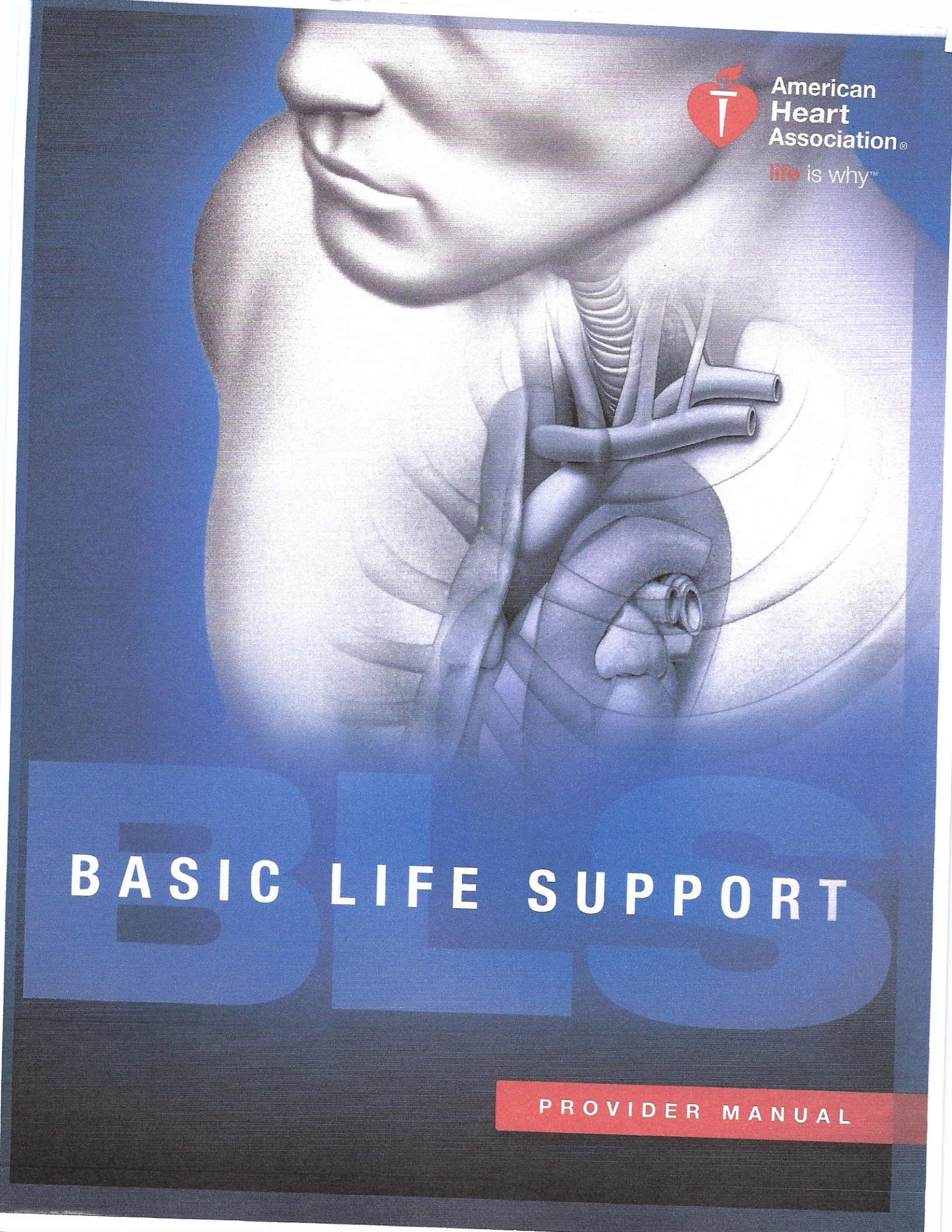
American Heart Association®
life is why™
BASIC LIFE SUPPORT
BLS
PROVIDER MANUAL

American Heart Association®

life is why™

BASIC LIFE SUPPORT

PROVIDER MANUAL

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To find out about any updates or corrections to this text, visit **www.heart.org/cpr**, navigate to the page for this course, and click on "Updates."

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life is why.

At the American Heart Association, we want people to experience more of life's precious moments. That's why we've made better heart and brain health our mission. It's also why we remain committed to exceptional training–the act of bringing resuscitation science to life–through genuine partnership with you. Only through our continued collaboration and dedication can we truly make a difference and save lives.

Until there's a world free of heart disease and stroke, the American Heart Association will be there, working with you to make a healthier, longer life possible for everyone.

Why do we do what we do?

life is why.

Life Is Why is a celebration of life. A simple yet powerful answer to the question of why we should all be healthy in heart and mind. It also explains why we do what we do: Lifesaving work. Every day.

Throughout your student manual, you will find information that correlates what you are learning in this class to **Life Is Why** and the importance of cardiovascular care. Look for the **Life Is Why** icon (shown at right), and remember that what you are learning today has an impact on the mission of the American Heart Association.

We encourage you to discover your **Why** and share it with others. Ask yourself, what are the moments, people, and experiences I live for? What brings me joy, wonder, and happiness? Why am I partnering with the AHA to help save lives? Why is cardiovascular care important to me? The answer to these questions is your **Why.**

Instructions

Please find on the back of this page a chance for you to participate in the AHA's mission and **Life Is Why** campaign. Complete this activity by filling in the blank with the word that describes your **Why.**

Share your **"_____ Is Why"** with the people you love, and ask them to discover their **Why.**

Talk about it. Share it. Post it. Live it. **#lifeiswhy** **#CPRSavesLives**

American Heart Association.

life is why™

_____ is why.

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1

General Concepts

Introduction

Welcome to the Basic Life Support (BLS) Provider Course. BLS is the foundation for saving lives after cardiac arrest. You will learn the skills of high-quality cardiopulmonary resuscitation (CPR) for victims of all ages and will practice delivery of these skills both as a single rescuer and as a member of a multirescuer team. The skills you learn in this course will enable you to recognize cardiac arrest, activate the emergency response system early, and respond quickly and confidently.

Despite important advances in prevention, sudden cardiac arrest remains a leading cause of death in the United States. Seventy percent of out-of-hospital cardiac arrests occur in the home. About half are unwitnessed. Outcome from out-of-hospital cardiac arrest remains poor. Only about 10% of adult patients with nontraumatic cardiac arrest who are treated by emergency medical services (EMS) survive to hospital discharge.

With the knowledge and skills you learn in this course, your actions can give victims the best chance of survival.

BLS Course Objectives

The BLS Course focuses on what rescuers need to know to perform high-quality CPR in a wide variety of settings. You will also learn how to respond to choking emergencies. After successfully completing the BLS Course, you should be able to

- Describe the importance of high-quality CPR and its impact on survival
- Describe all of the steps of the Chain of Survival
- Apply the BLS concepts of the Chain of Survival
- Recognize the signs of someone needing CPR
- Perform high-quality CPR for an adult
- Describe the importance of early use of an automated external defibrillator (AED)
- Demonstrate the appropriate use of an AED
- Provide effective ventilations by using a barrier device
- Perform high-quality CPR for a child
- Perform high-quality CPR for an infant
- Describe the importance of teams in multirescuer resuscitation
- Perform as an effective team member during multirescuer CPR
- Describe the technique for relief of foreign-body airway obstruction for an adult or child
- Describe the technique for relief of foreign-body airway obstruction for an infant

Provider Manual

The *BLS Provider Manual* contains all of the information that you need to know to successfully complete the BLS Course. Take time to read this manual carefully.

Study the skills and lifesaving sequences carefully. During the course, you will have an opportunity to apply this knowledge as a rescuer in simulated emergency scenarios.

Age Definitions

The manual presents specific BLS skills and sequences for training rescuers to care for an unresponsive adult, child, or infant until the next level of care arrives. For the purposes of the BLS Course, age definitions are as follows:

Age	Definition
Adults	Adolescents (ie, after the onset of puberty) and older
Children	1 year of age to puberty
Infants	Less than 1 year of age (excluding newly born infants in the delivery room)

Signs of puberty include chest or underarm hair in males and any breast development in females.

Boxes

Throughout the *BLS Provider Manual*, you will find specific information highlighted by boxes with icons. Pay special attention to this important information.

Box	Contains
Foundational Facts 	Basic information that every BLS provider should know
Critical Concepts 	Especially important information
Caution 	Alerts to potential problems or risks
Life Is Why 	Why taking this course matters

Review Questions

Review questions are provided at the end of each part. You may use these to confirm your understanding of important BLS concepts.

Student Notes

A blank section is provided at the end of each part for taking notes. You may find it useful to record key points to remember or questions to ask your instructor.

High-Quality CPR

The BLS Course focuses on preparing students to perform CPR skills. CPR is a lifesaving procedure for a victim who has signs of cardiac arrest (ie, unresponsive, no normal breathing, and no pulse). Components of CPR are chest compressions and breaths.

High-quality CPR improves a victim's chances of survival. Study and practice the characteristics of high-quality CPR so that you can perform each skill effectively.

Critical Concepts

High-Quality CPR

- **Start compressions within 10 seconds** of recognition of cardiac arrest.
- **Push hard, push fast:** Compress at a rate of 100 to 120/min with a depth of
  - At least 2 inches (5 cm) for adults
  - At least one third the depth of the chest, about 2 inches (5 cm), for children
  - At least one third the depth of the chest, about 1½ inches (4 cm), for infants
- **Allow complete chest recoil** after each compression.
- **Minimize interruptions** in compressions (try to limit interruptions to less than 10 seconds).
- **Give effective breaths** that make the chest rise.
- **Avoid excessive ventilation.**

Foundational Facts

Chest Compression Depth

Chest compressions are more often too shallow than too deep. However, research suggests that compression depth greater than 2.4 inches (6 cm) in adults may cause injuries. If you have a CPR quality feedback device, it is optimal to target your compression depth from 2 to 2.4 inches (5 to 6 cm).

Your Approach to a Resuscitation Attempt

The BLS techniques and sequences presented during the course offer 1 approach to a resuscitation attempt. Every situation is unique. Your response will be determined by

- Available emergency equipment
- Availability of trained rescuers
- Level of training expertise
- Local protocols

Personal Protective Equipment

Personal protective equipment (PPE) is equipment worn to help protect the rescuer from health or safety risks. PPE will vary based on situations and protocols. It can include a combination of items, such as

- Medical gloves
- Eye protection
- Full body coverage
- High-visibility clothing
- Safety footwear
- Safety helmets

Always consult with your local health authority or regulatory body on specific PPE protocols relevant to your role.

Life Is Why

High-Quality CPR Is Why

Early recognition and CPR are crucial for survival from cardiac arrest. By learning high-quality CPR, you'll have the ability to improve patient outcomes and save more lives.

The Chain of Survival

Learning Objectives

At the end of this part, you will be able to

- Describe the importance of high-quality CPR and its impact on survival
- Describe all of the steps of the Chain of Survival
- Apply the BLS concepts of the Chain of Survival

Adult Chain of Survival

The AHA has adopted, supported, and helped develop the concept of emergency cardiovascular care (ECC) systems for many years. The term *Chain of Survival* provides a useful metaphor for the elements of the ECC systems-of-care concept.

Cardiac arrest can happen anywhere—on the street, at home, or in a hospital emergency department, intensive care unit (ICU), or inpatient bed. The system of care is different depending on whether the patient has an arrest inside or outside the hospital.

The 2 distinct adult Chains of Survival (Figure 1), which reflect the setting as well as the availability of rescuers and resources, are

- In-hospital cardiac arrest (IHCA)
- Out-of-hospital cardiac arrest (OHCA)

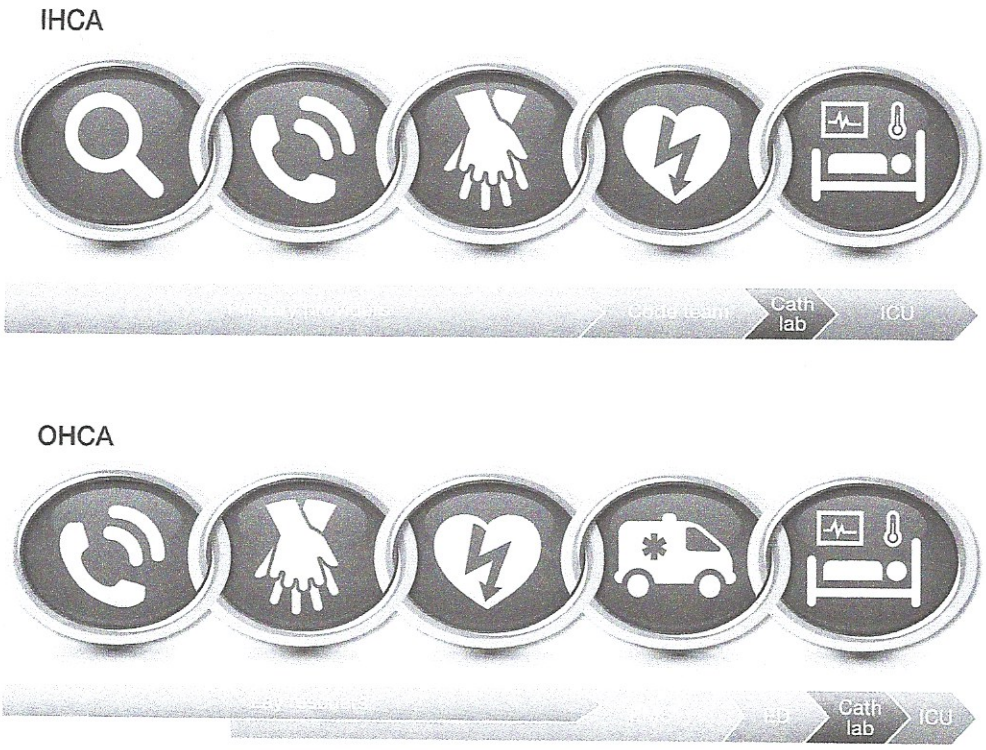

Figure 1. The AHA adult Chains of Survival. Links in the Chain of Survival for an adult cardiac arrest will differ based on whether the arrest occurs in or out of the hospital.

Chain of Survival for an In-Hospital Cardiac Arrest

For adult patients who are in the hospital, cardiac arrest usually happens as a result of serious respiratory or circulatory conditions that get worse. Many of these arrests can be predicted and prevented by careful observation, prevention, and early treatment of prearrest conditions. Once a primary provider recognizes cardiac arrest, immediate activation of the resuscitation team, early high-quality CPR, and rapid defibrillation are essential. Patients depend on the smooth interaction of the institution's various departments and services and on a multidisciplinary team of professional providers, including physicians, nurses, respiratory therapists, and others.

After return of spontaneous circulation (ROSC), all cardiac arrest victims receive post–cardiac arrest care. This level of care is provided by a team of multidisciplinary specialists and may occur in the cardiac catheterization suite and/or ICU. A *cardiac catheterization suite or laboratory* (sometimes referred to as a "cath lab") is a group of procedure rooms in a hospital or clinic where specialized equipment is used to evaluate the heart and the blood vessels around the heart and in the lungs. A cardiac catheterization procedure involves insertion of a catheter through an artery or vein into the heart to study the heart and its surrounding structures and function. Measurements are made through the catheter, and contrast material may be used to create images that will help identify problems. During the procedure, specialized catheters can be used to fix some cardiac problems (such as opening a blocked artery).

The links in the Chain of Survival for an adult who has a cardiac arrest *in the hospital* are

- Surveillance, prevention, and treatment of **prearrest conditions**
- Immediate **recognition** of cardiac arrest and **activation** of the emergency response system
- Early **CPR** with an emphasis on chest compressions
- Rapid **defibrillation**
- Multidisciplinary **post–cardiac arrest care**

Chain of Survival for an Out-of-Hospital Cardiac Arrest

Most out-of-hospital adult cardiac arrests happen unexpectedly and result from underlying cardiac problems. Successful outcome depends on early bystander CPR and rapid defibrillation in the first few minutes after the arrest. Organized community programs that prepare the lay public to respond quickly to a cardiac arrest are critical to improving outcome from OHCA.

Lay rescuers are expected to recognize the victim's distress, call for help, start CPR, and initiate public-access defibrillation until EMS arrives. EMS providers then take over resuscitation efforts. Advanced care, such as administration of medications, may be provided. EMS providers transport the cardiac arrest victim to an emergency department or cardiac catheterization suite. Follow-up care by a team of multidisciplinary specialists continues in the ICU.

The links in the Chain of Survival for an adult who has a cardiac arrest *outside the hospital* are

- Immediate **recognition** of cardiac arrest and **activation** of the emergency response system
- Early **CPR** with an emphasis on chest compressions
- Rapid **defibrillation** with an AED
- Effective **advanced life support** (including rapid stabilization and transport to post–cardiac arrest care)
- Multidisciplinary **post–cardiac arrest care**

Key Differences Between IHCA and OHCA Chains of Survival

Element	IHCA	OHCA
Initial support	Depends on an **in-hospital system** of appropriate **surveillance**, **monitoring**, and **prevention** with **responsive primary provider teams.**	Depends on **community** and **EMS providers** for support.
Resuscitation teams	Resuscitation efforts depend on the smooth interaction of the institution's **various departments** and services (such as the patient ward, emergency department [ED], cardiac catheterization laboratory, and ICU) and on a **multidisciplinary team of professional providers**, which includes physicians, nurses, respiratory therapists, pharmacists, counselors, and others.	**Lay rescuers** are expected to recognize the patient's unresponsiveness, call for help, and activate the emergency response system. They initiate CPR and use an AED (if available) until a team of **EMS providers** takes over resuscitation and then transports the patient to an **ED and/or cardiac catheterization laboratory**, before the patient is transferred to an **ICU** for continued care.
Available resources	Depending on the facility, in-hospital **multidisciplinary teams** may have immediate access to additional personnel as well as resources of the **ED**, **cardiac catheterization laboratory**, and **ICU**.	In out-of-hospital settings, lay rescuers may have access to an **AED**, such as through their local **public-access defibrillation system**, **emergency or first aid equipment,** and **dispatch-**

(continued)

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Element	IHCA	OHCA
		assisted guidance. EMS crews/paramedics may find themselves alone, with no **resources** except those they **brought with them**. Additional **backup resources** and equipment may take some time to arrive.
Resuscitation constraints	Both settings may be affected by factors such as **crowd control**, **family presence**, **space constraints**, **resources**, **training**, **transportation**, and **device failures**.	
Level of complexity	Both IHCA and OHCA cases are typically **complex**, requiring teamwork and coordination among responders and care providers.	

Importance of Each Link in the Chain of Survival

Notice that the links in the Chain of Survival are not separate, but connected. Each link describes an action during a resuscitation attempt that is critical to a successful outcome. If one link is broken, the chance for a good outcome is decreased. These mutually dependent links represent the most important actions in the management of cardiac arrest. The importance of each link is described in Table 1.

Table 1. Importance of Each Link in the Chain of Survival

Link	Description
In-hospital cardiac arrest (IHCA)	
 **Surveillance, prevention, and treatment of prearrest conditions**	• For adult patients who are in the hospital, cardiac arrest usually happens as a result of serious respiratory or circulatory conditions that get worse. • Many arrests can be predicted and prevented by careful observation, prevention, and early treatment of prearrest conditions.
 **Immediate recognition of cardiac arrest and activation of the emergency response system**	• You must first recognize that the victim is in cardiac arrest based on unresponsiveness, no breathing (or no normal breathing or only gasping), and no pulse. • Once you have recognized that the victim is in cardiac arrest, activate the emergency response system or ask someone else to do it. • The sooner you activate the emergency response system, the sooner the next level of care will arrive.

(continued)

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Link	Description
 **Early CPR with an emphasis on chest compressions**	• If the victim is in cardiac arrest, begin high-quality CPR without delay. • High-quality CPR started immediately after cardiac arrest can greatly improve a victim's chance of survival. • Bystanders who are not trained in CPR are encouraged to at least provide chest compressions. Chest compressions can be performed by those with no training and can be guided by dispatchers over the telephone.
 **Rapid defibrillation**	• Rapid defibrillation in combination with high-quality CPR can double or triple the chances of survival. Provide defibrillation with a manual defibrillator or AED as soon as the device is available. – The AED is a lightweight, portable device that can identify lethal heart rhythms and deliver a shock to terminate the abnormal rhythm and allow the heart's normal rhythm to resume. – AEDs are simple to operate, allowing lay rescuers and healthcare providers to attempt defibrillation safely.
 **Multidisciplinary post–cardiac arrest care**	• Once ROSC is achieved, the next link is for the patient to receive post–cardiac arrest care. • This advanced level of care is provided by a multidisciplinary team of healthcare providers. They focus on preventing the return of cardiac arrest and tailor specific therapies to improve long-term survival. • Post–cardiac arrest care may be provided in the cardiac catheterization suite and/or ICU.
Out-of-hospital cardiac arrest (OHCA)	
 **Immediate recognition of cardiac arrest and activation of the emergency response system**	• You must first recognize that the victim is in cardiac arrest based on unresponsiveness, no breathing (or no normal breathing or only gasping), and no pulse. • Once you have recognized that the victim is in cardiac arrest, activate the emergency response system or ask someone else to do it. • The sooner you activate the emergency response system, the sooner the next level of care will arrive.
 **Early CPR with an emphasis on chest compressions**	• If the victim is in cardiac arrest, begin high-quality CPR without delay. • High-quality CPR started immediately after cardiac arrest can greatly improve a victim's chance of survival. • Bystanders who are not trained in CPR are encouraged to at least provide chest compressions. Chest compressions can be performed by those with no training and can be guided by dispatchers over the telephone.
 **Rapid defibrillation with an AED**	• Rapid defibrillation in combination with high-quality CPR can double or triple the chances of survival. Provide defibrillation with a manual defibrillator or AED as soon as the device is available. – The AED is a lightweight, portable device that can identify lethal heart rhythms and deliver a shock to terminate the abnormal rhythm and allow the heart's normal rhythm to resume. – AEDs are simple to operate, allowing lay rescuers and healthcare providers to attempt defibrillation safely.

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Link	Description
 **Effective advanced life support (including rapid stabilization and transport to post–cardiac arrest care)**	• Advanced life support (ALS) bridges the transition from BLS to more advanced care. ALS can occur in any setting (both out of hospital and in hospital). Effective ALS teams may provide the patient with additional care if needed, such as – 12-lead electrocardiogram or advanced cardiac monitoring – Electrical therapy interventions (eg, cardioversion) – Obtaining vascular access – Giving appropriate drugs – Placing an advanced airway
 **Multidisciplinary post–cardiac arrest care**	• Once ROSC is achieved, the next link is for the patient to receive post–cardiac arrest care. • This advanced level of care is provided by a multidisciplinary team of healthcare providers. They focus on preventing the return of cardiac arrest and tailor specific therapies to improve long-term survival. • Post–cardiac arrest care may be provided in the cardiac catheterization suite and/or ICU.

Pediatric Chain of Survival

In adults, cardiac arrest is often sudden and results from a cardiac cause. In children, cardiac arrest is often secondary to respiratory failure and shock. Identifying children with these problems is essential to reduce the likelihood of pediatric cardiac arrest and maximize survival and recovery. Therefore, a prevention link is added in the pediatric Chain of Survival (Figure 2):

- **Prevention** of arrest
- Early high-quality **bystander CPR**
- **Rapid activation** of the emergency response system
- Effective **advanced life support** (including rapid stabilization and transport to post–cardiac arrest care)
- Integrated **post–cardiac arrest care**

Figure 2. The AHA pediatric Chain of Survival.

Cardiac Arrest or Heart Attack?

People often use the terms *cardiac arrest* and *heart attack* interchangeably, but they are not the same.

- **Sudden cardiac arrest** occurs when the heart develops an abnormal rhythm and can't pump blood.
- A **heart attack** occurs when blood flow to part of the heart muscle is blocked.

Make sure that you understand the difference by carefully studying Table 2.

Table 2. Sudden Cardiac Arrest vs Heart Attack

	Sudden Cardiac Arrest	Heart Attack
What it is	**Sudden cardiac arrest** occurs when the heart develops an abnormal rhythm and can't pump blood. Sudden cardiac arrest results from an abnormal heart rhythm. This abnormal rhythm causes the heart to quiver so it can no longer pump blood to the brain, lungs, and other organs. Sudden cardiac arrest is often a "**rhythm**" problem.	A **heart attack** occurs when blood flow to part of the heart muscle is blocked. A heart attack occurs when a clot forms in a blood vessel carrying oxygenated blood to the heart muscle. If the blocked vessel is not reopened quickly, the muscle normally nourished by that vessel begins to die. A heart attack is a "**clot**" problem.
What happens	Within seconds, the person becomes unresponsive and is not breathing or is only gasping. **Death occurs within minutes if the victim does not receive immediate lifesaving treatment.**	Signs of a heart attack may appear immediately or last weeks or longer, and may include • Severe discomfort in the chest or other areas of the upper body • Shortness of breath • Cold sweats • Nausea/vomiting Typically, during a heart attack, the heart continues to pump blood. **The longer the person with a heart attack goes without treatment, the greater the possible damage to the heart muscle.** Occasionally, the damaged heart muscle triggers an abnormal rhythm that can lead to sudden cardiac arrest. Heart attack symptoms in women can be different from those in men, and women may be more likely to experience • Pain in the jaw, arms, back, or neck • Light-headedness • Nausea/vomiting
What is the link?	Most heart attacks do not lead to sudden cardiac arrest, though a small percentage of people with a heart attack will develop sudden cardiac arrest. But when sudden cardiac arrest occurs, heart attack is a common cause. Other conditions may also change the heart's rhythm and lead to cardiac arrest.	

Sudden cardiac arrest is a **leading cause of death**. Nearly 360 000 out-of-hospital cardiac arrests occur annually in the United States. Fast action can save lives.

Review

1. In which locations do most out-of-hospital cardiac arrests occur?
   a. Healthcare clinics
   b. Homes
   c. Recreational facilities
   d. Shopping centers

2. Which is the most common cause of cardiac arrest in children?
   a. Cardiac problem
   b. Congenital or acquired heart defect
   c. Respiratory failure or shock
   d. Infection and sepsis

3. What is the third link in the adult out-of-hospital Chain of Survival?
   a. Advanced life support
   b. High-quality CPR
   c. Prevention
   d. Rapid defibrillation

4. Which statement best describes sudden cardiac arrest?
   a. When respiratory distress in adults occurs and the heart rate does not change
   b. When the heart rate is 40 to 60/min and respirations increase
   c. When blood flow to the heart is blocked and the heart rate increases
   d. When an abnormal rhythm develops and the heart stops beating unexpectedly

See Answers to Review Questions in the Appendix.

Student Notes

Part 2

BLS for Adults

BLS General Concepts

Overview

This section describes BLS for adults. You will learn to perform high-quality CPR skills, both as a single rescuer and as a member of a multirescuer team.

Use adult BLS skills for victims who are adolescents (ie, after the onset of puberty) and older. Signs of puberty include chest or underarm hair in males and any breast development in females.

Learning Objectives

At the end of this part, you will be able to

- Recognize the signs of someone needing CPR
- Perform high-quality CPR for an adult
- Provide effective ventilations by using a barrier device

Basic Framework for CPR

Everyone can be a lifesaving rescuer for a cardiac arrest victim (Figure 3). Which CPR skills you use will depend on your level of training, experience, and confidence (ie, rescuer proficiency). The type of victim (child vs adult) as well as the availability of equipment and other rescuers to assist will determine CPR efforts.

Consider the following examples:

- **Hands-Only CPR.** A single rescuer with little training and limited equipment who witnesses a cardiac arrest in a middle-aged man might provide only chest compressions until help arrives.
- **30:2 CPR.** A lifeguard who rescues a drowning young child or an adult in cardiac arrest will provide both chest compressions and breaths, using a ratio of 30 compressions to 2 breaths.
- **Teamwork.** Emergency responders who are called to a scene to care for a cardiac arrest victim will perform multirescuer coordinated CPR: one rescuer performs chest compressions, a second rescuer gives breaths with a bag-mask device, and a third rescuer uses the defibrillator. With a team approach, several lifesaving actions are performed at the same time.

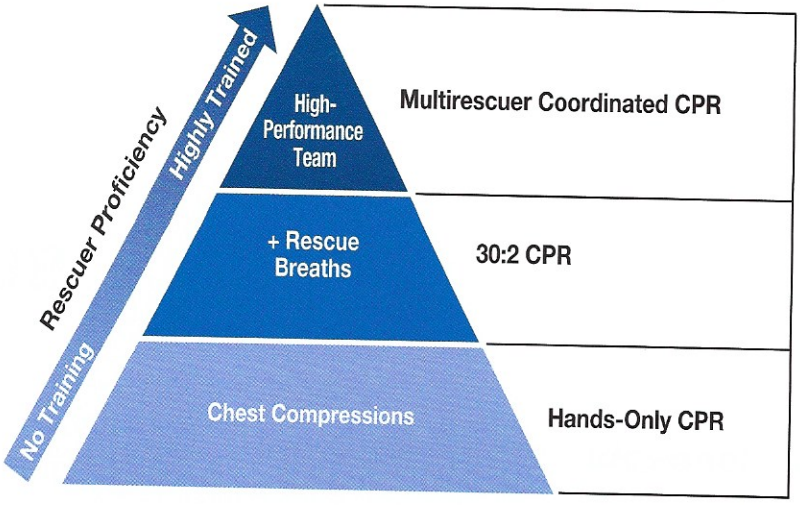

Figure 3. Building blocks of CPR.

High-Performance Rescue Teams

Coordinated efforts by several rescuers during CPR may increase chances for a successful resuscitation. High-performance teams divide tasks among team members during a resuscitation attempt. As a team member, you will want to perform high-quality CPR skills to make your maximum contribution to each resuscitation team effort.

See "Part 4: Team Dynamics" for more information.

Main Components of CPR

CPR consists of these main components:

- Chest compressions
- Airway
- Breathing

You will learn about each of these throughout this course.

Life Is Why

Saving Lives Is Why

Sudden cardiac arrest remains a leading cause of death, so the AHA trains millions of people each year to help save lives both in and out of the hospital. This course is a key part of that effort.

BLS Healthcare Provider Adult Cardiac Arrest Algorithm

The BLS Healthcare Provider Adult Cardiac Arrest Algorithm outlines steps for both single rescuers and multiple rescuers of an unresponsive adult (Figure 4). Refer to this algorithm as you read the steps below.

BLS Healthcare Provider
Adult Cardiac Arrest Algorithm—2015 Update

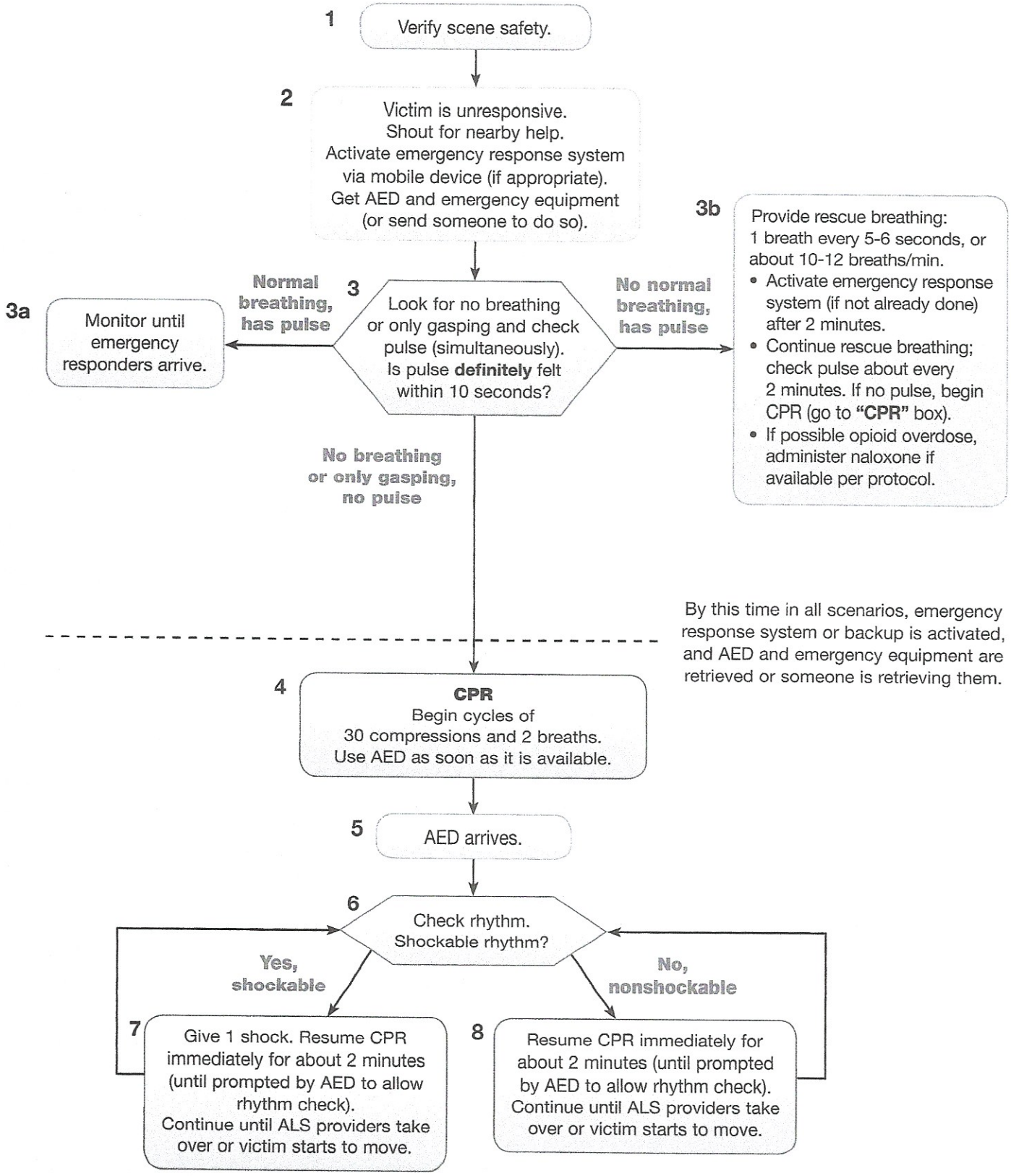

Figure 4. BLS Healthcare Provider Adult Cardiac Arrest Algorithm.

Adult 1-Rescuer BLS Sequence

Introduction

If the rescuer is alone and encounters an unresponsive adult, follow the steps outlined in the BLS Healthcare Provider Adult Cardiac Arrest Algorithm (Figure 4).

Verify Scene Safety, Check for Responsiveness, and Get Help (Algorithm Boxes 1, 2)

The first rescuer who arrives at the side of a potential cardiac arrest victim should quickly perform the following steps:

Step	Action
1	Verify that the scene is safe for you and the victim. You do not want to become a victim yourself.
2	Check for responsiveness. Tap the victim's shoulder and shout, "Are you OK?"
3	If the victim is not responsive, shout for nearby help.
4	Activate the emergency response system as appropriate in your setting (Figure 5). Depending on your work situation, call 9-1-1 from your phone, mobilize the code team, or notify advanced life support.
5	If you are alone, get the AED/defibrillator and emergency equipment. If someone else is available, send that person to get it.

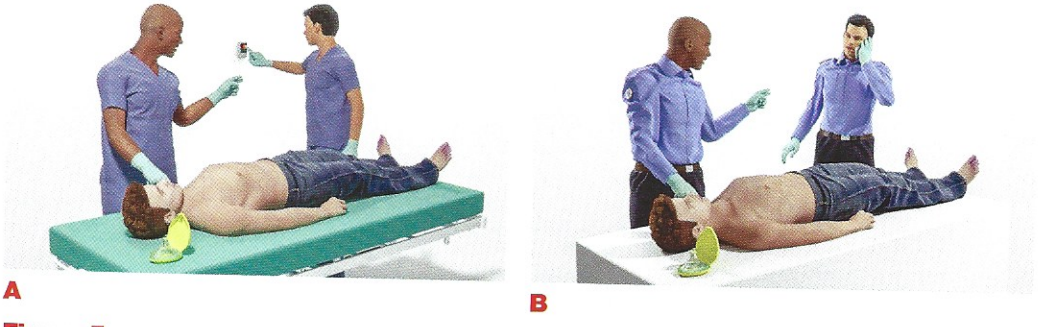

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Figure 5. Activate the emergency response system in your setting. **A,** In-facility setting. **B,** Prehospital setting.

Foundational Facts

Emergency Response System

Activation of the emergency response system may vary depending on your setting and local protocol. Examples include

- **Hospital:** Activating a specific hospital code, medical emergency team, or rapid response team
- **Prehospital:** Activating EMS, paramedics, medic units, or advanced life support or calling for backup
- **Workplace/facility:** Calling 9-1-1 (or the local emergency medical services number) or activating specific Occupational Safety and Health Administration or workplace emergency response protocols

Assess for Breathing and Pulse (Box 3)

Next, assess the victim for normal breathing and a pulse (Figure 6). This will help you determine the next appropriate actions.

To minimize delay in starting CPR, you may assess breathing at the same time as you check the pulse. This should take no more than 10 seconds.

Breathing

To check for breathing, scan the victim's chest for rise and fall for no more than 10 seconds.

- If the victim is breathing, monitor the victim until additional help arrives.
- If the victim is not breathing or is only gasping, this is not considered normal breathing and is a sign of cardiac arrest.

Check Pulse

To perform a pulse check in an adult, palpate a carotid pulse (Figure 7).

If you do not definitely feel a pulse within 10 seconds, begin high-quality CPR, starting with chest compressions. In all scenarios, by the time cardiac arrest is identified, the emergency response system or backup must be activated and someone must be sent to retrieve the AED and emergency equipment.

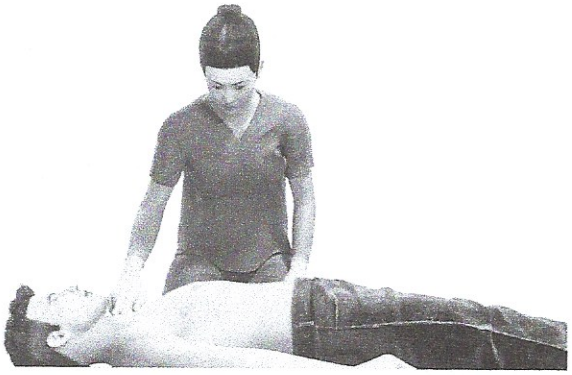
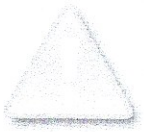


Figure 6. Check for breathing and pulse at the same time.

Caution



Agonal Gasps

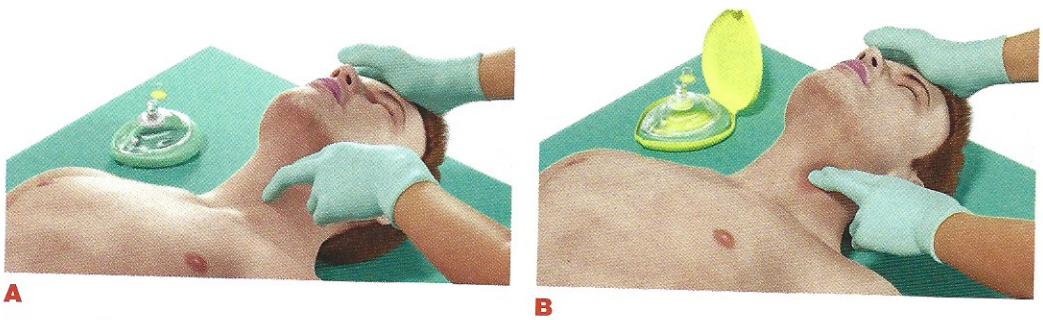
Agonal gasps are not normal breathing. Agonal gasps may be present in the first minutes after sudden cardiac arrest.

A person who gasps usually looks like he is drawing air in very quickly. The mouth may be open and the jaw, head, or neck may move with gasps. Gasps may appear forceful or weak. Some time may pass between gasps because they usually happen at a slow rate. The gasp may sound like a snort, snore, or groan. Gasping is not normal breathing. It is a sign of cardiac arrest.

Locating the Carotid Pulse

Follow these steps to locate the carotid pulse:

Step	Action
1	Locate the trachea (on the side closest to you), using 2 or 3 fingers (Figure 7A).
2	Slide these 2 or 3 fingers into the groove between the trachea and the muscles at the side of the neck, where you can feel the carotid pulse (Figure 7B).
3	Feel for a pulse *for at least 5 but no more than 10 seconds.* If you do not definitely feel a pulse, begin CPR, starting with chest compressions.



A B

Figure 7. Finding the carotid pulse. **A,** Locate the trachea. **B,** Gently feel for the carotid pulse.

Determine Next Actions (Boxes 3a, 3b)

Determine next actions based on the presence or absence of normal breathing and pulse:

If	Then
If the victim is breathing normally and a pulse is present	Monitor the victim.
If the victim *is not* breathing normally but a pulse *is* present	Provide rescue breathing (see Rescue Breathing in Part 7). • Confirm that the emergency response system has been activated. • Continue rescue breathing, and check pulse about every 2 minutes. Be ready to perform high-quality CPR if you do not feel a pulse. • If opioid use is suspected, consider naloxone if available and follow your local protocols (see Part 8 for more information).
If the victim is not breathing normally or is only gasping and has no pulse	Begin high-quality CPR (see next step below).

Begin High-Quality CPR, Starting With Chest Compressions (Box 4)

If the victim is not breathing normally or is only gasping and has no pulse, immediately begin high-quality CPR, starting with chest compressions (see Critical Concepts: High-Quality CPR in Part 1 and the section Adult Chest Compressions below). Remove or move the clothing covering the victim's chest so that you can locate appropriate hand placement for compression. This will also allow placement of the AED pads when the AED arrives.

Attempt Defibrillation With the AED (Boxes 5, 6, 7)

Use the AED as soon as it is available, and follow the prompts (see "Part 3: Automated External Defibrillator for Adults and Children 8 Years of Age and Older").

Resume High-Quality CPR (Box 8)

Immediately resume high-quality CPR, starting with chest compressions, when advised by the AED. Continue to provide CPR, and follow the AED prompts until advanced life support is available.

Adult Chest Compressions

Importance of Chest Compressions

Each time you stop chest compressions, the blood flow to the heart and brain decreases significantly. Once you resume compressions, it takes several compressions to increase blood flow to the heart and brain back to the levels present before the interruption. Thus, the more often chest compressions are interrupted and the longer the interruptions are, the lower the blood supply to the heart and brain is.

High-Quality Chest Compressions

If the victim is not breathing normally or is only gasping and has no pulse, begin CPR, starting with chest compressions.

Single rescuers should use the compression-to-ventilation ratio of 30 compressions to 2 breaths when giving CPR to victims of any age.

When you give chest compressions, it is important to

- Compress at a rate of 100 to 120/min.
- Compress the chest at least 2 inches (5 cm).
- Allow the chest to recoil (reexpand) completely after each compression.
- Minimize interruptions in compressions.

Caution

Do Not Move the Victim During Compressions

Do not move the victim while CPR is in progress unless the victim is in a dangerous environment (such as a burning building) or if you believe you cannot perform CPR effectively in the victim's present position or location.

When help arrives, the resuscitation team, based on local protocol, may choose to continue CPR at the scene or transport the victim to an appropriate facility while continuing rescue efforts.

Foundational Facts

The Importance of a Firm Surface

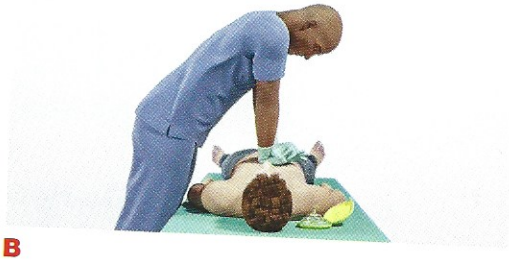
Compressions pump the blood in the heart to the rest of the body. To make compressions as effective as possible, place the victim on a firm surface, such as the floor or a backboard. If the victim is on a soft surface, such as a mattress, the force used to compress the chest will simply push the body into the soft surface. A firm surface allows compression of the chest and heart to create blood flow.

Chest Compression Technique

The foundation of CPR is chest compressions. Follow these steps to perform chest compressions in an adult:

Step	Action
1	Position yourself at the victim's side.
2	Make sure the victim is lying faceup on a firm, flat surface. If the victim is lying facedown, carefully roll him faceup. If you suspect the victim has a head or neck injury, try to keep the head, neck, and torso in a line when rolling the victim to a faceup position.
3	Position your hands and body to perform chest compressions: • Put the heel of one hand in the center of the victim's chest, on the lower half of the breastbone (sternum) (Figure 8A). • Put the heel of your other hand on top of the first hand. • Straighten your arms and position your shoulders directly over your hands.
4	Give chest compressions at a rate of 100 to 120/min.
5	Press down at least 2 inches (5 cm) with each compression (this requires hard work). For each chest compression, make sure you push straight down on the victim's breastbone (Figure 8B).
6	At the end of each compression, make sure you allow the chest to recoil completely.
7	Minimize interruptions of chest compressions (you will learn to combine compressions with ventilation next).

A



B

Figure 8. A, Place the heel of your hand on the breastbone, in the center of the chest. **B,** Correct position of the rescuer during chest compressions.

Foundational Facts

Chest Recoil

Chest recoil allows blood to flow into the heart. Incomplete chest recoil reduces the filling of the heart between compressions and reduces the blood flow created by chest compressions. Chest compression and chest recoil/relaxation times should be about equal.

Alternate Technique for Chest Compressions

If you have difficulty pushing deeply during compressions, put one hand on the breastbone to push on the chest. Grasp the wrist of that hand with your other hand to support the first hand as it pushes the chest (Figure 9). This technique may be helpful for rescuers with joint conditions, such as arthritis.

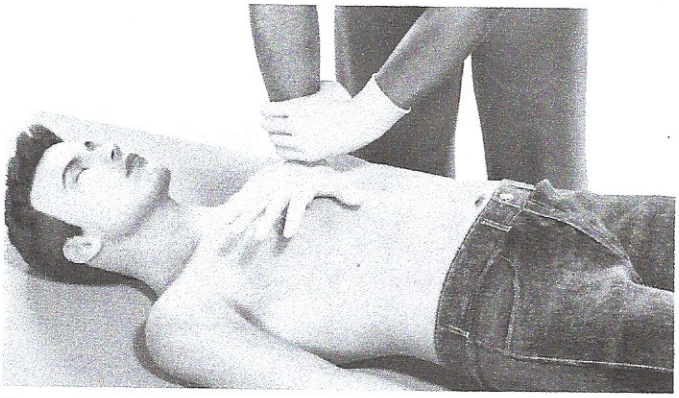


Figure 9. Alternate technique for giving chest compressions to an adult.

Adult Breaths

Opening the Airway

Introduction

For breaths to be effective, the victim's airway must be open. Two methods for opening the airway are

- Head tilt–chin lift
- Jaw thrust

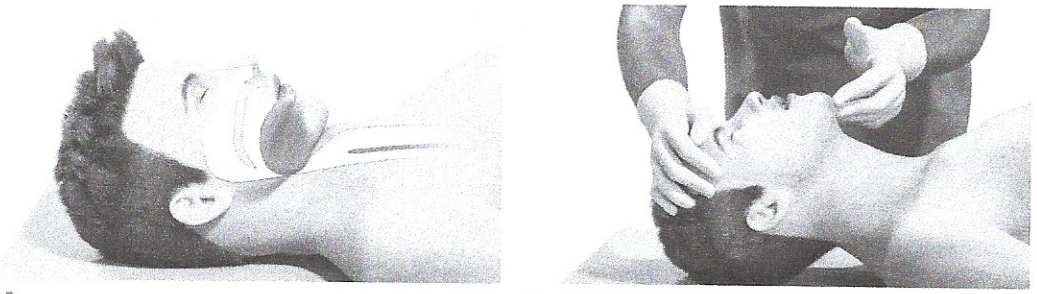
If a head or neck injury is suspected, use the jaw-thrust maneuver to reduce neck and spine movement. Switch to a head tilt–chin lift maneuver if the jaw thrust does not open the airway.

If multiple rescuers are available, one rescuer can perform a jaw thrust while another rescuer provides breaths with a bag-mask device. The third rescuer will give chest compressions.

Head Tilt–Chin Lift

Follow these steps to perform a head tilt–chin lift (Figure 10):

Step	Action
1	Place one hand on the victim's forehead and push with your palm to tilt the head back.
2	Place the fingers of the other hand under the bony part of the lower jaw near the chin.
3	Lift the jaw to bring the chin forward.



A B

Figure 10. The head tilt–chin lift relieves airway obstruction in an unresponsive victim. **A,** Obstruction by the tongue. When a victim is unresponsive, the tongue can block the upper airway. **B,** The head tilt–chin lift maneuver lifts the tongue, relieving the airway obstruction.

Caution

Things to Avoid With Head Tilt–Chin Lift

- Do not press deeply into the soft tissue under the chin because this might block the airway.
- Do not close the victim's mouth completely.

Jaw Thrust

The jaw-thrust maneuver is used when the head tilt–chin lift doesn't work or a spinal injury is suspected.

Rescuers may perform a jaw thrust to open the airway in a victim with a head or neck injury if a spinal injury is suspected (Figure 11). If the jaw thrust does not open the airway, use a head tilt–chin lift.

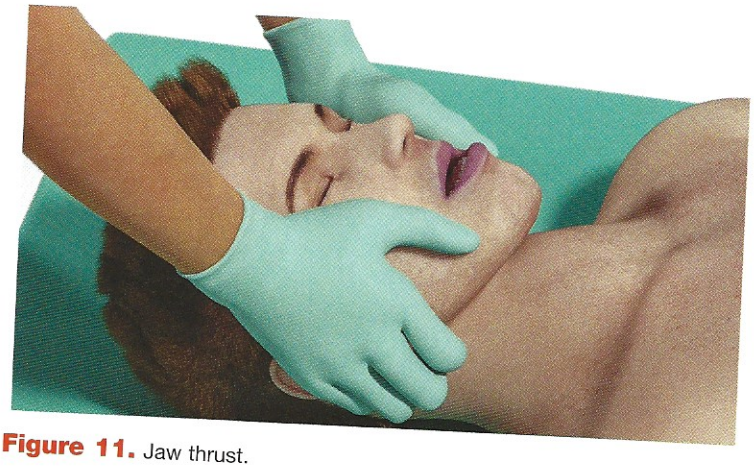


Figure 11. Jaw thrust.

Jaw-Thrust Maneuver

Follow these steps to perform a jaw thrust:

Step	Action
1	Place one hand on each side of the victim's head. You may rest your elbows on the surface on which the victim is lying.
2	Place your fingers under the angles of the victim's lower jaw and lift with both hands, displacing the jaw forward (Figure 11).
3	If the lips close, push the lower lip with your thumb to open the lips.

Barrier Devices

Introduction

Standard precautions include using barrier devices, such as a pocket mask, when giving breaths. Rescuers should replace face shields with a pocket mask at the first opportunity.

Foundational Facts

Low Infection Risk

The risk of infection from CPR is extremely low and limited to a few case reports. However, the US Occupational Safety and Health Administration (OSHA) requires that healthcare workers use standard precautions in the workplace, including during CPR.

Pocket Mask

For mouth-to-mask breaths, use a pocket mask (Figure 12). Pocket masks usually have a 1-way valve, which diverts exhaled air, blood, or bodily fluids away from the rescuer. The 1-way valve allows the rescuer's breath to enter the victim's mouth and nose and diverts the victim's exhaled air away from the rescuer. Some pocket masks have an oxygen inlet that allows you to administer supplementary oxygen.

Pocket masks are available in different sizes for adults, children, and infants (Figure 12). Effective use of the pocket mask barrier device requires instruction and practice.

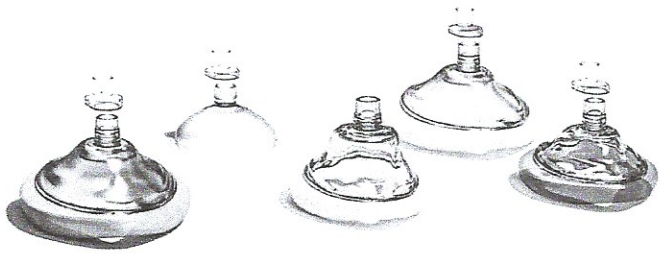


Figure 12. Adult, child, and infant pocket masks.

Use of a Pocket Mask

To use a pocket mask, position yourself at the victim's side. This position is ideal when performing 1-rescuer CPR because you can give breaths and perform chest compressions without repositioning yourself every time you change from compressions to giving breaths.

Follow these steps to open the airway with a head tilt–chin lift and use a pocket mask to give breaths to the victim:

Step	Action
1	Position yourself at the victim's side.
2	Place the pocket mask on the victim's face, using the bridge of the nose as a guide for correct position.

(continued)

(continued)

Step	Action
3	Seal the pocket mask against the face. • Using your hand that is closer to the top of the victim's head, place the index finger and thumb along the edge of the mask. • Place the thumb of your other hand along the edge of the mask.
4	Place the remaining fingers of your second hand along the bony margin of the jaw and lift the jaw. Perform a head tilt–chin lift to open the airway (Figure 10).
5	While you lift the jaw, press firmly and completely around the outside edge of the mask to seal the pocket mask against the face (Figure 13).
6	Deliver each breath over 1 second, enough to make the victim's chest rise.

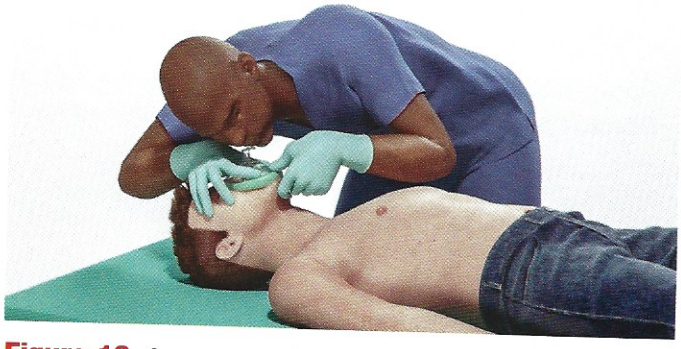


Figure 13. One rescuer using a pocket mask.

Foundational Facts

Oxygen Content of Exhaled Air

The air we breathe in contains about 21% oxygen. The air we breathe out contains about 17% oxygen. Because we use a relatively small amount of the oxygen we breathe, the air that the rescuer breathes out provides the victim with much-needed oxygen.

Foundational Facts

Adult Breaths

Remember the following when interrupting chest compressions to give 2 breaths with a barrier device:

- Deliver each breath over 1 second.
- Note visible chest rise with each breath.
- Resume chest compressions in less than 10 seconds.

Bag-Mask Devices

Bag-Mask Device

A *bag-mask device* is used to provide positive-pressure ventilation to a victim who is not breathing or not breathing normally (Figure 14). It consists of a bag attached to a face mask. If the bag is self-inflating, a bag-mask device may be used with or without an oxygen supply. If not attached to oxygen flow, it provides about 21% oxygen from room air. Some bag-mask devices include a 1-way valve. The type of valve may vary from one device to another.

Face masks are available in a variety of sizes. Common sizes are infant (small), child (medium), and adult (large). The mask should extend from the bridge of the nose to the cleft of the chin. It should cover the nose and mouth but not compress the eyes (Figure 15). The mask contains a cup that should provide an airtight seal. If the seal is not airtight, ventilation will be ineffective.

All BLS providers should be able to use a bag-mask device. Proficiency in the bag-mask ventilation technique requires practice. During CPR, 2 rescuers are recommended to deliver effective ventilation. One rescuer opens the airway and seals the mask against the face, while the other squeezes the bag.

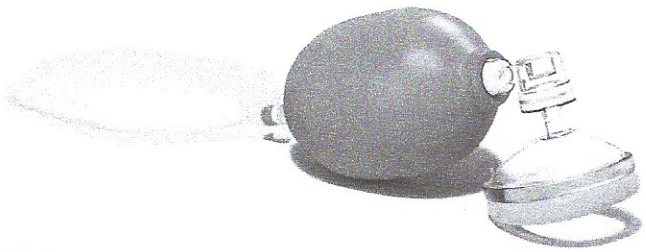


Figure 14. Bag-mask device.

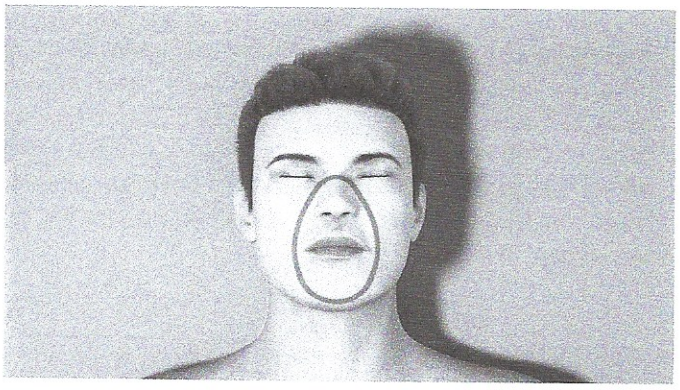
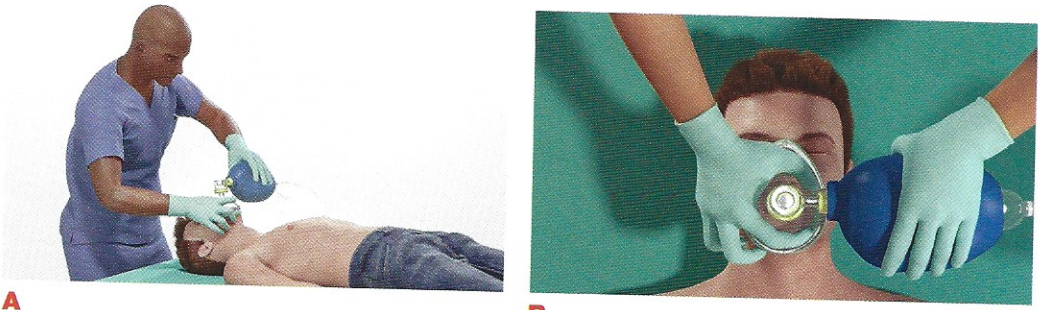


Figure 15. Proper area of the face for face mask application. Note that no pressure is applied to the eyes.

Bag-Mask Ventilation Technique (1 Rescuer)

Follow these steps to open the airway with a head tilt–chin lift and use a bag-mask device to give breaths to the victim:

Step	Action
1	Position yourself directly above the victim's head.
2	Place the mask on the victim's face, using the bridge of the nose as a guide for correct position.
3	Use the E-C clamp technique to hold the mask in place while you lift the jaw to hold the airway open (Figure 16). • Perform a head tilt. • Place the mask on the face with the narrow portion at the bridge of the nose. • Use the thumb and index finger of one hand to make a "C" on the side of the mask, pressing the edges of the mask to the face. • Use the remaining fingers to lift the angles of the jaw (3 fingers form an "E"), open the airway, and press the face to the mask.
4	Squeeze the bag to give breaths (1 second each) while watching for chest rise. Deliver each breath over 1 second, whether or not you use supplementary oxygen.



A B

Figure 16. E-C clamp technique of holding the mask while lifting the jaw.

Bag-Mask Ventilation Technique (2 Rescuers+)

When 3 or more rescuers are present, 2 rescuers can provide more effective bag-mask ventilation than 1 rescuer. When 2 rescuers use the bag-mask device, 1 rescuer opens the airway with a head tilt–chin lift (or jaw thrust) and holds the mask to the face while the other rescuer squeezes the bag (Figure 17). The first rescuer uses both hands to seal the mask to the patient's face and lift the jaw. The thumbs and index fingers of each hand form a "C" to seal the mask against the face. The 3 remaining fingers of each hand form an "E," lifting both sides of the jaw into the mask. The rescuer should be careful not to press too hard on the mask, because that could push the patient's jaw down and block the airway.

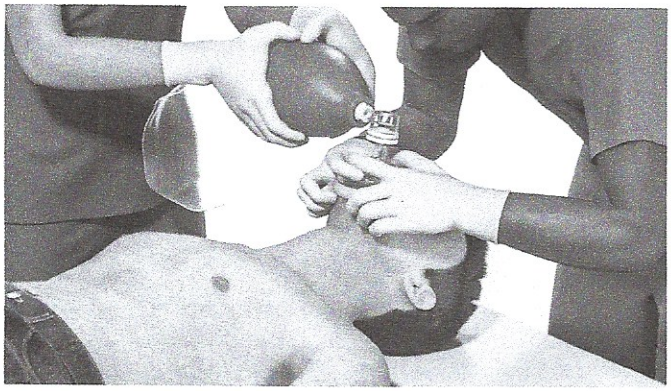


Figure 17. Two-rescuer bag-mask ventilation.

Critical Concepts

Two Rescuers for Jaw Thrust and Bag-Mask Ventilation

During CPR, jaw thrust and bag-mask ventilation are more efficiently performed when 2 or more rescuers are providing ventilation. One rescuer must be positioned above the victim's head and use both hands to open the airway, lift the jaw, and hold the mask to the face while the second rescuer squeezes the bag. The second rescuer is positioned at the victim's side.

Adult 2-Rescuer BLS Sequence

Introduction

If the rescuer encounters an unresponsive adult and other rescuers are available, follow the steps outlined in the BLS Healthcare Provider Adult Cardiac Arrest Algorithm (Figure 4).

Verify Scene Safety, Check for Responsiveness, and Get Help (Algorithm Boxes 1, 2)

The first rescuer who arrives at the side of a potential cardiac arrest victim should quickly perform the following steps. As more rescuers arrive, assign tasks (Table 3). When more rescuers are available for a resuscitation attempt, more tasks can be performed simultaneously.

Step	Action
1	Verify that the scene is safe for the rescuers and the victim. You do not want to become a victim yourself.
2	Check for responsiveness. Tap the victim's shoulder and shout, "Are you OK?"
3	If the victim is not responsive: The first rescuer assesses the victim and, if no mobile phone is available, sends the second rescuer to activate the emergency response system and retrieve the AED and emergency equipment.

Assess for Breathing and Pulse (Box 3)

For details on assessing the victim for normal breathing and a pulse, see Adult 1-Rescuer BLS Sequence earlier in Part 2.

Determine Next Actions (Boxes 3a, 3b)

For details on determining next actions based on breathing and pulse, see Adult 1-Rescuer BLS Sequence earlier in Part 2.

Begin High-Quality CPR, Starting With Chest Compressions (Box 4)

If the victim is not breathing normally or is only gasping and has no pulse, immediately do the following:

- One rescuer begins high-quality CPR, starting with chest compressions. Remove or move the clothing covering the victim's chest so that you can locate appropriate hand placement for compression. This will also allow placement of the AED pads when the AED arrives.
- Once the second rescuer returns and 2-rescuer CPR is provided, rescuers should switch compressors frequently (about every 2 minutes or 5 cycles, typically when the AED is analyzing the rhythm) so that CPR quality is not reduced because of fatigue (see Critical Concepts: High-Performance Teams later in Part 2).

Attempt Defibrillation With the AED (Boxes 5, 6, 7)

Use the AED as soon as it is available and follow the prompts (Figure 18) (see "Part 3: Automated External Defibrillator for Adults and Children 8 Years of Age and Older").

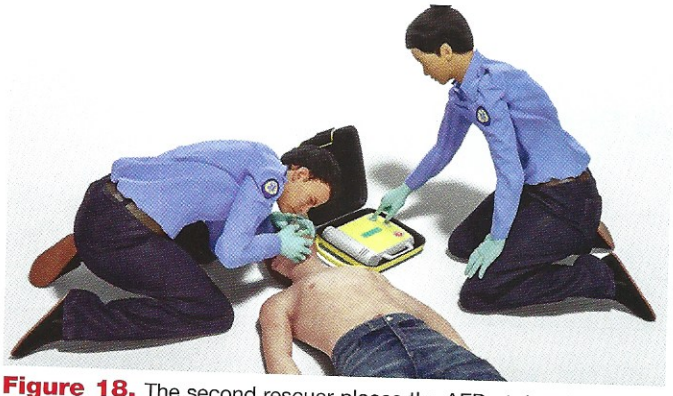


Figure 18. The second rescuer places the AED at the victim's side, near the rescuer who will be operating it.

Resume High-Quality CPR (Box 8)

After shock delivery or if no shock is advised, immediately resume high-quality CPR, starting with chest compressions. Continue to provide CPR and follow the AED prompts until advanced life support providers take over or the victim starts to breathe, move, or otherwise react.

Critical Concepts

High-Performance Teams

When giving compressions, rescuers should switch compressors after every 5 cycles of CPR (about every 2 minutes), or sooner if fatigued.

As additional rescuers arrive, they can help with bag-mask ventilation, compressions, and use of the AED and other emergency equipment (Figure 19).

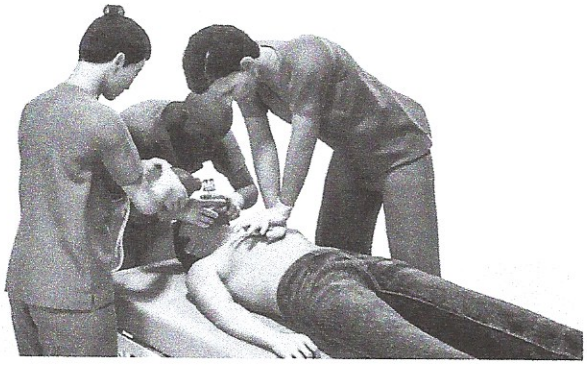


Figure 19. Multiple rescuers can perform simultaneous tasks during a resuscitation attempt.

Team Roles and Duties for 2-Rescuer CPR

Rescuer Tasks

In 2-rescuer CPR (Figure 20), each rescuer has specific tasks.

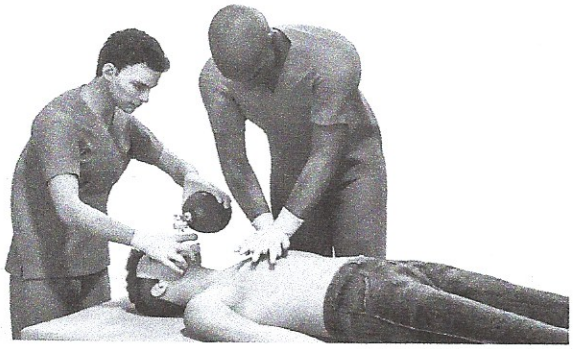


Figure 20. Two-rescuer CPR.

Table 3. Rescuer Tasks in 2-Rescuer CPR

Rescuer	Location	Duties
Rescuer 1 (compressions)	At the victim's side	• Make sure the victim is faceup on a firm, flat surface. • Perform chest compressions. – Compress at a rate of 100 to 120/min. – Compress the chest at least 2 inches (5 cm) for adults. – Allow the chest to recoil completely after each compression. – Minimize interruptions in compressions (try to limit any interruptions in chest compressions to less than 10 seconds). – Use a compression-to-ventilation ratio of 30:2. – Count compressions out loud. • Switch compressors about every 5 cycles or every 2 minutes (or more frequently if fatigued). Take less than 5 seconds to switch.
Rescuer 2 (breaths)	At the victim's head	• Maintain an open airway by using either – Head tilt–chin lift or – Jaw thrust • Give breaths, watching for chest rise and avoiding excessive ventilation. • Encourage the first rescuer to perform compressions that are deep enough and fast enough and to allow complete chest recoil between compressions. • When only 2 rescuers are available, switch compressors about every 5 cycles or every 2 minutes, taking less than 5 seconds to switch.

Foundational Facts

Effective Team Performance to Minimize Interruptions in Compressions

Effective teams communicate continuously. If the compressor counts out loud, the rescuer providing breaths can anticipate when breaths will be given. This will help the rescuer prepare to give breaths efficiently and minimize interruptions in compressions. Also, the count will alert both rescuers when the time for a switch is approaching.

It is hard work to deliver effective chest compressions. If the compressor tires, chest compressions won't be as effective. To reduce rescuer fatigue, switch compressors about every 5 cycles (or every 2 minutes) or sooner if needed. To minimize interruptions, perform the switch when the AED is analyzing the rhythm. Take less than 5 seconds to switch.

Review

Scenario: *A 53-year-old man suddenly collapses and becomes unresponsive. You witness him collapse and are the first rescuer to arrive at the scene. You find him lying motionless on the floor.*

1. Which is the first action you should take in this situation?
    a. Activate the emergency response system
    b. Start high-quality CPR, beginning with chest compressions
    c. Start providing rescue breaths
    d. Verify that the scene is safe for you and the victim

2. The man doesn't respond when you touch his shoulders and shout, "Are you OK?" What is your best next action?
    a. Check his pulse
    b. Start high-quality CPR
    c. Start providing rescue breaths
    d. Shout for nearby help

3. Several rescuers respond, and you ask them to activate the emergency response and retrieve the AED and emergency equipment. As you check for a pulse and breathing, you notice that the man is gasping for air and making "snorting" sounds. You do not feel a pulse. What is your best next action?
    a. Start high-quality CPR, beginning with chest compressions
    b. Monitor the victim until additional, more experienced help arrives
    c. Provide rescue breathing by delivering 1 breath every 5 to 6 seconds
    d. Find someone to help by retrieving the nearest AED

4. What is the ratio of chest compressions to breaths when providing CPR to an adult?
    a. 10 compressions to 2 breaths
    b. 15 compressions to 2 breaths
    c. 30 compressions to 2 breaths
    d. 100 compressions to 2 breaths

5. What are the rate and depth for chest compressions on an adult?
    a. A rate of 60 to 80 compressions per minute and a depth of about 1 inch
    b. A rate of 80 to 100 compressions per minute and a depth of about 1½ inches
    c. A rate of 120 to 140 compressions per minute and a depth of about 2½ inches
    d. A rate of 100 to 120 compressions per minute and a depth of at least 2 inches

6. What action should you take when more rescuers arrive?
    a. Assign tasks to other rescuers and rotate compressors every 2 minutes or more frequently if needed to avoid fatigue
    b. Continue CPR while the AED is attached even if you are fatigued
    c. Wait for the most experienced rescuer to provide direction to the team
    d. Direct the team to assign a team leader and roles while you continue CPR

7. If you suspect that an unresponsive victim has head or neck trauma, what is the preferred method for opening the airway?
    a. Head tilt–chin lift
    b. Jaw thrust
    c. Head tilt–neck lift
    d. Avoid opening the airway

See Answers to Review Questions in the Appendix.

Student Notes

Part 3

Automated External Defibrillator for Adults and Children 8 Years of Age and Older

General Concepts

Overview

An *automated external defibrillator* (AED) is a lightweight, portable, computerized device that can identify an abnormal heart rhythm that needs a shock. The AED can then deliver a shock that can stop the abnormal rhythm (ventricular fibrillation or pulseless ventricular tachycardia) and allow the heart's normal rhythm to return. AEDs are simple to operate, allowing laypersons and healthcare providers to attempt defibrillation safely.

Learning Objectives

At the end of this part, you will be able to

- Describe the importance of early use of an AED for adults and children 8 years of age and older
- Demonstrate the appropriate use of an AED for adults and children 8 years of age and older

Early Defibrillation

The time between collapse and defibrillation is an important factor in survival from sudden cardiac arrest caused by ventricular fibrillation or pulseless ventricular tachycardia (see Foundational Facts boxes below).

Public-Access Defibrillation

To make early defibrillation possible, an AED or defibrillator should be immediately available to BLS providers responding to a cardiac arrest. *Public-access defibrillation* (PAD) means having trained rescuers and AEDs available in public places where large numbers of people gather or where there is reasonable likelihood of witnessed cardiac arrests. Examples include airports, convention centers, sports facilities, industrial buildings, offices, fitness facilities, shopping malls, apartments, and healthcare facilities. Communities, businesses, or public facilities where AEDs are available are encouraged to participate in local PAD programs by

- Notifying or registering their AED with the local EMS agency
- Establishing medical authority (appointing a local physician) to provide medical oversight for quality control
- Ensuring that all expected rescuers are trained in high-quality CPR and AED use

Critical Concepts

Maintaining the AED and Supplies

AEDs should be properly maintained according to the manufacturer's instructions. Maintenance may include

- Battery replacement
- Calibration and testing of energy dose
- Ordering and replacing supplies
  - AED pad replacement, including pediatric pads
  - Additional emergency equipment,* such as
    - Scissors
    - Razor (for shaving a hairy chest)
    - Wipes
    - Gloves
    - Barrier device (eg, pocket mask)

*These items are sometimes kept in a separate emergency or first aid kit.

AED Arrival

Once the AED arrives, place it at the victim's side, next to the rescuer who will operate it. This position provides ready access to AED controls and easy placement of AED pads. It also allows a second rescuer to perform high-quality CPR from the opposite side of the victim without interfering with AED operation.

Foundational Facts

Importance of Minimizing Time Between Last Compression and Shock Delivery

Research has shown that if rescuers minimize the interval between the last compression and shock delivery, the shock is much more likely to be effective (ie, eliminating ventricular fibrillation and increasing the chances of return of spontaneous circulation). Minimizing this interval will require practice and excellent team coordination, particularly between the compressor and the rescuer operating the AED.

Foundational Facts

Life-Threatening Arrhythmias

An *arrhythmia* is an irregular or abnormal heart beat. Arrhythmias occur when the electrical impulses that cause the heart to beat happen too quickly, too slowly, or erratically. Arrhythmias can be life threatening. Two life-threatening arrhythmias that cause cardiac arrest are pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF).

- **Pulseless ventricular tachycardia:** When the lower chambers of the heart (ventricles) begin contracting at a very fast pace, a rapid heart rate known as ventricular tachycardia develops. In extremely severe cases, the ventricles pump so quickly and inefficiently that no pulse can be detected (ie, pVT). Body tissues and organs, especially the heart and brain, no longer receive oxygen.
- **Ventricular fibrillation:** VF is an arrest rhythm. The heart's electrical activity becomes disordered. The heart muscles quiver in a fast, unsynchronized way so the heart does not pump blood.

Rapid defibrillation, high-quality CPR, and all components of the Chain of Survival are needed to improve chances of survival from pulseless pVT and VF.

Foundational Facts

Defibrillation

An AED analyzes the heart rhythm to identify the presence of a rhythm that responds to shock therapy (a so-called shockable rhythm). If VF or pVT is identified, the device prompts the delivery of an electrical shock to the heart. The shock temporarily "stuns" the heart muscle. This stops the VF or pVT and "resets" the electrical system of the heart, so a normal (organized) heart rhythm can return. If an organized rhythm returns and high-quality CPR continues, the heart muscle can begin to contract and pump blood effectively. If circulation returns, a pulse is palpable, and this is called *return of spontaneous circulation* (ROSC).

Using the AED

Be Familiar With the AED Equipment in Your Setting

AED equipment varies according to the model and manufacturer. There are a few differences from model to model, but AEDs all operate in basically the same way. In this manual, we include the universal steps for operating an AED during a resuscitation attempt. However, you must be familiar with the AED used in your particular setting. For example, some AEDs must be powered on while others power on automatically when the lid is opened.

Universal Steps for Operating an AED

Table 4 explains the universal steps for operating an AED. However, always turn on the AED and follow the AED prompts as displayed or heard during the resuscitation attempt.

To reduce the time to shock delivery, you should ideally perform the first 2 steps listed below within 30 seconds after the AED arrives at the victim's side.

Table 4. Universal Steps for Operating an AED

Step	Action
1	**Open** the carrying case. **Power on the AED** (Figure 21) if needed. • Some devices will "power on" automatically when you open the lid or case. • Follow the AED prompts as a guide to next steps.
2	**Attach AED pads** to the victim's bare chest. Choose adult pads (not child pads or a child system) for victims 8 years of age and older. • Peel the backing away from the AED pads. • Attach the adhesive AED pads to the victim's bare chest. Follow the placement diagrams on the pad (Figure 22). See Critical Concepts: AED Pad Placement Options later in Part 3 for common placement options. • Attach the AED connecting cables to the AED device (some AED cables are already preconnected to the device).
3	"Clear" the victim and allow the AED to **analyze** the rhythm (Figure 23). • When the AED prompts you, clear the victim during analysis. Be sure that no one is touching the victim, not even the rescuer in charge of giving breaths. • Some AEDs will tell you to push a button to allow the AED to begin analyzing the heart rhythm; others will do that automatically. The AED may take a few seconds to analyze. • The AED then tells you if a shock is needed.

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Step	Action
4	If the AED advises a shock, it will tell you to **clear** the victim (Figure 24A) and then deliver a shock. • Clear the victim before delivering the shock: be sure that no one is touching the victim. • Loudly state a "clear the victim" message, such as "Everybody clear" or simply "Clear." • Look to be sure that no one is in contact with the victim. • Press the shock button (Figure 24B). • The shock will produce a sudden contraction of the victim's muscles.
5	If no shock is needed, and after any shock delivery, **immediately resume CPR**, starting with chest compressions.
6	After about 5 cycles or 2 minutes of CPR, the AED will prompt you to repeat steps 3 and 4.

Do Not Delay High-Quality CPR After AED Use

Immediately resume high-quality CPR, starting with chest compressions (Figure 25), after

- A shock is delivered or
- The AED prompts "no shock advised"

After about 5 cycles or 2 minutes of high-quality CPR, the AED will prompt you to repeat steps 3 and 4. Continue until advanced life support providers take over or the victim begins to breathe, move, or otherwise react.

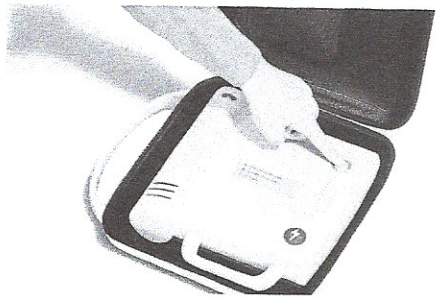


Figure 21. Power on the AED.

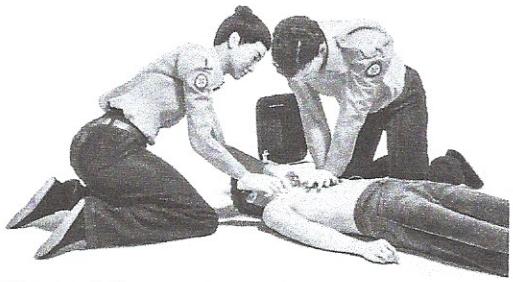


Figure 22. The rescuer attaches AED pads to the victim and then attaches the electrodes to the AED.

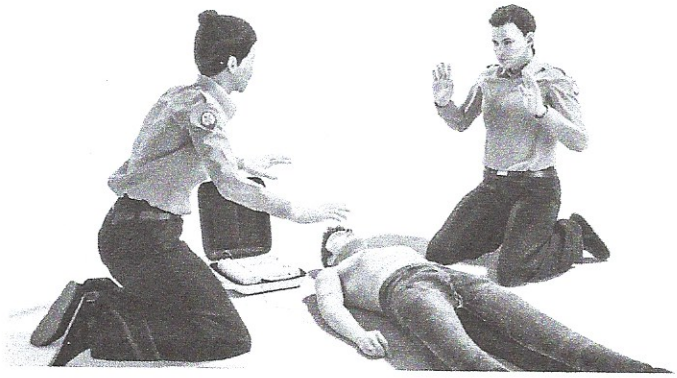


Figure 23. The AED operator clears the victim before rhythm analysis. If needed, the AED operator then activates the analyze feature of the AED.

A

B

Figure 24. A, The AED operator clears the victim before delivering a shock. **B,** When everyone is clear of the victim, the AED operator presses the shock button.

Figure 25. If no shock is indicated and immediately after any shock delivered, rescuers start CPR, beginning with chest compressions.

Critical Concepts

AED Pad Placement Options

AED pads should be placed by following the diagram on the pads. The 2 common placements are anterolateral and anteroposterior.

Anterolateral Placement

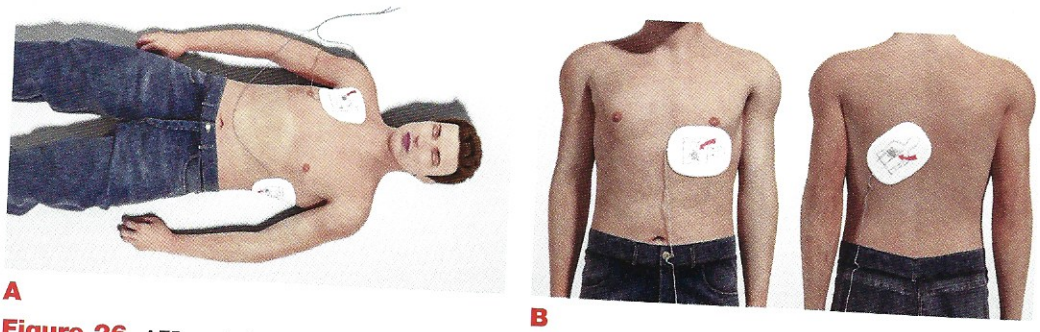
As shown in Figure 26A, both pads will be placed on the victim's bare chest.

- Place one AED pad directly below the right collarbone.
- Place the other pad to the side of the left nipple, with the top edge of the pad a few inches below the armpit.

Anteroposterior Placement

As shown in Figure 26B, one pad will be placed on the victim's bare chest (anterior), and the other will be placed on the victim's back (posterior).

- Place one AED pad on the left side of the chest, between the victim's left side of the breastbone and left nipple.
- Place the other pad on the left side of the victim's back, next to the spine.



A B

Figure 26. AED pad placement options on an adult victim. **A,** Anterolateral. **B,** Anteroposterior.

Caution

Child AED Pads

Your AED may also include smaller pads that are designed for children under 8 years of age. However, you should not use the child pads for an adult. The shock dose delivered by child pads is too small for an adult and will likely not be successful. It is better to provide high-quality CPR than to attempt to shock an adult victim with child pads.

Special Circumstances

Special circumstances may require the rescuer to take additional actions when placing AED pads for a victim who

- Has a hairy chest
- Is immersed in water or has water covering the chest
- Has an implanted defibrillator or pacemaker
- Has a transdermal medication patch or other object on the surface of the skin where the AED pads are to be placed

Hairy Chest

If the victim has a hairy chest, the AED pads may stick to the hair and not to the skin on the chest. If this occurs, the AED will not be able to analyze the victim's heart rhythm. The AED will display a "check electrodes" or "check electrode pads" message.

Remember to note whether or not the victim has a hairy chest *before you apply the pads*. Then you can shave the area where you will place the pads by using the razor from the AED carrying case.

If you have a second set of pads, you can use the first set to remove the hair. Apply the first set of pads, press them down so they stick as much as possible, and quickly pull them off. Then apply the new second set of pads.

Water

Water is a good conductor of electricity. Do not use an AED in water.

- If the victim is in water, pull the victim out of the water.
- If the chest is covered with water, quickly wipe the chest before attaching the AED pads.
- If the victim is lying on snow or in a small puddle, you may use the AED after quickly wiping the chest.

Implanted Defibrillators and Pacemakers

Victims with a high risk for sudden cardiac arrest may have implanted defibrillators or pacemakers that automatically deliver shocks directly to the heart. If you place an AED pad directly over an implanted medical device, the implanted device may block delivery of the shock to the heart.

These devices are easy to identify because they create a hard lump beneath the skin of the upper chest or abdomen. The lump is about half the size of a deck of playing cards.

If you identify an implanted defibrillator/pacemaker:

- If possible, avoid placing the AED pad directly over the implanted device.
- Follow the normal steps for operating an AED.

Transdermal Medication Patches

Do not place AED pads directly on top of a medication patch. The medication patch may block the transfer of energy from the AED pad to the heart and also cause small burns to the skin. Examples of medication patches are nitroglycerin, nicotine, pain medication, and hormone replacement therapy patches.

If it does not delay delivery, remove the patch and wipe the area before attaching the AED pad.

Caution

Use Protective Gloves to Remove a Medication Patch

To avoid delivery of the medication to the rescuer, use protective gloves or another barrier to remove the patch. Remember to avoid delays as much as possible.

Life Is Why

Science Is Why

Cardiovascular diseases claim more lives than all forms of cancer combined. This unsettling statistic drives the AHA's commitment to bring science to life by advancing resuscitation knowledge and research in new ways.

Review

1. What is the most appropriate first step to take as soon as the AED arrives at the victim's side?
   a. Power on the AED
   b. Apply the pads
   c. Press the analyze button
   d. Press the shock button

2. Which step is one of the universal steps for operating an AED?
   a. Placing the pads on the victim's bare chest
   b. Shaving the victim's hairy chest
   c. Removing the victim from water
   d Finding the victim's implanted pacemaker

3. If a victim of cardiac arrest has an implanted pacemaker or defibrillator, what special steps should be taken?
   a. Avoid placing the AED pad directly over the implanted device
   b. Avoid using the AED to prevent damage to the implanted device
   c. Turn off the implanted device before applying the AED pads
   d. Consider using pediatric pads to decrease the shock dose delivered

4. What action should you take when the AED is analyzing the heart rhythm?
   a. Check the pulse
   b. Continue chest compressions
   c. Give rescue breaths only
   d. Stand clear of the victim

See Answers to Review Questions in the Appendix.

Student Notes

4

Team Dynamics

General Concepts

Overview

Successful team dynamics are critical during a multirescuer resuscitation attempt, regardless of location. Poor communication among team members can negatively affect performance. Effective team dynamics may increase the chance of a successful resuscitation.

Whether you are a team member or team leader, it is important to understand not just *what* to do in a resuscitation attempt but *how* to communicate and perform effectively as part of a multirescuer team.

Learning Objectives

At the end of this part, you will be able to

- Describe the importance of teams in multirescuer resuscitation
- Perform as an effective team member during multirescuer CPR

Foundational Facts

Chest Compression Fraction

Shorter duration of interruptions in chest compressions is associated with a greater likelihood of return of spontaneous circulation, shock success, and survival to hospital discharge. Performing CPR with a chest compression fraction as high as possible is advisable to achieve this. The chest compression fraction is the proportion of time that chest compressions are performed during a cardiac arrest. A chest compression fraction of at least 60% is recommended, and a goal of 80% is often achievable with good teamwork.

Critical Concepts

Effective Team Dynamics

Successful multirescuer team members not only have medical expertise and mastery of resuscitation skills, but also practice good communication and effective team dynamics. This enables rescuers to respond rapidly and effectively in an emergency situation. Effective multirescuer team dynamics help give victims the best chance of survival.

Elements of Effective Team Dynamics

The elements of team dynamics can be grouped into 3 categories:

- Roles during a resuscitation attempt
- What to communicate
- How to communicate

Roles During a Resuscitation Attempt

Clear Roles and Responsibilities

During a resuscitation attempt, clear roles and responsibilities should be defined as soon as possible. The team leader's role is to clearly define and delegate tasks according to each team member's skill level. When all team members know their jobs and responsibilities, the team functions more smoothly.

Figure 27 shows an example of a team formation with assigned roles.

Resuscitation Triangle Roles

Compressor

- Assesses the patient
- Does 5 cycles of chest compressions
- Alternates with AED/Monitor/Defibrillator every 5 cycles or 2 minutes (or earlier if signs of fatigue set in)

AED/Monitor/Defibrillator

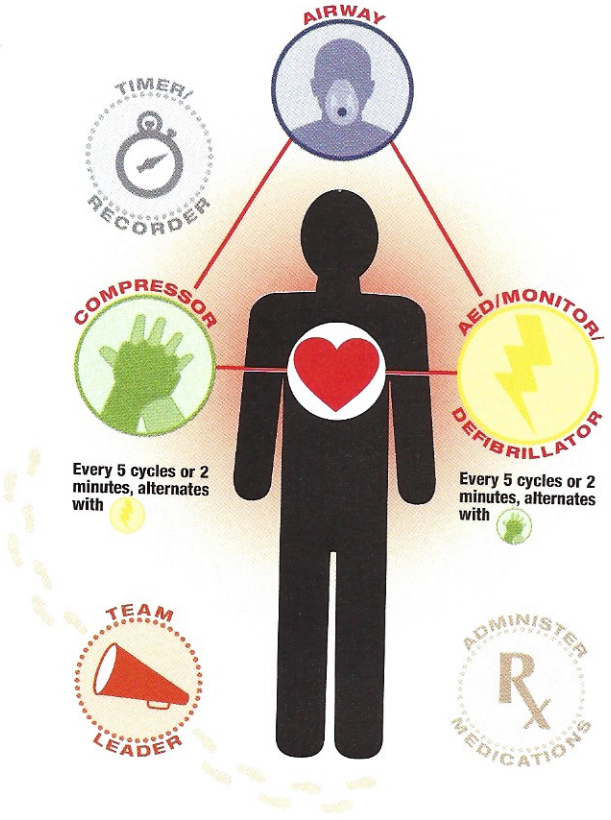
- Brings and operates the AED/monitor/defibrillator
- Alternates with Compressor every 5 cycles or 2 minutes (or earlier if signs of fatigue set in), ideally during rhythm analysis
- If a monitor is present, places it in a position where it can be seen by the Team Leader (and most of the team)

Airway

- Opens and maintains the airway
- Provides ventilation

The team owns the code. No team member leaves the triangle except to protect his or her safety.

Positions for 6-Person High-Performance Teams*



Leadership Roles

Team Leader

- **Every resuscitation team must have a defined leader**
- Assigns roles to team members
- Makes treatment decisions
- Provides feedback to the rest of the team as needed
- Assumes responsibility for roles not assigned

Administer Medications

- An ALS provider role
- Administers medications

Timer/Recorder

- Records the time of interventions and medications (and announces when these are next due)
- Records the frequency and duration of interruptions in compressions
- Communicates these to the Team Leader (and the rest of the team)

*This is a suggested team formation. Roles may be adapted to local protocol.

Figure 27. Team diagram.

Knowing Your Limitations

Every member on the team should know his or her limitations, and the team leader should be aware of them. Each team member should ask for assistance and advice early, not when the situation starts to get worse.

Constructive Intervention

Sometimes a team member or team leader may need to correct actions that are incorrect or inappropriate. It's important to be tactful, especially if you have to correct someone who is about to make a mistake, whether it's a drug, dose, or intervention. Any person on the team should stop someone else from making a mistake, regardless of that person's role on the team.

What to Communicate

Knowledge Sharing

Knowledge sharing is important for effective team performance. Team leaders should ask frequently for observations and feedback. This includes good ideas for management and observations about possible oversights.

Summarizing and Reevaluating

Summarizing information out loud is helpful during a resuscitation attempt for the following reasons:

- Provides an ongoing record of treatment
- Acts as a way to reevaluate the victim's status, the interventions performed, and the team's progress within the algorithm of care
- Helps team members respond to the victim's changing condition

How to Communicate

Closed-Loop Communication

Closed-loop communication is important for both the team leader and team members. To practice closed-loop communication, the team leader and team members should do the following:

Team leader

- Call each team member by name and make eye contact when giving an instruction.
- Don't assign additional tasks until you are sure that the team member understands the instruction.

Team members

- Confirm that you understand each task to which you are assigned by verbally acknowledging the task.
- Tell the team leader when you have finished a task.

Clear Messages

Team leaders and team members should give clear messages. Using concise, clear language helps prevent misunderstandings. Speaking in a tone of voice that is loud enough to hear, but is also calm and confident, helps keep all team members focused.

Mutual Respect

All team members should display mutual respect and a professional attitude to other team members, regardless of their skill level or training. Emotions can run high during a resuscitation attempt. So it's especially important for the team leader to speak in a friendly, controlled voice and avoid shouting or aggression.

Debriefing

Debriefing is an important part of every resuscitation attempt, both during and after the attempt. Debriefing is the opportunity for team members to identify why certain actions were taken. Debriefing has been shown to

- Help individual team members perform better
- Aid in identification of system strengths and deficiencies

Implementation of debriefing programs may even improve patient survival after cardiac arrest.

Life Is Why

Education Is Why

Heart disease is the No. 1 cause of death in the world—with more than 17 million deaths per year. That's why the AHA is continuously transforming our training solutions as science evolves, and driving awareness of how everyone can help save a life.

Review

1. After performing high-quality CPR for 5 minutes, the team leader frequently interrupts chest compressions to check for a pulse even though the victim has no organized rhythm when the AED analyzes the rhythm. Which action demonstrates constructive intervention?
   a. Ask another rescuer what he thinks should be done
   b. Say nothing that contradicts the team leader
   c. Suggest to resume chest compressions without delay
   d. Wait until the debriefing session afterward to discuss it
2. The team leader asks you to perform bag-mask ventilation during a resuscitation attempt, but you have not perfected that skill. What would be an appropriate action to acknowledge your limitations?
   a. Pick up the bag-mask device and give it to another team member
   b. Pretend you did not hear the request and hope the team leader chooses someone else to do it
   c. Tell the team leader that you are not comfortable performing that task
   d. Try to do it as best you can and hope another team member will see you struggling and take over
3. What is the appropriate action to demonstrate closed-loop communication when the team leader assigns you a task?
   a. Repeat back to the team leader the task you were assigned
   b. Nod your head as an acknowledgment of the assigned task
   c. Start performing the assigned tasks, but do not speak, to minimize noise
   d. Wait for the team leader to address you by name before acknowledging the task

See Answers to Review Questions in the Appendix.

Student Notes