked by loss of consciousness and often by convulsions.

**Shock** – A life-threatening condition in which the circulatory system fails to deliver blood to all parts of the body, causing body organs to fail.

**Standard of care** – The minimal customary and quality of care expected of an emergency care provider.

**Standard precautions** – Safety measures, such as body substance isolation, taken to prevent occupational-risk exposure to blood or other potentially infectious materials, such as body fluids containing visible blood.

**Sterile** – Free from germs.

**Stoma** – An opening in the front of the neck through which a person whose larynx has been removed breathes.

**Stroke** – A disruption of blood flow to a part of the brain, causing permanent damage.

**Submerged** – Underwater, covered with water.

**Suctioning** – The process of removing foreign matter from the upper airway by means of manual device.

**Universal precautions** – Practices required by the federal Occupational Safety and Health Administration to control and protect employees from exposure to blood and other potentially infectious materials.

**Universal sign for choking** – Clutching of the throat by a responsive person due to an airway blockage.

**Vector-borne transmission** – Transmission of a disease by an animal or insect bite through exposure to blood or other body fluids.

**Ventricles** – The two lower chambers of the heart.

**Ventricular fibrillation (V-fib)** – An abnormal heart rhythm characterized by disorganized electrical activity, which results in the quivering of the ventricles.

**Ventricular tachycardia (V-tach)** – An abnormal heart rhythm characterized by rapid contractions of the ventricles.

**Wheezing** – The hoarse whistling sound made when inhaling and/or exhaling.

**Work practice controls** – Employee and employer behaviors that reduce the likelihood of exposure to a hazard at the job site.

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## Thank You for Participating in the CPR/AED for Professional Rescuers Program

Designed for those with a duty to act, this course helps participants respond to breathing and cardiac emergencies in adults, children and infants. This handbook covers:

Primary Assessment ▪ Ventilations (includes BVM) ▪ Choking (conscious and unconscious) ▪ CPR (one-and two-rescuer) ▪ AED ▪ and More.

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This handbook: ▪ Has been reviewed by the American Red Cross Scientific Advisory Council ▪ Meets 2010 Consensus on Science for CPR and Emergency Cardiovascular Care (ECC) ▪ Meets 2010 Guidelines for First Aid.

