LOS ANGELES COUNTY EMERGENCY MEDICAL SERVICES

AUTOMATED EXTERNAL DEFIBRILLATION (AED)

Upon completion of this unit of instruction, the student will be able to:

<table>
<thead>
<tr>
<th>LEARNING OBJECTIVES</th>
<th>LESSON CONTENT</th>
<th>NOTES / RATIONALE</th>
</tr>
</thead>
</table>
| 1. List the links in the chain of survival. | Chain of survival includes:  
- Early access  
- Early CPR  
- Early defibrillation  
- Early advanced care | |
| 2. Identify which of the 2 links in the chain of survival the EMT can provide. | The EMT can provide:  
- CPR  
- Defibrillation | |
| 3. Explain the most effective intervention in the treatment of prehospital sudden cardiac death. | The most effective intervention in sudden cardiac death:  
- Early CPR  
- Early defibrillation | Public Access Defibrillation (PAD) has the potential to be the single greatest advance in the treatment of prehospital sudden cardiac death since the development of CPR. |
| 4. Explain when EMTs in Los Angeles County are authorized to use an AED. | In order for EMTs in Los Angeles County to use an AED they must:  
- Work for an approved AED Service Provider  
- Complete an approved 4 hour AED course  
- Demonstrate skill proficiency at least once annually | EMTs are only able to use an AED when on duty with an approved AED service provider. When using an AED off duty the EMT is covered under the regulations of a private citizen.  
Reference No. 412 - Automated External Defibrillation (AED) Service Provider Program Requirements, Section 1-D. |
| 5. Describe the purpose of an AED. | The purpose of an AED is to:  
- Analyze a heart rhythm  
- Identify shockable vs. nonshockable heart rhythms  
- Advise the AED operator to initiate a defibrillation, if indicated  
- Delivers an electrical shock when the shock button is pressed | The AED CANNOT analyze a heart rhythm to determine if a patient is having a “heart attack”.  
The AED CANNOT make recommendations about whether or not a patient should be evaluated at a hospital. |
| 6. Explain the purpose of defibrillation. | The purpose of defibrillation:  
- Defibrillation discharges all the electrical activity of the cardiac cells (cells enter a resting period) to stop the useless quivering of the heart in ventricular fibrillation.  
- Once all cells are in the resting phase, the fastest cells to recharge are the pacemaker cells that will resume control of the heart’s contraction. | Without defibrillation in ventricular fibrillation the rhythm deteriorates into cardiac standstill which is called asystole.  
An electrical shock DOES NOT restart heart contractions if the heart is in asystole. |
<table>
<thead>
<tr>
<th>LEARNING OBJECTIVES</th>
<th>LESSON CONTENT</th>
<th>NOTES / RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Describe the difference between a fully automated and a semi-automated external</td>
<td><em>Difference between a fully automated and a semi-automated external defibrillator:</em></td>
<td>• The majority of the AEDs used today are semi-automated.</td>
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<td>defibrillator.</td>
<td>• Fully automated – only requires the provider to apply pads and turn on the power</td>
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<td>• Semi-automated – uses a computer voice to advise the provider as to the steps to take based on analysis of the cardiac rhythm</td>
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<td>8. Discuss the normal path of an impulse traveling through the electrical conduction</td>
<td><em>Normal path of the conduction system:</em></td>
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<td>system of the heart.</td>
<td>• Sinoatrial node (SA)</td>
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<td>• Atrioventricular junction (AV)</td>
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<td></td>
<td>• Bundle of His</td>
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<td></td>
<td>• Bundle branches</td>
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<td></td>
<td>• Purkinje network (fibers)</td>
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<td>• Ventricular muscle</td>
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<td>9. Define/describe the following electrocardiogram (ECG) rhythms:</td>
<td><em>ECG rhythms:</em></td>
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<td>A. Normal sinus rhythm – normal cardiac rhythm that originates in the SA node produces normal cardiac output and perfusion</td>
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<td>B. Ventricular fibrillation – lethal dysrhythmia that originates from many sites in the ventricles leading to ineffective quivering of the ventricular muscle produces no pulse or cardiac output</td>
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<td>C. Ventricular tachycardia – very rapid heart rhythm that is organized and originates in the ventricles usually produces inadequate cardiac output, decreased blood pressure, and decreased perfusion</td>
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<tr>
<td>9. (Continued)</td>
<td><strong>Rhythms continued:</strong></td>
<td>[Image: Pulseless Electrical Activity (PEA)]</td>
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| D. Pulseless electrical activity (PEA) | D. Pulseless electrical activity – the electrical activity is normal, but the heart muscle has failed or the patient is severely hypovolemic (produces no pulse or cardiac output)  
  * If due to hypovolemia, the heart is unable to pump since there is no fluid in the vascular system | \[Image: Asystole\] |
| E. Asystole | E. Asystole – no electrical impulses exist (flatline)! produces no pulse or cardiac output  
  * Can result from untreated ventricular fibrillation, a sick heart, a terminal illness or severe blood loss | \[Image: Artifact\] |
| F. Artifact | F. Artifact – electrical energy created by something besides the heart muscle, i.e. loose leads, agonal respirations or patient movement! no effect on pulse or cardiac output, but may interfere with interpretation of ECG reading | \[Image: Many other ECG rhythms exist, but are not important in understanding the use and operation of the AED.\] |
| 10. State the rationale for early defibrillation. | **Rationale for early defibrillation:**  
  • To increases the survival of patients who have:  
    - Ventricular fibrillation  
    - Pulseless ventricular tachycardia | \[Image: Defibrillation works best if accomplished within 2 minutes of onset of V-fib or V-tach.\]  
  • Increased survival was demonstrated after early defibrillation programs were started and the links in the chain of survival were present. |
| 11. Explain the effect of defibrillation. | **Effect of defibrillation:**  
  • Defibrillation is the definitive treatment of ventricular fibrillation and pulseless ventricular tachycardia. | \[Image: Defibrillation stops all chaotic electrical impulses in the heart and allows for the normal pacemaker to re-establish a viable heart beat.\]  
  • A ventricular tachycardia rate above 180 will usually result in defibrillation by an AED. |
### LEARNING OBJECTIVES

12. Describe the rhythms that are shockable and non-shockable.

13. Discuss the indications for the use of an AED.

14. List the contraindications for the use of an AED.

15. Discuss the concepts that are important when using an AED on children 1-year-of-age and older.

### LESSON CONTENT

#### Shockable vs. non-shockable rhythms:

- **Shockable rhythms**
  - Ventricular fibrillation
  - Ventricular tachycardia
- **Non-shockable rhythms**
  - Normal sinus
  - Pulseless electrical activity
  - Asystole

#### Indications for the use of an AED:

- Adults and children age 1-year-of-age and older that are:
  - Unresponsive
  - Pulseless
  - Non-breathing

**A 1-year-old measures purple on the Broselow tape**

#### Contraindications for the use of an AED:

- **A. Absolute contraindication**
  - Patient is conscious
  - Patient has a pulse

- **B. Relative contraindication**
  - Traumatic full arrest

**Traumatic full arrest is caused by severe hypovolemia or injury to major organs. These patients are generally not in a rhythm that requires defibrillation. Attaching an AED may delay pertinent treatment and transport. However, if the arrest appears to be related to medical causes, an AED should be applied.**

#### Important concepts in using an AED on children 1-year-of-age and older are:

- Airway management is the single most important consideration in pediatric arrests
- AEDs are not recommended for infants under 1-year-of-age
- There is a decreased incidence of shockable rhythms in children
- The anterior-posterior position using pediatric or adult sized pads is recommended by most manufacturers

**Initial priority in pediatric resuscitation is to provide oxygenation and ventilation.**

**Most arrests in children are due to SIDS, respiratory disease, trauma and drowning. The most common cardiac arrest rhythms found are asystole or PEA.**

**If pads are applied in an anterior-anterior position the pads must be at least ½ inch apart to prevent arcing and/or burns.**

An AED should NOT be applied to any patient who is awake, has a pulse or is breathing.

AEDs should NOT be applied to a patient who meets conditions outlined in Reference No. 814-Determination/Pronouncement of Death in the Field.

Pediatric pads with an attenuator (decreases the joules delivered) or an AED that is specific for pediatric patients are recommended in Los Angeles County unless otherwise approved by the manufacturer of the AED.
<table>
<thead>
<tr>
<th>LEARNING OBJECTIVES</th>
<th>LESSON CONTENT</th>
<th>NOTES / RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Discuss when pulse checks should not be done.</td>
<td><em>Pulse checks should not be done:</em></td>
<td>• There is no pulse check after shocks 1 &amp; 2 and 4 &amp; 5 since this would interrupt the analysis of the rhythm and may place the provider at risk for an inadvertent shock.</td>
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<td></td>
<td>• During rhythm analysis</td>
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<td>• Between stacked shocks</td>
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<td>17. Explain when CPR should be interrupted.</td>
<td><em>CPR should be interrupted when:</em></td>
<td>• The AED is unable to analyze the rhythm when there is artifact from chest compressions</td>
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<td>• Rhythm is being analyzed</td>
<td>• Touching the patient during defibrillation may also shock the provider. Therefore, the AED operator needs to make sure everyone is clear.</td>
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<td>• Shocks are delivered</td>
<td>• If 3 shocks are necessary, resume CPR only after the 3rd shock is delivered.</td>
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<td>18. Discuss when inappropriate shocks may be delivered or when an AED may fail to deliver a shock.</td>
<td><em>Delivery of inappropriate shocks or failure to shock may occur due to:</em></td>
<td>• Low battery may result in incorrect analysis of the ECG rhythm and should be checked at the beginning of each shift.</td>
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<td>• <strong>Human error</strong></td>
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<td></td>
<td>- AED applied to a moving patient</td>
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<td>- AED applied to an awake patient in V-Tach</td>
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<td></td>
<td>• <strong>Mechanical error</strong></td>
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<td></td>
<td>- low battery</td>
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<td></td>
<td>- expired electrode pads</td>
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<td>- inappropriate machine maintenance</td>
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<td>19. Explain the safety considerations when using an AED under the following circumstances:</td>
<td><em>Safety considerations:</em></td>
<td>• Safety Considerations:</td>
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<td>A. <strong>Metal surfaces</strong></td>
<td>A. <strong>Metal surfaces</strong> do not pose a hazard to either the patient or the provider.</td>
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<td>B. <strong>Water</strong></td>
<td>B. <strong>Water</strong> conducts electricity and may provide a pathway for energy from the AED to the provider or bystanders or from one electrode pad to another. This may result in an inadvertent shock or minor burns to others and arcing may decrease the effectiveness of the shock delivered to the heart.</td>
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<td></td>
<td>C. <strong>Medication patches</strong></td>
<td>C. <strong>Medication patches</strong> may block energy delivery to the heart and cause minor burns due to arcing. Gloves should be worn to prevent provider from exposure to medications which may be absorbed through the skin.</td>
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<td>- remove the patient from free standing water and dry the chest thoroughly</td>
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<td>- do not place electrode pads over medication patches. Remove patches with gloves before defibrillating.</td>
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<td>NOTES / RATIONALE</td>
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<td>19. Explain the safety considerations when using an AED under the following circumstances (Continued):</td>
<td>Safety considerations (Continued)</td>
<td>D. Pacemakers and ICDs may reduce energy delivery to the heart. If an ICD shocks the patient, it may take 30-60 seconds for the implanted defibrillator to complete its cycle. Occasionally the ICD and AED’s analysis and defibrillation cycle may conflict.</td>
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<td>D. Pacemaker and Implanted Cardiac Defibrillator (ICD)</td>
<td>DO NOT place electrode pads over device. Place pad at least 1 inch away from device</td>
<td>E. Excessive chest hair may interfere with electrode pad placement.</td>
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<td>E. Excessive chest hair</td>
<td>Excessive chest hair – remove chest hair with razor or pull off initial pads to remove hair under the pads and apply new pads when a razor is not available.</td>
<td>F. Electrical devices may cause electrical interference and create wave forms that could be misinterpreted by the AED.</td>
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<td>F. Electrical interference</td>
<td>Electrical devices – reduce/eliminate stray electrical energy from devices such as electric blankets, TVs, radios, wireless phones, pagers, etc.</td>
<td>G. Body piercing – DO NOT attempt to remove jewelry, but avoid pad placement over or near jewelry if possible.</td>
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<td>G. Body piercing</td>
<td>Body piercing – electrical charge may arc, but defibrillate as usual.</td>
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20. Discuss the landmarks for electrode pad placement for:

<p>| Landmarks for electrode placement: |
|---------------------|-------------------|
| A. Adults: | Some manufacturers recommend that pads be placed on specific sides. Always follow the manufacturer's directions. |
| • Upper – right sternal border directly below the clavicle | If a child is older than 8 years-of-age or more than 55 pounds, use adult defibrillation pads. Do NOT delay treatment to determine child's age or weight. |
| • Lower – left midaxillary line 5th - 6th intercostal space with top margin below the axilla | Only use the Anterior-Posterior position in small children. |
| B. Small Child: | Ensure that pads NEVER TOUCH in either an adult or child. If the pads touch, this may cause arching and result in skin burns. If pads overlap, the AED is unable to read rhythm and will result in no shocks being delivered. |
| • Anterior-Posterior – | |
| - 1st pad anterior over sternum between nipples | |
| - 2nd pad posterior between shoulder blades | |
| C. Large Child: | |
| • Anterior- Posterior as above | |
| • Anterior-Anterior – <strong>Pads must not touch</strong> | |
| - Right pad – wrap over child’s shoulder | |
| - Left pad – left anterior to cover midclavicular and midaxillary lines | |
| C. Large Child: | |
| • Anterior- Posterior as above | |
| • Anterior-Anterior – <strong>Pads must not touch</strong> | |</p>
<table>
<thead>
<tr>
<th>LEARNING OBJECTIVES</th>
<th>LESSON CONTENT</th>
<th>NOTES / RATIONALE</th>
</tr>
</thead>
</table>
| 21. Discuss and demonstrate the general operational steps in using the AED on a patient in cardiopulmonary arrest in an "unwitnessed arrest" (unwitnessed by EMS personnel or an AED Service Provider). | **Operational steps in an "unwitnessed arrest":**  
- Verify patient is unresponsive, pulseless and non-breathing  
- Perform CPR for 1½ - 2 minutes prior to attaching AED  
- Attach AED (if partner available, continue CPR while attaching AED)  
- Turn on power  
- Stop CPR  
- Follow AED voice prompt | • EMS personnel include EMTs and paramedics. Law enforcement officers are not considered EMS personnel.  
• EMS personnel must perform CPR 1½ -2 minutes even if bystander CPR is in progress. The arrest must be witnessed by the EMS provider or an AED Service Provider. If not witnessed by EMS personnel or an AED Service provider, it is still considered an unwitnessed arrest.  
• Several studies have shown that providing CPR for at least 90 seconds (1½ minutes) prior to delivery of a shock has improved survival rates.  
• Whenever possible the AED should be placed near the patient’s left side to allow for easier control by the provider due to cable length and pad placement. |
| 22. Discuss and demonstrate the general operational steps in using the AED on a patient in a "witnessed arrest" (witnessed by EMS personnel or an AED Service Provider). | **Operational steps in a witnessed arrest:**  
- Verify patient is unresponsive, pulseless and non-breathing  
- Attach AED - have partner start CPR while attaching AED if possible  
- Turn on power  
- Stop CPR  
- Follow AED voice prompt | • Whenever possible the AED should be placed near the patient’s left side to allow for easier control by the provider due to cable length and pad placement. |
| 23. Recognize that a shock has been delivered. | **Recognizing that a shock has been delivered:**  
- Delivery of a shock can be recognized by the display of muscular activity:  
  - Brief straightening of arms  
  - Arching of the back | • Muscular contraction decreases with repeated shocks until finally no stimulation occurs.  
• No contractions may be noted if the patient has been in the arrest state for a prolonged period of time. |
| 24. Explain what occurs if the shock button is not depressed when recommended by voice prompt. | **Result when the shock button is not depressed:**  
- As a safety feature, the electrical charge will eventually be dumped internally by the AED. | • When an AED recommends a shock for a pulseless, apneic patient, it should not be withheld except in an unsafe situation. |
| 25. Discuss the 3 results which may occur after shock(s) has/have been delivered. | **Three (3) results which may occur after shock(s) has/have been delivered:**  
- Pulse regained – Do not remove AED  
- No pulse and AED indicates “no shock”  
- No pulse and AED indicates “shock” | • If a pulse is present and the patient is breathing, place patient in recovery position.  
• If pulse is present but patient is not breathing, start BVM ventilations.  
• If no pulse and the AED indicates “no shock”, start CPR and ready for transport.  
• If no pulse and AED indicates “shock”, stand clear and follow voice prompt. |
<table>
<thead>
<tr>
<th>LEARNING OBJECTIVES</th>
<th>LESSON CONTENT</th>
<th>NOTES / RATIONALE</th>
</tr>
</thead>
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| 26. Discuss the interface with ALS in Los Angeles County. | **Interface with ALS includes:**  
- No shock advised – turn care over to ALS.  
- Analyzing and delivering 3 shock series is in progress -- complete series allowing ALS to begin other procedures  
- ALS and BLS arrive simultaneously – AED provider should defer decision to use the AED to ALS providers (defibrillation of shockable rhythm is of prime importance) | **ALS providers become the primary care providers.**  
A verbal report should be given; length of time of arrest, number of shocks delivered and the patient’s response to treatment,  
Some ALS providers have the capability to attach AED cables to their monitor/ defibrillator in order to view an ECG rhythm and defibrillate through the AED electrodes. |
| 27. Explain what should be done if a physician is on scene. | **Physician on scene:**  
- EMTs should continue to follow AED protocols. | **Reference No. 816 – Physician on Scene** |
| 28. Explain what is meant by “shock until a no shock indicated” message is received. | **Meaning of ‘Shock until a no shock indicated’ message is received:**  
- EMTs should continue to shock until ALS arrives or the patient is transported. | **If EMTs transport the patient, they must transport to the most appropriate medical facility per Reference No. 502 – Patient Destination.** |
| 29. Discuss the number of shocks that should be delivered before deciding to transport, if ALS arrival is delayed. | **Number of shocks delivered before transporting if ALS is delayed:**  
- Six (6) shocks should be administered prior to transporting if ALS is delayed:  
  - 3 initial shocks  
  - 3 after 1 minute of CPR | **Analysis and a third set of shocks should be given prior to driving. The AED cannot accurately analyze the cardiac rhythm and it is unsafe to defibrillate in a moving vehicle.**  
**The ambulance must be at a complete stop in order for the AED to analyze and deliver additional shocks.** |
| 30. Discuss when the patient should be transported when ALS is not available. | **Transporting the patient when ALS is not available:**  
- EMTs should transport the patient when:  
  - Patient regains a pulse  
  - 6 shocks have been delivered  
  - 3 consecutive messages that “no shock” is indicated | **The AED should remain applied during transport even if the patient regains a pulse.**  
**1 minute of CPR should be performed in between analyzes.**  
**The patient should be reassessed frequently to monitor for a pulse – every 30-60 seconds.** |
| 31. Discuss the procedure for a single rescuer on scene. | **Procedure for a single rescuer:**  
- Stop CPR if in progress (bystander CPR)  
- Verify patient is unresponsive, pulseless and non-breathing  
- Ensure that ALS has been called  
- Perform CPR for 1 ½ - 2 minutes  
- Attach AED  
- Turn on power  
- Follow AED voice prompt | **CPR should be performed prior to rhythm analysis.**  
**Basic CPR is unlikely to convert Ventricular-fibrillation to a normal sinus rhythm.** |
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| 32. List the 3 main considerations during post-resuscitation care. | **Three (3) main considerations post-resuscitation:**  
- Perform pulse check every 30-60 seconds  
- Perform a focused assessment and reassessment every 5 minutes  
- Keep AED on patient enroute |  |
| 33. Identify what form should be used by the EMT to document the use of an AED. | **AED Documentation:**  
- Documentation must be on either on the Los Angeles County EMS Report or Patient Care Record form. |  |
| 34. Discuss the necessary written documentation that is required by the EMT when an AED is applied. | **Written documentation includes:**  
- Patient name  
- Patient assessment  
- Analysis result - shock vs. no shock advised  
- Time and number of shocks - *if applicable*  
- Patient response to shocks - *if applicable* |  |
| 35. List the additional supplies that should be kept with the AED. | **Additional supplies that should be kept with AED:**  
- Gloves  
- Towel  
- Razor  
- Spare electrode pads |  |
| 36. Discuss the responsibilities of defibrillator maintenance. | **AED operators must ensure that:**  
- AED is ready to use at anytime  
- All supplies are available in the field |  |

Los Angeles County EMS Report form

Refer to sample EMS Report form.

A maintenance and inventory check list is required for AED service providers.

Failure to properly maintain AED ready for use may pose liability.
AUTOMATED EXTERNAL DEFIBRILLATION (AED)

PREREQUISITE MODULES:
Preparatory / Basic Sciences
Airway / Basic Life Support

BASIC EQUIPMENT:
CPR manikin
AED trainer

SKILLS:
Automated External Defibrillation (AED)

REQUIRED STUDENT HANDOUTS:
Automated External Defibrillation Protocols
AED Skills Sheet
Sample of Los Angeles County EMS Report Form
Reference No. 412 - Automated External Defibrillation (AED) Service Provider Program Requirements
Reference No. 502 - Patient Destination
Reference No. 814 - Determination/Pronouncement of Death in the Field
Reference No. 816 – Physician on Scene

REFERENCES:
Department of Health Services: Prehospital Care Policy Manual. Los Angeles County Emergency Medical Services Agency.