

# The Automated External Defibrillator (AED) and Public Access Defibrillation (PAD)

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**Please Share This Valuable Information With All Doctors, Hygienists, and Assistants in the Office**

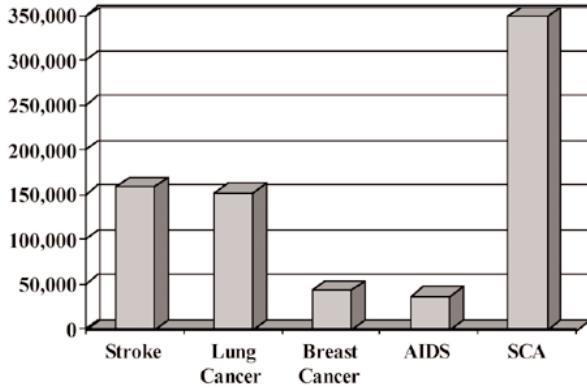


Figure 1

Sudden cardiac arrest (SCA) in non-hospitalized persons (out-of-hospital cardiac arrest) is responsible for approximately 1000 deaths in the United States every day<sup>1</sup> (Figure 1). Most of these deaths result from the sudden development of a chaotic, ineffectual beating of the heart called ventricular fibrillation (VF)<sup>2</sup> (Figure 2). Even with prompt administration of basic life support (BLS) (position/airway/breathing/circulation) VF is uniformly fatal within minutes in the absence of defibrillation.<sup>3</sup> The overall mortality rate in the USA for out-of-hospital cardiac arrest in adults is >95%<sup>4,5</sup> (approximately one out of twenty victims of out-of-hospital cardiac

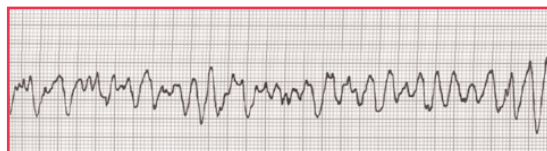


Figure 2

arrest is the first sign they have of its presence.<sup>7</sup> Living or dying at this point is dependent upon whether their collapse has been witnessed; whether the first persons to arrive on the scene (first responders) are trained in BLS, resuscitation, and defibrillation; and whether they access an emergency medical services (EMS) system that can bring about early arrival of BLS and ACLS (advanced cardiovascular life support) resources.<sup>1</sup>

With loss of consciousness, cessation of both breathing (respiratory arrest) and effective circulation (cardiac arrest) the

arrest are resuscitated and survive to be discharged from the hospital neurologically intact [e.g., no brain damage].<sup>6</sup>

For many people with serious coronary artery disease (CAD), sudden

victim appears lifeless — they are “clinically dead (they look dead).” The cells in their body, however, are not yet dead, continuing to function, albeit with increasingly diminished effectiveness, until all remaining oxygen in the blood has been consumed, at which point biological (cellular, permanent) death occurs. The period of time between clinical death (collapse of the victim) and biological death presents a window of opportunity during which resuscitation may be successful.



Figure 3

Successful resuscitation from cardiac arrest is dependent upon a number of factors, collectively known as the “Chain of Survival (Figure 3).”<sup>8</sup> The adult chain of survival has four links: (1) **early access to EMS** (9-1-1) (to bring help); (2) **early BLS** (to buy time); (3) **early defibrillation** (to restart the heart); and (4) **early ACLS** (advanced cardiovascular life support)(to stabilize the victim).

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THE most important component in the Chain of Survival is the elapsed time between collapse and defibrillation.<sup>9-11</sup>

The shorter this span of time, the greater the chance of successful resuscitation. The likelihood of successful resuscitation from out-of-hospital cardiac arrest decreases at a rate of approximately 7% to 10% per minute, even if basic life support is administered effectively.<sup>12</sup>

### Rationale behind the concept of early defibrillation<sup>13</sup>

The most frequent initial rhythm in witnessed sudden cardiac arrest is ventricular fibrillation (VF)

The most effective treatment for VF is electrical defibrillation

The probability of successful defibrillation diminishes rapidly over time

VF tends to convert to asystole (a nonshockable rhythm) within a few minutes

Early defibrillation (shock delivered within 5 minutes of receipt of the EMS call) is a high priority goal of EMS care.<sup>14</sup> Unfortunately this goal is only rarely achieved. Large USA cities, such as New York and Chicago have EMS response times of 11.4 minutes and 16 minutes, respectively, with depressingly low survival rates from out-of-hospital cardiac arrest (1.4% and 2.0%, respectively).<sup>15,16</sup>

The desired time interval from EMS call (9-1-1) to delivery of shock of less than 5 minutes is rarely achieved with conventional EMS services. Public Access Defibrillation (PAD) is a public health initiative that seeks to shorten this interval by placing AEDs

in the hands of trained laypersons throughout the community. It has been stated that “PAD has the potential to be the single greatest advance in the treatment of VF cardiac arrest since the development of CPR in the 1960s.”<sup>17</sup> Studies of PAD have demonstrated survival rates as high as 75%, many times those previously reported for the most effective EMS systems.<sup>4, 18</sup>

Automated external defibrillators are sophisticated, yet simple, battery-operated computerized devices that have been shown to be reliable and easy to operate. Simply stated AEDs are computers that are only able to recognize the two

cardiac dysrhythmias, VF and pulseless ventricular tachycardia (VT), which may be effectively treated through defibrillation.

The AED advises the rescuer that a shock is (or is not) indicated, but it will not deliver the shock without the rescuer activating the unit (pushing the “SHOCK” button). AEDs record and analyze the ECG signal to determine if it is consistent with VF/VT.<sup>19</sup> The AED then verbally advises a shock if an ECG signal consistent with these rhythms is detected. Their accuracy in rhythm analysis is extremely high.<sup>20</sup>

Although numerous manufacturers market AEDs in the USA, most operate in the same way and have similar component parts. The American Heart Association (AHA) recommends that AEDs be stored beside a telephone, permitting the rescuer to activate EMS rapidly and deliver the AED to the scene of the cardiac arrest promptly. Once available, the AED should be placed close to the victim’s left ear. The following are the 4 universal steps of AED operation:

### Use of the AED (automated external defibrillator)<sup>21</sup>

Store AED beside a telephone

Once delivered to scene, place AED close to victim’s LEFT EAR, then:

**Step 1:** POWER ON the AED

**Step 2:** Attach the electrode pads

**Step 3:** “Clear” the victim and analyze the rhythm

**Step 4:** “Clear” the victim and press the SHOCK

Once the adhesive electrodes are attached to the patient, the AED looks for and analyzes the rhythm. If VT/VF is present (VF/VT is the initial rhythm present approximately 80% of the time when paramedics record an ECG during SCA<sup>12, 22-23</sup>) the AED indicates “shock indicated.”

If any rhythm other than VF/VT is found, the AED states: “no shock indicated,” “check airway, check breathing, check circulation. If no pulse continue CPR.”

In the presence of VF/VT the AED next says “charging,” “stand back,” and “press shock button.” Depending

upon whether the AED is monophasic or biphasic an initial charge of either 200 joules or 150 joules is delivered across the electrodes, depolarizing the myocardium. Heart muscle has the unique property of automaticity. When depolarized, the myocardium will seek to initiate a new beat on its own. So, in essence, defibrillation is a procedure that “turns off the heart” so that it may restart itself – hopefully with a functional rhythm. Defibrillation may therefore be looked at as something akin to rebooting of a computer which has “frozen.” Turning the computer off (defibrillation) and allowing it to reboot (automaticity of myocardium) is oftentimes successful.

Following delivery of the first shock the AED then states, “analyzing rhythm, do not touch patient.” If VF/VT is still present the monophasic AED will charge to a higher energy level (300 joules–monophasic; 300 joules–biphasic) and deliver a second, and if necessary, after reanalyzing the subsequent rhythm a third shock (360 joules–monophasic; 360 joules–biphasic).

Most recent AEDs introduced into the market are biphasic. Evidence has demonstrated that biphasic waveform defibrillation converts VF/VT to a functional rhythm with fewer shocks required, results in a lesser degree of myocardial damage, and survivors emerge with more intact cerebral functioning (lesser risk of permanent brain damage).<sup>24</sup>

### **Why should the dentist consider purchase of an AED?**

Basic life support (CPR) certification is mandated for dental licensure in most states and provinces “BLS for healthcare providers” as now defined by the American Heart Association includes defibrillation (P-A-B-C-D).<sup>25</sup> To this authors knowledge (as of 14 October 2003) no state dental board has yet come to the logical conclusion that since defibrillation is a part of CPR for healthcare providers, and since “our state” mandates CPR for dental licensure, we must require dentists to have the availability of an AED in the dental office. At present and only in special situations, such as where the doctor is permitted by the state board of dental examiners to administer parenteral conscious sedation or general anesthesia, is the availability of a defibrillator mandated. It is this author’s fervent hope that the availability of AEDs in dental offices will become mandated in the not-too-distant future.

AEDs are easy to use, they are safe, they are proven to save lives, and they are no longer expensive. In addition, the AED can be taken home by the doctor (approximately 70% to 80% of cardiac arrests occur in the home).<sup>26</sup>

In November 2002, the United States Food and Drug Administration approved the sale of AEDs to laypersons who live in a home environment in which the likelihood of cardiac arrest is great.<sup>27</sup> A prescription from a medical doctor is required before a layperson can

obtain an AED, which can then be purchased at a pharmacy.<sup>28</sup>

### **Consider the following scenario:**

You are in your office, or in your home; a member of your office staff or a loved one at home, collapses. Trained in BLS you quickly come to the victim’s aide: “shake and shout” — determining that they are unconscious. You yell for someone to “call 9-1-1” as you start assessing the airway (head tilt – chin lift), breathing (look, listen, feel) – noting that the victim is not breathing. You start rescue breathing – 2 complete, full ventilations, the victim’s chest rising each time. Next you check the carotid pulse for 10 seconds and find it absent. Chest compression is started at a compression/ventilation ratio of 15 to 2. You yell to the person on the phone that the victim is in cardiac arrest.

9-1-1 is called and the primary EMS operator answers the phone within 5 to 10 seconds (in an ideal scenario; in reality, response times make take several minutes). You state you have a medical emergency and you are transferred to EMS medical emergency operator (another 5 to 10 seconds or longer elapses). The following table lists the information that the caller should make available to the EMS operator.

## Information to be given to EMS (9-1-1) operator

1. The location of the emergency (with names of cross streets or roads or office or room number, if possible).

2. The telephone number from which the call is being made.

3. What happened – heart attack, motor vehicle crash, etc.

4. How many persons need help.

5. Condition of the victim(s).

6. What aid is being given to the victim(s); e.g., “CPR is being performed” or “we’re using an AED.”

7. Any other information requested.

To ensure that EMS personnel have no more questions, the caller should hang up only when instructed to do so by the EMS system operator.

You are informed that “the ambulance has been dispatched.” Approximately 1 minute (ideal time frame has elapsed).

### **How many minutes would it take the emergency ambulance to arrive at your dental office or your home?**

Once the ambulance arrives at the scene, the EMS personnel gather their equipment and walk into the office or house, assessing the situation. They arrive at the victim’s side and prepare the AED for use. From ambulance arrival to being “ready to defibrillate” is probably an additional 3 to 4 minutes.

In all likelihood the elapsed time from the moment of collapse to the delivery of the first shock is in excess of ten minutes. Even with the delivery of exemplary BLS, the expected survival rate in this scenario is not more than 10% (at 9 to 11 minutes) and between 2% and 5% beyond 12 minutes.<sup>24, 25</sup>

Wouldn’t you like to have a greater chance at survival if **YOU** were the victim?

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# Continuing Education Test Questions

## Answer Sheet on Back Cover

- Sudden cardiac arrest (SCA) in non-hospitalized persons ('out-of-hospital cardiac arrest') is responsible for approximately \_\_\_\_\_ deaths in the United States every day.**
  - 10
  - 100
  - 1000
  - 2000
  - 5000
- The overall mortality rate from out-of-hospital cardiac arrest in adult victims in the USA is approximately:**
  - 5%
  - 25%
  - 50%
  - 75%
  - 95%
- For many people with serious coronary artery disease (CAD), sudden cardiac arrest is the first sign they have of its presence.**
  - True
  - False
- With loss of consciousness, cessation of both breathing (respiratory arrest) and effective circulation (cardiac arrest) the victim is:**
  - Dead
  - Biologically dead
  - Clinically dead
  - Cellularly dead
- Successful resuscitation from cardiac arrest is dependent upon a number of factors, collectively known as:**
  - Cardiopulmonary resuscitation
  - Basic life support
  - Advanced cardiovascular life support
  - The Chain of Survival
  - First aid
- THE most important component in the successful resuscitation from cardiac arrest is the elapsed time between:**
  - Collapse and defibrillation
  - Collapse and basic life support
  - Activating EMS and arrival of ACLS
  - Basic life support and defibrillation
  - Activating EMS and basic life support
- The most commonly seen cardiac rhythm on arrival of EMS at the scene of an out-of-hospital cardiac arrest is:**
  - Normal sinus rhythm
  - Asystole
  - Ventricular tachycardia
  - Ventricular fibrillation
- A high priority goal of EMS care is a shock delivered within \_\_\_\_\_ minutes of receipt of the EMS call).**
  - 1
  - 3
  - 5
  - 10
  - 15
- \_\_\_\_\_ has the potential to be the single greatest advance in the treatment of VF cardiac arrest since the development of CPR in the 1960's.**
  - ACLS
  - BLS
  - PAD
  - EMS
  - SOS
- Other than ventricular fibrillation, which cardiac rhythm may be treated with defibrillation?**
  - Asystole
  - Atrial fibrillation
  - Premature ventricular contractions
  - Pulseless ventricular tachycardia
  - Pulseless electrical activity
- On arrival of the AED at the site of cardiac arrest, basic life support should be continued for at least \_\_\_\_\_ before attaching the AED to the patient.**
  - 1 minute
  - 2 minutes
  - 3 minutes
  - 5 minutes
  - None. On arrival on scene the AED supercedes all other treatment modalities
- In the biphasic AED the initial shock delivered to the victim will be:**
  - 150 joules
  - 200 joules
  - 300 joules
  - 360 joules
- Delivery of a shock through the electrodes of an AED has what initial effect on the myocardium?**
  - Immediately converts the cardiac rhythm to a more functional rhythm
  - Depolarizes all myocardial fibers and 'turns off the heart'
  - Converts VF into asystole
  - Defibrillation has no immediate effect on the myocardium. Several minutes are required for any effect to develop
- Defibrillation may be compared to:**
  - Rebooting of a 'frozen' computer
  - Hitting a computer with a stick
  - Dropping a computer onto the floor from a height of 5 feet
  - The last, final step to use when all else has failed in resuscitation
- \_\_\_\_\_ waveform defibrillation converts VF/VT to a functional rhythm with fewer shocks required, results in a lesser degree of myocardial damage, and survivors emerge with more intact cerebral functioning (lesser risk of permanent brain damage).**
  - Monophasic
  - Biphasic
  - Triphasic
  - Quadraphonic
  - DTS
- According to the American Heart Association's 2000 Guidelines for Basic Life Support, BLS for Healthcare Providers is defined as which of the following?**
  - A\_B\_C\_D\_E
  - A\_P\_B\_C\_D
  - D\_A\_P\_B\_C
  - P\_D\_C\_B\_A
  - P\_A\_B\_C\_D
- Approximately \_\_\_\_\_% of out-of-hospital cardiac arrests occur in the victim's home.**
  - 10%
  - 25%
  - 50%
  - 75%
  - 99%
- The AED is a sophisticated medical device that must only be employed under the direct supervision of a trained physician.**
  - True
  - False
- In an adult victim of cardiac arrest, the ratio of chest compressions to ventilation, when two rescuers are available is:**
  - 5 to 1
  - 5 to 2
  - 10 to 2
  - 15 to 1
  - 15 to 2
- Survival rates from out-of-hospital cardiac arrest in the USA when basic life support is administered and the initial shock is delivered in 13 minutes is approximately:**
  - 0%
  - 2% to 5%
  - 10%
  - 25%
  - 50%

# The Automated External Defibrillator (AED) and Public Access Defibrillation (PAD)

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## ANSWER SHEET

- |                         |                         |
|-------------------------|-------------------------|
| 1. (A) (B) (C) (D) (E)  | 11. (A) (B) (C) (D) (E) |
| 2. (A) (B) (C) (D) (E)  | 12. (A) (B) (C) (D)     |
| 3. (A) (B)              | 13. (A) (B) (C) (D)     |
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| 9. (A) (B) (C) (D) (E)  | 19. (A) (B) (C) (D) (E) |
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