

# AED Resource Information

The following information is provided as a resource for instructors and instructor trainers who teach automated external defibrillation (AED). It is not intended for this information to be added to all the current American Red Cross AED training courses. Significant guidance, review and input was provided by the American Red Cross Advisory Council on First Aid and Safety (ACFAS) chair and subject matter expert, David Markenson, MD, FAAP, EMT-P.

## Introduction

Each year, at least 250,000 people die of sudden cardiac arrest in the United States. Sudden cardiac arrest in *adults* is commonly caused by an abnormal heart rhythm called ventricular fibrillation (V-Fib). Sudden cardiac arrest can happen to anyone, at any time and not just to adults. Defibrillation is an electric shock that can correct ventricular fibrillation by interrupting the chaotic electrical activity by helping the heart to reestablish an effective electrical rhythm.

An AED is a machine that analyzes the heart's rhythm and, if necessary, tells the responder to deliver a shock to a victim of sudden cardiac arrest.

## Defibrillation Recommendations for Pediatric Victims

On July 1, 2003, the Pediatric Advanced Life Support (PALS) Task Force of the International Liaison Committee on Resuscitation (ILCOR) released updated guidance and an advisory statement that supports the use of pediatric AED pads on victims between the ages of 1 and 8 (and less than 55 pounds) who have no signs of life. The American Red Cross supports the consensus of the scientific community.

While the incidence is relatively low compared to adults, cardiac arrest resulting from V-Fib does happen to young children and infants and is no less dramatic. The emotional trauma and devastation of the loss of a child to a family and community cannot be measured.

While it is not known exactly how many pediatric instances occur, studies suggest that there may be more occurrences of V-Fib than previously believed. Recent studies have also shown that the chance for survival is much higher for V-Fib than other rhythms. Traditional therapy for children has not included early rhythm detection and possible defibrillation and these recent studies have shown that this may represent missed opportunities to save a child's life. Unfortunately, there is a shortened window of opportunity for detection of V-Fib in children when compared to an adult and, as such, a small window of opportunity for subsequent rapid defibrillation. This window of opportunity may be lost for a lack of early recognition of V-Fib because of initial emphasis placed on airway and breathing problems at the exclusion of all else by traditional emergency care procedures. Early detection of V-Fib in children and infants is critical to the best chance of survival for a child in cardiac arrest with a shockable rhythm. Even though studies began suggesting that this window of opportunity to treat V-Fib in children existed, there still was a lack of equipment for rapid detection and early defibrillation.

Care for *adult victims* of sudden cardiac arrest has been greatly improved through the advent of AEDs. These devices allow for rapid detection and defibrillation of V-Fib by trained, *non-professional* rescuers and even the lay public. This technological breakthrough has led to increased detection and treatment of V-Fib in adults. Many believed the energy settings for an adult could be damaging to the child's heart, and there were questions as to whether these devices could correctly identify V-Fib in children.

The recent development of special *pediatric AED pads* addresses concerns regarding the possibility of injury to young children and infants caused by the higher energy levels of conventional AEDs used for adult victims. AEDs that are configured for victims under age 8 or less than 55 pounds have been proven to be reliable and accurate in determining shockable rhythms and delivering effective shocks. Further, this advance in defibrillation technology has been reviewed and approved by the U.S. Food and Drug Administration (FDA).

The ILCOR advisory statement **does not** make a recommendation for or against the use of AEDs in children less than 1 year of age because there is insufficient scientific evidence.

## Causes of Cardiac Arrest in Children and Infants

Most cases of cardiac arrest in children are not sudden. Causes of cardiac arrest in infants and young children include—

- Airway problems.
- Breathing problems.
- Traumatic injuries or an accident (e.g., automobile accident, drowning, electrocution or poisoning).
- A hard blow to the chest (i.e., *commotio cordis*).
- Congenital heart disease.
- Sudden Infant Death Syndrome (SIDS).

## The Role of CPR

CPR, if started promptly, can help by keeping blood containing oxygen flowing to the brain and other vital organs. However, in cases of V-Fib that have the best chance for survival of pediatric or adult cardiac arrest, CPR by itself is insufficient to correct the underlying heart problem. AEDs and those equipped with pediatric AED pads or adapters for children are needed to correct the problem.

## Defibrillation

- AEDs provide an electrical shock to the heart called defibrillation.
- Delivering an electrical shock with an AED disrupts abnormal electrical activity long enough to allow the heart to develop an effective rhythm on its own.
- The most common abnormal electrical rhythm in children and infants suffering from cardiac arrest that defibrillation can correct is the same as in *adults* and is called ventricular fibrillation (V-Fib).
- The sooner a shockable rhythm is identified and the defibrillation shock is administered, the greater the likelihood the victim will survive.
- Defibrillation is not intended to restart a heart without any electrical activity. It treats the specific abnormal electrical rhythm, V-Fib.
- Although current defibrillation equipment was designed for adults, it has been viewed by the scientific community as able to deliver the needed amount of electricity and accurately identify the rhythms in children 8 years and older.

- For infants and children under age 8 or less than 55 pounds, AEDs without the use of pediatric AED pads may provide a higher level of energy than needed and may not be completely accurate at recognizing V-Fib. As such, for defibrillation of infants and children younger than 8 years of age or less than 55 pounds, optimal energy delivery and accurate rhythm recognition requires the use of pediatric AED pads to deliver lower energy levels and to accommodate the smaller torsos of young children.

## Defibrillation Equipment Operation and Pad Placement

- The location for pad placement is usually the same in children and adults, anterior (upper right chest) and anterior (lower left side), except in the case of young children; one must deal with a smaller torso.
- Since the AED pads **must not** contact each other, in the case of young children, this requires smaller pads and possibly different placement of the pads, such as anterior (chest) and posterior (back).
- The ILCOR advisory makes no primary recommendation on pad placement.
- If a trained responder is unsure and the child appears to be older than 8 years of age or weighing more than 55 pounds, care should not be delayed to determine exact age and weight. The adult AED pads and AED equipment should be applied and used.
- The manufacturer's operating instructions and local protocols should always be followed.
- In some areas of the country, local protocols may allow the use of AEDs with non-pediatric AED pads for children and infants of all ages. This protocol will be based on the local medical directors' estimate of potential risk of use of these devices being far less than the benefit of defibrillating a child in V-Fib. A responder should only use a non-pediatric AEDs on infants and children between the ages of 1 and 8 years of age or less than 55 pounds if approved and allowed by local medical protocol and if pediatric pads or adapters are not available.
- If the pads are not securely attached to the victim's chest or if the cables are not fastened properly, the responder will receive a "connect electrodes" or other error message from the AED. This message may appear in print on the small screen on the front of the machine or in a voice prompt. If you receive such a message, check to see that the pads and cables are attached properly. In all cases, the manufacturer's instructions must be followed since AEDs differ in the type of cables and adhesive electrode pads used.
- At this point, the AED is ready to analyze the heart rhythm. Some devices require the responder to press a button marked "analyze" to have the machine examine the heart rhythm. Other models will automatically analyze the heart rhythm. The responder must ensure that **no one** is touching or moving the victim during this time. If the AED identifies a rhythm that should be defibrillated, it will prompt with either an on-screen message or by voice prompt, or both. This message often states "shock advised," followed by "press to shock" or "press the shock button now," indicating that the responder must press a button to defibrillate the victim.
- A voice prompt from the AED will also advise everyone to "stand clear" before administering a shock. This is an important measure that all present must follow. Any time an AED is analyzing the rhythm, charging to a specific energy level or delivering a shock, **the responder and others must not be in contact with the victim**. It is the responsibility of the person who operates the AED to warn rescuers and bystanders to move away from contact with the victim before analyzing and

before depressing the shock button. This can be done by shouting, “Stand clear!” Another common warning is “I’m clear, you’re clear, everybody clear!” while actually checking around the victim before pressing the shock button.

**Note:** *AEDs function differently. Some AEDs are fully automatic and do not require the operator to press a button to deliver a shock. Extra care should be taken to ensure that no one is touching the victim before this type of AED delivers a shock. Follow the manufacturer’s instructions and local protocols to use the unit correctly.*

- The number of shocks the AED delivers and the energy level for each shock is often preset by the manufacturer according to the standard of care established by the state or local EMS authority. The medical director for the individual or local AED program can establish local operating protocols based on the area EMS or regulatory guidelines. The *2005 Consensus on Science* recommends a standard AED protocol of 1 shock immediately followed by 2 minutes of CPR.

## Common Features of Pediatric Defibrillation with AEDs

Currently, several of the devices available use technology that attenuates, or lowers, the energy level of the defibrillation shock. This may either be one, single energy level shock or multiple shocks of either single energy or escalating energy, but **all** will be at a lower energy level than would be delivered without the attenuation circuitry.

The energy lowering circuitry is encased in a conspicuous plastic housing located between the pad’s connector on one end and the pads themselves on the other end. Some AEDs have a “key-pad” adapter that is inserted into the AED for switching to pediatric operation.

- This visible feature and other visible markings unique to the pediatric pads lead to easier recognition of the pads as appropriate for pediatric (younger than age 8 or less than 55 pounds) and less likely to be confused with other defibrillation equipment.
- Pad placement is the same regardless of the make or model (see “Defibrillation Equipment Operation and Pad Placement” above).
- Pads are reversible. Reversal of pads may affect data display and analysis of rhythm but **not** the delivery of the defibrillation. However, always try to assure correct pad placement.
- In some instances, the heart will *not* require defibrillation. In these cases, the AED device will inform you that no shock is needed. The AED should be left attached to the victim and turned on. Unless there is an obvious sign of life, immediately resume CPR.

## Special Resuscitation Situations

Some situations require rescuers to pay special attention when using an AED. It is important that rescuers be familiar with these situations and able to respond appropriately.

- **Hypothermia.** Victims of hypothermia have been resuscitated even after prolonged exposure. It will take longer to do your check or assessment of the victim since you may have to check for signs of life and pulse for up to 30 to 45 seconds. If you do not find a sign of life, begin CPR until an AED becomes readily available. Dry the victim’s chest and attach the AED. If a shock is indicated,

deliver a shock and follow the instructions of the AED. If there is still no sign of life, continue CPR. Follow local protocol as to whether additional shocks should be delivered. CPR should be continued and the victim should be protected from further heat loss. Wet garments should be removed, if possible. The victim should not be defibrillated in water. CPR or defibrillation should not be withheld to rewarm the victim. Responders should take care not to shake a hypothermia victim unnecessarily, as this could result in ventricular fibrillation.

- **AEDs and Implantable Cardiac Devices.** Some people whose hearts are weak and not able to generate an electrical impulse may have a pacemaker implanted. The pacemaker serves the function of the sinoatrial node. These small implantable devices may sometimes be located in the area below the right collarbone. There may be a small lump that can be felt under the skin. Sometimes the pacemaker is placed somewhere else. Other individuals may have an implantable cardioverter-defibrillator (ICD), a miniature version of an AED, which acts to automatically recognize and restore abnormal heart rhythms. If visible, or you know that the victim has an implanted cardiac device, do not place the defibrillation pads directly over the implanted device. This may interfere with the delivery of the shock. Adjust pad placement if necessary and continue to follow the established protocol. If you are not sure, use the AED if needed. It will not harm the victim or rescuer.
- **Nitroglycerin Patches and AEDs.** People that have a history of cardiac problems may use nitroglycerin patches (Nitropatch®). These patches are usually placed on the chest. If you encounter a victim with a patch on his or her chest, remove it with a gloved hand. Nitroglycerin patches pose a possible absorption risk for rescuers, not an explosion hazard. Nitroglycerin patches look very similar to nicotine patches that people use to stop smoking. Although these patches do not interfere with defibrillation, time may be wasted attempting to identify the type of patch. Therefore, any medication patches that are on the victim's chest should be removed.
- **Trauma and AEDs.** If a person is in cardiac arrest resulting from traumatic injuries, the AED may still be used. Defibrillation should be continued according to local protocol.

***Note:** Metal surfaces are not included as a special circumstance because they pose no shock hazard to either victim or rescuer. Additional information directly from AED manufacturers confirms that it is indeed safe to defibrillate a victim on a metal surface as long as the appropriate safety precautions are taken. Specifically, care should be taken that the defibrillation electrodes do not contact the conductive surface and that no one is touching the victim when the discharge button is pressed.*

- **AEDs Around Water.** AEDs can be used in a variety of environments including rain and snow. Always use common sense when using an AED and follow the manufacturer's recommendations. Generally, the victim should not be in a puddle of water, nor should the rescuer be kneeling in a puddle of water when operating the AED. If it is raining, steps should be taken to ensure that the victim is as dry as possible and sheltered from the rain. Ensure that the victim's chest is wiped dry. However, minimize delaying defibrillation when taking steps to provide for a dry environment. The electrical current of an AED is very directional between the electrode pads and AEDs are very safe when all precautions and manufacturer's operating instructions are followed. When using an AED near the water, such as at a pool facility, attempt to put the victim on a dry surface, such as a backboard. The victim's chest should be wiped dry. If possible, the victim should be placed on a backboard and moved away from the water. Proceed to use the defibrillator as in any situation.

## Maintenance of AEDs

For defibrillators to perform optimally, they must be maintained like any other machine. The AEDs that are available today require minimal maintenance. These devices have various self-testing features. However, it is important that operators are familiar with any visual or audible warning prompts the AED may have to warn of malfunction or a low battery. It is important that you read the operator's manual thoroughly and check with the manufacturer to obtain all necessary information regarding maintenance.

In most instances, if the machine detects any malfunction, you should 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 batteries have enough energy for one complete rescue. (A fully charged back-up battery should be readily available.)
- Make sure that the correct defibrillator pads are in the package and properly sealed.
- Check any expiration dates on defibrillation 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.
- If at any time the machine fails to work properly or warning indicators are recognized, discontinue use and contact the manufacturer immediately.

## AEDs and Oxygen

When using AEDs in conjunction with administration of emergency supplemental oxygen, follow these guidelines:

- Avoid the use of supplemental, free-flowing oxygen and the use of an AED in a confined space.
- Prior to shocking a victim with an AED, ensure that no one is touching or in contact with the victim or the resuscitation equipment.
- Keep breathing devices with free-flowing oxygen away from the victim during defibrillation.
- Follow local protocols.

## Using AED Training Devices

When training is conducted or sponsored by the American Red Cross, only AED training devices incapable of delivering a shock or AED rhythm simulators should be used. The training devices and rhythm simulators allow using shockable and non-shockable scenarios that can enhance decision-making skills and diversify training activities.

An AED rhythm simulator is an operational or "live" AED whose shock delivery feature has been overridden for training purposes through the insertion of a training data card or other device. Like any manufactured device, there is a risk that the device or the override feature may fail to perform

as designed. Follow standard safety procedures whenever using an AED whether it is live or a rhythm simulator.

The following are responsibilities of instructors for all Red Cross AED training:

- AED training devices or AED rhythm simulators should never be connected to humans—only to manikins.
- Live AEDs (those that can deliver a shock) should never be attached to a human for purposes of training.
- Since a live AED has the capacity to deliver a potentially lethal shock if not properly deactivated by applying the rhythm simulation mode before being used as a training device, instructors must follow all manufacturers' instructions for deactivation of all AEDs used in training.
- Students must be cautioned not to tamper with the deactivation mode (i.e., removal of the data card).
- Instructors should visually check and verify that the deactivation mode (rhythm simulation) is in use.
- Instructors are to ensure that students treat the AED trainers and rhythm simulators with respect and do not allow horseplay involving any AED trainer or rhythm simulator.
- Throughout the course, participants and instructors are to treat the manikins as if they are actual victims.
- Instructors should have at least one AED training device (AED device designed not to deliver an electrical shock) with AED training pads appropriate for the victim's age range (i.e., adult or pediatric) or AED rhythm simulator per two participants.

These responsibilities also include ensuring that all AED precautions are followed during the class, including, but not limited to, the following:

- Do not use alcohol to wipe the victim's chest dry. Alcohol is flammable.
- Do not use an AED on a victim in contact with water.
- Do not touch the victim while the AED is analyzing or delivering a shock.
- Do not defibrillate someone around flammable materials, such as gasoline or free-flowing oxygen.
- Do not use a cellular phone or radio within 6 feet of the AED. This may interrupt analysis.

## Definitions

- Free-flowing oxygen is defined as any oxygen that is released into the environment either intentionally or unintentionally, which could reach potentially dangerous levels.
- Confined space is a space that—
  - Is large enough and configured so that a person can enter and perform assigned work.
  - Has limited or restricted means of entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults and pits are spaces that may have limited means of entry).
  - Is not designed for continuous occupancy.

## Frequently Asked Questions—Using an AED

**Q. If the location of the pads on the chest is reversed, will the AED still work?**

A. Yes, if the placement of the pads is reversed, the AED will still work properly.

**Q. Should the pads be removed and/or the AED turned off if the AED prompts, “No shock advised, continue CPR” (or similar)?**

A. No, the pads should not be removed nor should the AED be turned off. It is possible that the AED will tell you that additional shocks are needed.

**Q. Should I use pediatric AED pads on an adult?**

A. No. Pediatric AED pads **should not** be used on an adult, as they may not deliver enough energy for defibrillation.

**Q. Do AEDs need regular maintenance?**

A. Yes, all AEDs require regular maintenance. Maintenance includes checking and changing batteries and electrode cables and pads. Always follow the manufacturer’s instructions for maintenance of the AED at your worksite.

**Q. Can AEDs be used safely in the rain and snow?**

A. AEDs can be used in a variety of environments including rain, snow and ice. When using an AED, always follow the manufacturer’s recommendations. Generally, the person should not be lying in a puddle of water, nor should the rescuer be kneeling in a puddle of water when operating the AED. If it is raining, ensure that the person is as dry as possible and sheltered from the rain. Minimize delaying defibrillation when providing for a dry environment. Wipe the person’s chest (and the back for a smaller child if using anterior/posterior pad placement). Manufacturers state that AEDs are safe when all precautions and their operating instructions are followed.

**Q. Should an AED be used on an infant?**

A. The International Liaison Committee on Resuscitation (ILCOR) advisory statement **does not** currently support a recommendation for or against the use of AEDs on children under 1 year of age because there is insufficient evidence. Always follow local protocols and medical direction.

**Q. Can I defibrillate someone who has a pacemaker or other implantable cardiac device?**

A. Yes. If visible or if you know the victim has an implanted cardiac device, do not place the defibrillation pads directly over the implanted device. This may interfere with the delivery of the shock. Adjust pad placement if necessary and continue to follow the established protocol.

**Q. Are there any special considerations when placing electrode pads on a female?**

A. If the female is wearing a bra, remove it before placing the electrode pads. As with all victims, place one electrode pad on her upper right chest and one on her lower left side under her left breast.

**Q. Can I defibrillate a pregnant woman?**

A. Yes. Defibrillation shocks transfer no significant electrical current to the fetus. Local protocols and medical direction should be followed.