Automated External Defibrillator: Use of In-Hospital

What is an Automated External Defibrillator?

› An automated external defibrillator (AED) is a computerized device used to analyze the cardiac rhythm of a person in sudden cardiac arrest (SCA) and deliver an unsynchronized electrical charge (commonly referred to as a shock) to convert pulseless ventricular tachycardia (VT) or ventricular fibrillation (VF) to an effective rhythm; the AED device, not the user, determines if a shock should be administered. There are two types of AEDs; one type is used in the community by nonmedical persons who have been trained in its use and the other type is used exclusively in the acute healthcare setting by clinicians who are certified in Basic Life Support (BLS) or Advanced Cardiac Life Support (ACLS). This Nursing Practice & Skill will focus on the AED type that is used in the acute healthcare setting by trained clinicians (Figure 1). (For information regarding AED use by nonmedical persons in the community, see Nursing Practice & Skill ... Patient and Family Education: Teaching Use of an Automated External Defibrillator for the Outpatient Setting)

Figure 1: The AED analyzes EKG rhythm prior to delivering an electrical shock. Copyright© 2014, EBSCO Information Services.

- What: Defibrillation involves administration of an unsynchronized shock to the heart to treat SCA in patients with VT (Figure 2), (Figure 3) or VF (Figure 4), (Figure 5). Defibrillation by healthcare personnel can be administered using an AED or a manual defibrillator; use of manual defibrillation requires that the clinician be ACLS certified because the clinician, not the device, analyzes the patient’s rhythm and determines whether or not to deliver a shock. (For information regarding manual defibrillation, see Nursing Practice & Skill ... Defibrillation (External): Performing). Although manual defibrillation is preferred over use of an AED in hospitals, AEDs are commonly used by non-ACLS-certified personnel before the arrival of the ACLS-certified emergency response team (commonly called the code team); in addition, some AEDs allow manual override by clinicians trained in ACLS
Figure 2: EKG rhythm strip reflecting ventricular tachycardia (monomorphic). Copyright © 2014, EBSCO Information Services.

Figure 3: EKG rhythm strip reflecting polymorphic ventricular tachycardia. Copyright © 2014, EBSCO Information Services.

Figure 4: EKG rhythm strip reflecting coarse ventricular fibrillation. Copyright © 2014, EBSCO Information Services.
• How: Cardiopulmonary resuscitation (CPR) should be initiated while the AED is being retrieved. The operator attaches the AED electrode pads to the patient and powers on the device. The AED analyzes the cardiac rhythm and alerts the operator, using a visual or vocal prompt, either that it will administer an unsynchronized shock or it directs the operator to administer the shock, according to the particular AED in use. Following administration of the shock, CPR should be continued immediately for 2 minutes, whereupon the AED should be used to reanalyze the patient’s cardiac rhythm and deliver another shock if needed.

• Where: AEDs can be used in all hospitals and other medical facilities; most facilities now require every non-critical care unit to have an AED available.

• Who: AEDs can be used by any BLS-certified healthcare personnel, which typically includes licensed as well as assistive personnel; manual override of the AED should only be performed by personnel who are ACLS certified. Although it is not preferred that family members or visitors be present during use of the AED, use of the device should not be delayed in order to remove family members or visitors.

What is the Desired Outcome of In-Hospital Use of an Automated External Defibrillator?

› Defibrillation depolarizes the heart, which allows for the reestablishment of an effective heart rhythm (e.g., sinus rhythm) in patients with pulseless VT or VF. Termination of pulseless VT or VF is necessary to restore myocardial oxygenation, cardiac output, and systemic perfusion.

Why is In-Hospital Use of an Automated External Defibrillator Important?

› In patients with pulseless VT or VF, rapid defibrillation improves the likelihood of survival.

• In the hospital setting, defibrillation should be provided within 3 minutes of patient collapse. In order to facilitate this, the AED can be used by BLS-certified assistive personnel before the arrival of an ACLS-trained clinician or the emergency response team.

Facts and Figures

› Approximately 200,000 in-hospital cardiac arrests occur each year in the United States (Chan et al., 2012)

› AEDs are presently considered to be the most effective treatment for VF and pulseless VT (Lippincott, 2015)

› It is crucial to minimize the time from onset of pulseless VT or VF to defibrillation because these arrhythmias can rapidly lead to asystole, which reduces the likelihood of successful rhythm conversion and patient survival. For patients in pulseless VT or in VF, each minute that passes lowers the chance for successful defibrillation by 7–10%. AEDs are described by the American Heart Association (AHA) as “sophisticated and reliable” devices that, when used in combination with CPR, double survival rates in patients with sudden cardiac arrest due to pulseless VT or VF (McDonald et al., 2010)

› In 2010 the AHA changed the recommended sequence of CPR from A-B-C (airway, breathing, chest compression) to C-A-B (chest compression, airway, breathing), and recommended that providers no longer “look, listen, and feel” for breathing but proceed directly to performing chest compressions to increase the likelihood of survival (AHA, 2010)
In-hospital AED use has not been shown to improve hospital survival

- Investigators in one U. S. study reviewing the effect of in-hospital AED use on survivability determined that in-hospital AED use did not increase patients’ rate of survival (Chan et al., 2010)
  - The overall survival rate associated with in-hospital AED use was 16.3%, while the survival rate was 19.6% when an AED was not used
  - In cardiac arrest without a shockable rhythm (i.e., a rhythm that can be terminated by defibrillation), AED use was associated with a survival rate of 10.4% compared with a 15.4% survival rate when an AED was not used
  - The majority of patients who experienced in-hospital cardiac arrest did not have a shockable rhythm
  - In cardiac arrest with a shockable rhythm, AED use was not associated with a statistically significant difference in survivability when compared with no AED use (38.4% vs. 39.8%, respectively)
- In a similar study conducted in an Australian teaching hospital, researchers compared 82 cardiac arrests prior to AED use with 84 cardiac arrests occurring after AEDs were made available. Although return of spontaneous circulation was higher in the AED patient sample, the in-hospital survival rate was not improved with AED use. Like previous studies, investigators determined that an initial shockable rhythm was present in a low percentage (16% in this study) of hospitalized patients with cardiac arrest (Smith et al., 2011)

What You Need to Know Before Initiating In-Hospital Use of an Automated External Defibrillator

- Understanding of how to correctly use the AED and knowledge of BLS is essential
  - Unlike when using a manual defibrillator, no training in rhythm interpretation is needed prior to using an AED. The user should receive instruction in proper use of the AED, safety precautions that must be followed when using the AED (e.g., verifying lack of contact with the patient when the shock is delivered), and BLS, as CPR is provided before the AED analyzes the patient’s cardiac rhythm and after the AED has either determined that a shock is not indicated or has administered a shock. Some AEDs prompt the user to perform CPR
  - Although all AEDs have an internal computer to analyze the patient’s EKG rhythm and to determine whether or not a shock is indicated, device models have different features. Some AED models direct the operator using vocal direction, some use text direction, and others use colored lights and/or images. Fully automated AED models deliver the shock automatically, while semi-automated AED models prompt the user to depress a “shock” or “discharge” button; some AEDs have a manual override option to allow the operator to use the AED as a manual defibrillator (i.e., the operator interrupts the cardiac rhythm and determines whether or not to administer a shock). All AEDs also record the user’s interactions with the patient during defibrillation; many units also include a printer for immediate documentation of these interactions. The AHA does not recommend a specific brand or model of AED
  - AEDs manufactured for use with adults are indicated for patients who are 8 years of age or older and require the use of adult-size pads. Specially-designed pediatric AEDs and pads should be used for children 1–8 years of age, but standard adult pads can be substituted if pediatric pads are not available. For infants, a manual defibrillator is strongly preferred. However, if a manual defibrillator is not available, a pediatric AED may be used. As a last resort when neither a pediatric or manual defibrillator is available, an adult AED may be used
    - Review facility protocol and manufacturer instructions for proper placement when using adult AED pads for infants or children. For infants, protocol may include placing one pad in the center of the infant’s chest, and the second pad in the center of the infant’s upper back

- Knowledge of facility protocols for AED use is important
- Understanding of the risks associated with AED use is important. (For details, see Red Flags, below)
- Preliminary steps that should be performed prior to in-hospital use of an AED include the following:
  - Review the facility/unit specific protocol for AED use, if one is available
  - Most facilities have protocols in place mandating that the AED is charging when not in use and tested for proper functioning at least once per shift
  - Review manufacturer’s instructions for the AED models used in your healthcare facility and verify that all equipment is in good working order
  - Review state or local laws regarding AED use
  - Assign someone to review the patient’s medical record for
    - diagnosis and medications received
    - information on allergies (e.g., to latex, medications, or other substances); use alternative materials, as appropriate
  - Assign someone to verify completion of facility informed consent documents, as needed
The general consent for treatment executed by patients at the outset of admission to a healthcare facility commonly contains provisions that include providing emergency resuscitative care using an AED.

- Gather the following supplies:
  - Personal protective equipment (PPE; e.g., sterile/nonsterile gloves); use additional PPE (e.g., gown, mask, eye protection) if exposure to body fluids is anticipated
  - Equipment for monitoring vital signs (e.g., thermometer, pulse oximeter)
  - Emergency/crash cart with AED and adhesive defibrillator pads and additional equipment for performing CPR (e.g., mouth-to-mouth barrier, bag-mask device)

**How To Perform In-Hospital Defibrillation Using an Automated External Defibrillator**

- Perform hand hygiene and don PPE, as indicated by clinical situation
- Establish unresponsiveness (e.g., "shake and shout") and quickly note if breathing is present
  - Call for help and for the AED
- Initiate CPR
  - Before initiating CPR in the healthcare setting, quickly check for a DNR (Do Not Resuscitate) armband that designates modifications to the patients’ code status
  - Check for a pulse and start compressions if no pulse is detected within 5–10 seconds. The AED should not be used on an individual who has a pulse. (For details, see **Red Flags**, below)
  - Updated AHA recommendations call for alternating 30 chest compressions with 2 breaths, with compressions administered at a rate of at least 100 per minute and the chest compressed at a depth of 2 inches in adults and children
- When the AED is brought to the patient’s room/location, attach the defibrillator pads to the patient’s chest according to the manufacturer’s instructions
  - Continue performing CPR while the pads are being attached
  - Use the illustrations on the defibrillator pads to properly place the pads on the patient’s chest in the anterior-lateral or the anterior-posterior position
- Place the pads in the anterior-lateral position by placing one on the upper right border of the sternum just below the clavicle, and the second lateral to the left nipple with the top just a few inches under the axilla (Figure 6)

![Figure 6: Place defibrillator pads on the patient’s chest in the anterior-lateral or anterior-posterior position. Copyright© 2014, EBSCO Information Services.](image)

- Remove any ointments, transdermal patches, or EKG/telemetry electrodes used on the patient prior to attaching the defibrillator pads
- If the patient is wet or lying in water, dry the chest and move the patient to a dry area as necessary before attaching the defibrillator pads
- For women with large breasts, place left defibrillator pad underneath or lateral to the left breast
- Remove any source of oxygen that is near the patient
- Do not attach the defibrillator pads closer than 1 inch from implanted devices (e.g., a pacemaker)
- Apply pediatric defibrillator pads and select the pediatric algorithm option on the device, as available and indicated
- Remove excessive chest hair on males by applying then quickly pulling off the defibrillator pads. Reapply new pads to continue with defibrillation

- Power on the AED and depress the “analyze” button (if required), call “All clear!” and verify by sight that no one is directly or indirectly in contact with the patient
  - Some AEDs automatically begin to analyze heart rhythm when the device is powered on
  - Most AEDs advise to “stop touching the patient” during rhythm analysis. This step will take 5–15 seconds
- If prompted by the AED to deliver a shock, call “All clear! I am shocking on 3—1, 2, 3, shocking,” and depress the “shock” button
  - Some AEDs automatically deliver the shock after emitting a verbal warning
- Immediately after the shock is administered, or if a shock is not advised by the AED, resume CPR for 2 minutes by performing five cycles of 30 compressions and 2 breaths. Do not delay compressions to recheck rhythm or pulse
- After 2 minutes or when prompted by the AED, reanalyze the patient’s rhythm and deliver an additional shock, if needed. Continue to alternate CPR, AED analysis, and shock delivery until the patient responds or an ACLS-trained clinician or emergency response team arrives and assumes care

- Provide verbal report to the clinician or emergency response team assuming care for the patient; include the number of shocks administered and any possible precipitating events and pertinent clinical details (e.g., diagnosis, medications received), if known
  - Some AEDs list the number of shocks provided on the device’s display
- Dispose of used procedure materials according to facility protocols
- Remove gloves and other PPE and discard appropriately; perform hand hygiene
- Follow facility protocol for updating the patient’s plan of care, and documenting patient resuscitation procedures in the patient’s medical record, including:
  - Date, time, indication for, and duration of resuscitation efforts and use of the AED
  - Number of shocks delivered
  - Patient assessment findings before, during, and after use of the AED
  - Patient disposition and name of the person assuming care for the patient
  - Any unexpected events that occurred, whether or not the treating clinician was notified, interventions performed, and patient outcome
  - All patient/family education provided

Other Tests, Treatments, or Procedures That May be Necessary Before or After In-Hospital Use of an Automated External Defibrillator

- Assist with transfer of the patient to the intensive care unit, if appropriate
- Laboratory testing will be completed to determine the cause of the arrhythmia
- Antiarrhythmic medication or other treatment (e.g., fluid or electrolyte therapy) may be administered to reduce risk for recurrence of VT without a pulse or VF
- Inspect skin under defibrillator pads for burns. Analgesia or topical cream may be prescribed if muscle soreness or burns result from defibrillation. (For details, see Red Flags, below)
- A 12-lead EKG will be performed to assess cardiac status and determine if the patient had an acute myocardial infarction (AMI)
- Therapeutic hypothermia may be initiated if the patient remains comatose to protect the brain and other vital organs
- Intubation may be performed to maintain oxygen saturation above 94%
- After use, the AED should be cleaned according to manufacturer’s instructions, restocked with new disposable defibrillator pads, and returned to the appropriate storage location. In addition, the AED should be periodically checked according to manufacturer’s instruction and unit-specific/facility protocol to ensure that the AED is functioning properly and always ready for use

What to Expect After In-Hospital Use of an Automated External Defibrillator

- Pulseless VT or VF will be successfully terminated and a perfusing heart rhythm will be reestablished
- Neither the operator, the patient, or any bystanders will experience adverse effects related to AED use
Red Flags
› The operator should utilize the AED only if the patient is in cardiac arrest (i.e., does not have a pulse). The operator should check manually for a pulse because the AED is not capable of performing this function
› It is essential that AED operators recognize the importance of verifying that no bystanders are directly or indirectly touching the patient when a shock is delivered
› Adverse effects of defibrillation include superficial burns and arrhythmia, the risks for which are reduced if the AED is used according to manufacturer’s instructions and only for patients with pulseless VT or VF. Defibrillation in the presence of medication patches (e.g., nitroglycerin) or oxygen can potentially result in an explosion

What Do I Need to Tell the Patient/Patient’s Family?
› Educate the patient (as appropriate to patient status) and family members regarding the need for CPR and defibrillation
› Emphasize the importance of keeping scheduled medical appointments after discharge to monitor the patient’s cardiac status

Note
› Recent review of the literature has found no updated research evidence on this topic since previous publication on July 24, 2015

References