

AUTOMATED EXTERNAL DEFIBRILLATORS



From FDA Heart Health Online – Web site: www.fda.gov

What is an automated external defibrillator?

An automated external defibrillator (AED) is a portable automatic device used to restore normal heart rhythm to patients in cardiac arrest.

An AED is applied outside the body. It automatically analyzes the patient's heart rhythm and advises the rescuer whether or not a shock is needed to restore a normal heart beat. If the patient's heart resumes beating normally, the heart has been *defibrillated*.

When is it used?

An AED is used to treat cardiac arrest. It is a life-saving device because cardiac arrest is a sudden condition that is fatal if not treated within a few minutes.

Heart attacks and other conditions can cause ventricular fibrillation. In ventricular fibrillation, the electrical signals in the lower part of the heart are uncoordinated and ineffective. Very little blood is pumped from the heart to the body or the lungs. If ventricular fibrillation is not treated, it will result in Cardiac Arrest.

How does it work?

An AED consists of a small computer (microprocessor), electrodes, and electrical circuitry. The electrodes collect information about the heart's rhythm. The microprocessor interprets the rhythm.

If the heart is in ventricular fibrillation, the microprocessor recommends a defibrillating shock. The shock is delivered by adhesive electrode pads, through the victim's chest wall, and into the heart. There are special low-power electrode pads for use on children.

What will it accomplish?

The AED delivers an electric shock that stuns the heart momentarily; stopping all activity. This gives the heart a chance to restart normal electrical activity and resume beating effectively.

What are the risks?

Most trained users can operate AEDs safely. There is some risk of electric shock to the operator and others if the operator has not been trained to avoid touching the patient. Other risks include skin burns from the electrodes, abnormal heart rhythms, and blood clots.

When should it not be used?

The device should not be used in a patient who has a pulse. It should also be avoided under conditions where the patient cannot be isolated from other people (for example, in the standing water of a rowboat that is filled with passengers who are either touching the patient or the water).

Links:

[AEDs and Public Access Defibrillation Programs](#)

US Food and Drug Administration

http://www.fda.gov/cdrh/consumer/AED_PAD.html

[Wikipedia – Web site: en.wikipedia.org](http://en.wikipedia.org)

Usage

An automated external defibrillator is used in cases of life threatening cardiac arrhythmias, which may lead, or have led to cardiac arrest. The rhythms the device will treat are usually limited to:

- Ventricular fibrillation (shortened to VF or V-Fib)
- Pulseless Ventricular tachycardia (shortened to VT or V-Tach)^[1]

AEDs (and all other defibrillators) are not designed to shock asystole or 'flat line' patterns, as this will not have a positive clinical outcome. The asystolic patient only has a chance of survival if, through a combination of CPR and cardiac stimulant drugs, one of the shockable rhythms can be established, which makes it imperative for CPR to be carried out by any lay rescuer prior to the arrival of a defibrillator.

In each of the two types of shockable cardiac arrhythmia, the heart is in activity (possibly even beating), yet in an unusual pattern, which can be life-threatening if left uncorrected. In ventricular fibrillation, the electrical activity of the heart becomes chaotic, preventing the ventricle from effectively pumping blood.

In ventricular tachycardia, the heart beats too fast to effectively pump blood. Frequently, ventricular tachycardia leads to ventricular fibrillation. The fibrillation in the heart decreases over time, and will eventually reach Asystole, with an absence of any rhythm.

Uncorrected, these cardiac conditions rapidly lead to irreversible brain damage and death. After approximately three minutes, irreversible brain/tissue damage occurs. For every minute that a person in cardiac arrest goes without being successfully treated (by defibrillation), the chance of survival decreases by 10 percent.

AED's are designed to be used by laypersons, who ideally should have received specialist training. They are usually limited in their interventions to delivering high joule shocks for VF and VT. This is in contrast to more sophisticated manual and semi-automatic defibrillators used by health professionals, which can act as a pacemaker if the heart rate is too slow (bradycardia) and perform other functions which require a skilled operator, able to read electrocardiograms.

Placement

Automated external defibrillators are generally either held by trained personnel who will attend incidents, or are public access units which can be found in places such as corporate and government offices, shopping centers, airports, restaurants, casinos, hotels, sports stadiums, schools and universities, community centers, fitness centers and health clubs.

In many areas, emergency services vehicles are likely to carry AEDs, with some Ambulances carrying an AED in addition to a manual unit. In addition, some police or fire service vehicles carry an AED for first responder use. Some areas have dedicated community first responders, who are volunteers tasked with keeping an AED and taking it to any victims in their area. It is also increasingly common to find AEDs on transport such as commercial airlines and cruise ships.

In order to make them highly visible, public access AEDs often are brightly colored, and are mounted in protective cases near the entrance of a building. All trained AED operators should know to phone for an Ambulance when sending for or using an AED, as the patient will be unconscious, which always requires ambulance attendance.

Preparation for operation



The use of easily visible status indicator and pad expiry date on one model of AED

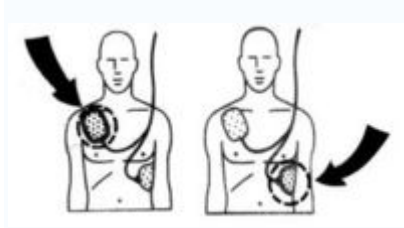
Most manufacturers recommend checking the AED before every 'duty' or on a regular basis if a fixed unit. Some units need to be switched on in order to perform its self check. Other models, such as the one pictured, have a self check system built in, with a visible indicator.

All manufacturers mark their pads with an expiry date, and it is important to ensure that the pads are in date. This is usually marked on the outside of the pads. Some models are designed to make this date visible through a 'window', although others will require the opening of the case to find the date stamp.

Mechanism of operation

An AED is called *external* because the operator applies the electrode pads to the bare chest of the victim, as opposed to internal defibrillators, which have electrodes surgically implanted inside the body of a patient.

The 'Automatic' part of the title refers to the unit's ability to autonomously analyze the patient's condition, and to assist this, the vast majority of units have spoken prompts, and some may also have visual displays to instruct the user.



Usual placement of pads on chest

When turned on, or opened, the AED will instruct the user to connect the electrodes (pads) to the patient. Once the pads are attached to the patient, everyone should avoid touching the victim so as to avoid false readings by the unit. The pads allow the AED to examine the electrical output from the heart and determine if the patient is in a viable, shockable rhythm (either ventricular fibrillation or ventricular tachycardia). If the device determines that a shock is viable, it will use the battery to charge its internal capacitor in preparation to deliver the shock. This system is not only safer (charging only when required), but also allows for a faster delivery of the electrical current.

When charged, the device instructs the user to ensure no one is touching the victim and then to press a button to deliver the shock. Human intervention is usually required to deliver the shock to the patient, to avoid the possibility of accidents. After the shock is delivered, the device will either instruct the user to commence CPR, or will continue to monitor the heart rhythm of the patient to determine if another shock is necessary.

Many AED units have an 'event memory', which stores the ECG of the patient along with details of the time the unit was activated and the number and strength of any shocks delivered. Some units also have voice recording facilities, to monitor the actions taken by the personnel, to ascertain if these had any impact on the survival outcome. All this memorized data can be either downloaded to a computer, or printed out, so that the providing organization or responsible body (such as a coroner) can see the effectiveness of both CPR and defibrillation on the patient's heart.

AEDs available to the public may be semi-automatic or fully automatic. Fully automatic units are likely to have few buttons, often activating as soon as the case is opened, and possibly just one button to shock, or in some cases, this will be performed automatically. The user has no input in to the operation of the unit, apart from attaching the pads, and following the prompts. Health care professionals, and other trained persons, may use a Semi-Automatic defibrillator, which is likely to have an ECG readout display,

and the possibility to override the rhythm analysis software. This allows trained personnel to give a higher standard of care, shocking at specific times in the cycle.

Simplicity of use

Unlike regular defibrillators, an automated external defibrillator requires very little training to use. It automatically diagnoses the heart rhythm and determines if a shock is needed. Automatic models will administer the shock without the user's command. Semi-automatic models will tell the user that a shock is needed, but the user must tell the machine to do so, usually by pressing a button. In most circumstances, the user cannot override a "no shock" advisory by an AED.

All AEDs approved for use in the United States use an electronic voice to prompt users through each step. Because the user of an AED may be deaf or hard of hearing, many AEDs now include a screen to provide visual prompts. Most units today are designed for use by non-medical operators. Their ease of use has given rise to the notion of public access defibrillation (PAD), which experts agree has the potential to be the single greatest advance in the treatment of out-of-hospital cardiac arrest since the invention of CPR ^[2].

References

1. Kerber, Richard E; Becker, Lance B; Bourland, Joseph D; Cummins, Richard O; Hallstrom, Alfred P; Michos, Mary B; Nichol, Graham; Ornato, Joseph P; Thies, William H; White, Roger D; Zuckerman, Bram D (1997). "[Automatic External Defibrillators for Public Access Defibrillation](#)". *Circulation* **95** (1677-1682). American Heart Association. Retrieved on [2007-06-28](#).
2. [Introduction to the International Guidelines 2000 for CPR and ECC](#)

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www.redcross.org

Saving a Life Is as Easy as A-E-D

Defibrillation Overview

In the time it takes you to read this information, sudden cardiac arrest will have claimed another victim. Statistics show that more than 200,000 Americans die of sudden cardiac arrest every year. Up to 50,000 of these deaths could have been prevented if someone had initiated the Cardiac Chain of Survival, and an automated external defibrillator (AED) had been available for immediate use at the time of the emergency.

What is an AED program?

An AED program is a plan that can be developed in a workplace, school, or community environment, or in places where large groups of people gather.

Do AED programs differ based on the environment?

Yes. Each AED program will differ based on the needs of the organization; however, the initial steps necessary to form the basis for the program are similar.

What are some things to consider when developing an AED program?

Assessment. Determine the needs for your environment. How many devices are necessary? How long will it take EMS to arrive at your location? How long will it take EMS to arrive at the site of the emergency; are there obstacles such as stairs, secured doors, etc.?

Funding. Determine the budget necessary to purchase the equipment, train employees, volunteers or other staff and provide program maintenance.

Legislation. Understand the current laws concerning AED use in your state. Consult with your legal advisor or local state EMS department for further information on the most current AED legislation in your state.

Implementation. Determine if your organization needs an internal implementation team to manage the program or needs to purchase a solution package to provide management oversight. The management of the program could include a program point of contact, medical direction, program maintenance, data management, development of protocols and response plans.

Who can be trained?

Organizations should consider whether the staff responsible for AED program oversight and/or management will consist of existing staff that already have safety as a part of their job description; or will staff need to be trained? If staff is trained, but safety is not a part of their job description, organizations will need to determine whether these individuals will have a responsibility to respond.

What type of support is needed for staffing an AED program?

Organizations should consider the possible salary costs for program staff that are designated to respond in an emergency; any OSHA requirements, such as Blood Borne Pathogens training, vaccinations, and quality assurance requirements.

What is sudden cardiac arrest (SCA)?

Sudden cardiac arrest cases are usually due to abnormal heart rhythms called arrhythmias, the vast majority of which are ventricular fibrillation. Ventricular fibrillation is a condition in which the heart's electrical impulses suddenly become chaotic, causing the heart to cease pumping blood effectively. Victims of SCA collapse and quickly lose consciousness, often without warning. Unless a normal heart rhythm is restored, death will follow within a matter of minutes.

The cause of sudden cardiac arrest is not well understood. Many victims have no history of heart disease, or if heart disease is present, it has not functionally impaired them. Unlike a heart attack, which is the death of muscle tissue from loss of blood supply, many victims of SCA have no prior symptoms. SCA can strike anyone, at any time, anywhere.

How common is SCA and who is at risk?

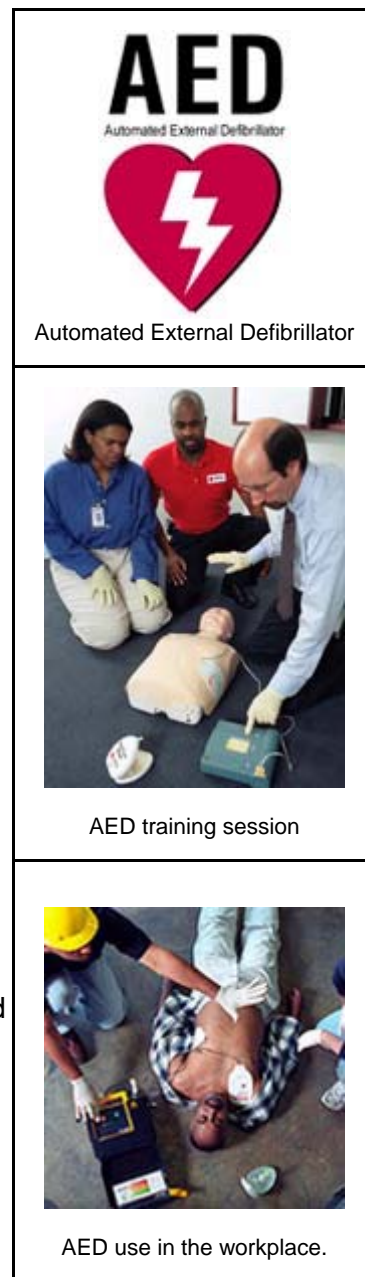
SCA is one of the leading causes of death in the United States. It strikes more than 200,000 Americans each year: nearly one death every two minutes.

What is the current treatment for sudden cardiac arrest?

The cardiac chain of survival is the current treatment for sudden cardiac arrest.

What is the cardiac chain of survival?

The cardiac chain of survival is a series of four critical steps. All four steps of the chain must be present to help ensure survival from sudden cardiac arrest. The four steps are:



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AED training session

AED use in the workplace.

- Step one: Early access to care (calling 9-1-1 or another emergency number)
- Step two: Early cardiopulmonary resuscitation (CPR)
- Step three: Early defibrillation
- Step four: Early advanced cardiac life support, as needed

The third step, delivering an electrical shock to the heart, which is known as defibrillation, is recognized as the most critical step in restoring cardiac rhythm and resuscitating a victim of SCA.

What is an automated external defibrillator (AED)?

An AED is a device about the size of a laptop computer that analyzes the heart's rhythm for any abnormalities and, if necessary, directs the rescuer to deliver an electrical shock to the victim. This shock, called defibrillation, may help the heart to reestablish an effective rhythm of its own.

How does an AED work?

An AED is easy to operate. It uses voice prompts to instruct the rescuer. Once the machine is turned on, the rescuer will be prompted to apply two electrodes provided with the AED to the victim's chest. Once applied, the AED will begin to monitor the victim's heart rhythm. If a "shockable" rhythm is detected, the machine will charge itself and instruct the rescuer to stand clear of the victim and to press the shock button.

If an AED is so easy to use, why do I need training?

Training is necessary in order to understand the role of defibrillation in the broader context of the cardiac chain of survival. Training in CPR and AED skills will enable the rescuer to use all the steps in the cardiac chain of survival, thereby significantly increasing the victim's chance of survival.

How can I get trained in the use of an AED?

Contact your local American Red Cross for a listing of training classes. The Red Cross offers half-day courses that include CPR and AED skills and comprehensive, daylong sessions that also include first aid. These interactive courses are taught by certified Red Cross instructors and use hands-on practice scenarios and videos that reflect a variety of situations. Each participant receives a skills card for use during in-class practice sessions. The skills cards can also aid in retaining skills after completing the course and serves as a quick reference tool in an emergency.

Who can use an AED?

In most cases, EMTs and first responders (police and firefighters) are required to know how to use an AED as part of their job responsibilities. Furthermore, all 50 states now have AED Good Samaritan provisions that help protect laypersons. Contact your local or state emergency medical services ("EMS") department to find out about Good Samaritan protections that your state provides for users of AEDs.

Where can I find AEDs?

AEDs can be found in corporate offices, shopping malls, airports, sports stadiums, schools, community centers, and other places where large groups of people gather and the risk of a sudden cardiac arrest incident is very likely. The number of devices in the community will continue to grow as more and more people begin to understand the importance of AEDs and AED training.

How can I buy an AED?

A physician's prescription is needed in order to purchase most AEDs. This means that the medical director of a facility or a physician used by such facility must prescribe and oversee the AED program at any workplace or other facility that houses an AED. Some AEDs can be purchased over the counter without a prescription. The cost of an AED varies by manufacturer and model. Currently, an average price for a single AED unit is about \$2,300.