### Clinical question.

In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of an AED or a multifunctional defib in automatic mode (I) compared with standard resuscitation (using manual defibrillation) (C), improve outcomes (eg. successful defibrillation, ROSC, survival) (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention/therapy

State if this is a proposed new topic or revision of existing worksheet: revision

### Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No conflict of interest

### Search strategy (including electronic databases searched).

“Heart Arrest” OR “Ventricular Fibrillation” as MeSH headings AND “Defibrillation” OR “Electric Countershock” as MeSH headings AND “Automated External Defibrillator” OR “Manual Defibrillator” text words in the title, abstract and text. The search was further refined including “In Hospital” OR “Out of Hospital” text words in the title and abstract.

Search was conducted in the following databases: PubMed, EMBASE, Cochrane database for systematic reviews and Central Register of Controlled Trials, and AHA EndNote Master Library. Hand searches of journals and reviews of references from articles were also performed.

Last search was performed on November 30, 2009

- **State inclusion and exclusion criteria**

  Inclusion criteria: only cardiac arrest studies; only human studies; only peer-reviewed manuscripts; only studies reporting actual use of AEDs.

  Exclusion criteria: review articles; technical measurements; engineering studies; abstract only; case reports; animal studies.

- **Number of articles/sources meeting criteria for further review:**

  24 studies met criteria for further review. Of these, four were of Level of Evidence (LOE) 1, seven of LOE 2, five of LOE 3, and eight of LOE 4.
# Summary of evidence

## Evidence Supporting Clinical Question

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**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  
* = Meta-analysis
## Evidence Neutral to Clinical question

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## Evidence Opposing Clinical Question

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**Level of evidence**

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**REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:**

From the literature search, 24 studies investigated the effects of the use of automated external defibrillators (AEDs) on human victims of cardiac arrest (4 of LOE 1, 7 of LOE 2, 5 of LOE 3 and 8 of LOE 4).

**Out-of-hospital cardiac arrest**

Nineteen of these studies were focused on out-of-hospital cardiac arrest victims. Seven studies were supportive of the use of AEDs and showed improvements in return of spontaneous circulation (ROSC) and survival (Cappato 2006 LOE 3, Ho 1997 LOE 4, Lim 2005 LOE 4, Ko 2004 LOE 4, Mosesso 1998 LOE 3, Myerburg 2002 LOE 3, Sanna 2008 LOE 2), and three of them also reported improvement in neurological outcome (Cappato 2006 LOE 3, Hallstrom/Powell 2004 LOE 1, Ho 1997 LOE 4). The other ten studies showed no benefits in survival and two studies instead showed decreases in survival when AEDs were employed (Hamer 1993 LOE 4 and Stotz 2003 LOE 2). One of these two negative reports also showed worse neurological recovery in the experimental group employing AEDs (Stotz 2003 LOE 2). However, all the studies presenting no improvement in ROSC and survival and neurological outcomes related to the use of AEDs, employed the old defibrillation algorithm of up to 3 consecutive shocks and therefore greater interruptions in CPR. Only three studies employed the use of the defibrillation algorithm with only a single shock (Sanna 2008 LOE 2 and Bardy 2008 LOE 1 and Moore 2008 LOE 2). One study showed improvements in survival while the other two did not (Bardy 2008 LOE 1). In particular, the investigation from Bardy and colleagues, 2008, was limited to home cardiac arrest, where a high percentage of those cardiac arrests were unwitnessed and AEDs were not attached. Four studies evidenced that the better outcome following the use of AEDs was specifically related to the cases of witnessed cardiac arrests (Bardy 2008 LOE 1, Cappato 2006 LOE 3, Ko 2004 LOE 4, Walters 1990 LOE 2).

Most of the studies have showed significant reductions in the time of response and specifically in the interval prior to the delivery of the first shock when an AED was employed (Cappato 2006 LOE 3, Cummins 1997 LOE 1, Groh 2001 LOE 3, Moore 2008 LOE 2, Mosesso 1998 LOE 3, Myerburg 2002 LOE 3, Sanna 2008 LOE 2, Scheneider 1994 LOE 2, Stotz 2003 LOE 2, Stults 1986 LOE 2). This could have played an important role in the better outcome showed in some of these studies. A faster delivery of the defibrillation shock was also observed in the studies showing reduction in survival when AEDs were employed (Stotz 2003 LOE 2). The absence of improvement in outcome might be related to other causes, such as the greater number of interruptions in CPR due to the three-shock protocol or to the quality of CPR which was not controlled in the studies (or at least, no data are reported regarding this issue).

Finally, these studies evidenced neither cases of incorrect rhythm analyses nor inappropriate delivery of defibrillation. There was some instance of failure to deliver a shock and it was related to operator’s error or to some mechanical problems. These problems, however, did not occur in a diverse proportion than when a manual defibrillator was employed (Bardy 2008 LOE 1, Cappato 2006 LOE 3, Cummins 1997 LOE 1, Hallstrom/Powell 2004 LOE 1, Ho 1997 LOE 4, Scheneider 1994 LOE 2). In one study (Sweeney 1998 LOE 2), the defibrillators failed in 7 times out of the 260 uses. In 5 cases the failure to defibrillate was due to operator errors.


**Use of AEDs by “lay rescuers” (out of hospital cardiac arrest):**

**Summary of Bardy, 2008 (LOE 1):**
- 7001 patients assessed, 3506 in control group and 3495 in AED group
- Patients who died: 228/3506 [6.5% in control group] vs 222/3495 [6.4% in AED group] (RR 0.97; ARR 0.01; 95%CI 0.81-1.17; NNT 100)
- Patients resuscitated: 19/3506 [0.5% in control] and 19/3495 [0.5% in AED]

**Summary of Hallstrom/Powell, 2004 (LOE 1):**
- Patients enrolled 107 in CPR only vs 128 in CPR plus AED
- Patients admitted to hospital: 29/107 [27.1% in CPR only] vs 50/128 [39.1% in CPR plus AED] (RR 0.986; ARR -0.010; 95%CI 0.851-1.143; NNT 100)
- Patients survived to hospital discharge: 15/107 [14% in CPR only] vs 30/128 [17.2% in CPR plus AED] (RR 0.890; ARR 0.094; 95%CI 0.788-1.007; NNT 10.6)

Contingency table analyses

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<td>no</td>
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- Patients with normal cerebral performance category: 10/15 [71.4% in CPR only] vs 22/30 [73.3% in CPR plus AED] (RR 0.8; ARR 0.067; 95%CI 0.316-2.027; NNT 14.9)

Use of AEDs by “trained providers” (out-of-hospital cardiac arrest):

Summary of Cappato, 2006 (LOE 3):
- 1394 patients assessed, 692 in the historical control group and 702 in AED group
- Patients who had ROSC: 72/702 [10.2% in AED group] vs 50/692 [7.2% in control group] (RR 0.967; ARR 0.030; 95%CI 0.936-0.999; NNT 33.3)
- Patients admitted to hospital: 57/702 [8.1% in AED group] and 38/692 [5.5% in control group] (RR 0.972; ARR 0.026; 95%CI 0.945-1; NNT 38.4)
- Patients survived to hospital discharge: 29/702 [4.1% in AED group] vs 10/692 [1.4% in control group] (RR 0.973; ARR 0.027; 95%CI 0.956-0.990; NNT 37)
- Patients survived free of neurological impairment: 29/702 [4.1% in AED group] vs 10/692 [1.4% in Control group] (RR 0.973; ARR 0.027; 95%CI 0.956-0.990; NNT 37)

Summary of Cummins, 1987 (LOE 1):
- 321 patients enrolled (163 in the AED group and 158 in the manual defibrillation group)
- Patients admitted to hospital: 40/163 [25% in AED group] vs 55/158 [35% in manual defibrillation] (RR 1.158; ARR -0.013; 95%CI 1.003-1.336; NNT 9.7)
- Patients discharged from hospital: 18/163 [11% in AED group] vs 23/158 [15% in manual defibrillation] (RR 1.041; ARR -0.035; 95%CI 0.957-1.132; NNT 28.5)
- Patients in VF in whom device was attached: 63 in AED group and 84 in manual defibrillation
- Patients admitted to hospital: 32/63 [51% in AED group] vs 43/84 [51% in manual defibrillation] (RR 1.008; ARR -0.004; 95%CI 0.723-1.407; NNT 250)
- Patients discharged from hospital: 16/84 [25% in AED group] vs 21/84 [25% in manual defibrillation] (RR 1.079; ARR -0.060; 95%CI 0.919-1.268; NNT 16.6)
- Patients in VF and dfibrillated: 46 in AED group vs 64 in manual defibrillation
- Patients admitted to hospital 25/46: [54% in AED group] vs 33/64 [52% in manual defibrillation] (RR 0.942; ARR 0.028; 95%CI 0.629-1.412; NNT 35.7)
- Patients discharged from hospital: 13/46 [28% in AED group] vs 15/64 [in manual defibrillation] (RR 0.937; ARR 0.048; 95%CI 0.747-1.175; NNT 20.8)

Summary of Ho, 1997 (LOE 4):
- 358 cases of cardiac arrest
- 271 received CPR
- 109 were in VF/VT
- 109 patients were defibrillated by AED used by firefighters
- 42 patients had ROSC [11.7% of total patients, 38.5% of VF/VT patients]
- 22 patients survived to hospital discharge [6.2% of total patients, 20.1% of VF/VT patients]
- 17 patients had moderate CPC score

Summary of Mosesso, 1998 (LOE 3):
- including 520 patients (203 in the historical control and 317 in the intervention AED group) assessed and 465 patients enrolled (183 in the historical control and 282 in the intervention AED group)
- in 171 cases (61%) police arrived before EMS and AEDs were applied in 118 cases (69%)
- Police delivered the first shock in 6.8 min (1.9 SD) and EMS in 10.3 min (4.2 SD)
- patients in VF as initial rhythm were 80 in the historical control vs 127 in the intervention AED group
- Patients had ROSC increased from 36% to 52% after introduction of AEDs usage from police officers (no data available) (odds ratio 1.90, p=0.03; 95%CI 1.03-3.52)
- Patients survived to hospital discharge were 6/80 [6.3% in the historical control] vs 18/127 [14.2% in the intervention group] ((odds ratio 2.48; p=0.1; 95%CI 0.82-8.01)
- Patients survived to hospital discharge were 3/40 [6.3% in the historical control when police arrived first to scene] vs 12/46 [26.1% in the intervention group, police plus AEDs] (odds ratio 9.88; p=0.027; 95%CI 1.19-59.3)
Summary of Myerburg, 2002, LOE 3:
- Patients enrolled 738 (318 as historical control and 420 police AED)
- Patients survived to hospital discharge: 28/163 [17.2% in police AED] vs 11/122 [9% in historical control] (odds ratio 2.1; 95%CI 1.4-4.2)

Summary of Stotz, 2003, LOE 2:
- Patients treated for cardiac arrest 380, included 168 (76 in control group and 92 in AED group)
- Patients achieving ROSC: 37/76 [47.4% in control] vs 34/92 [37% in AEDs group] (RR 1.278; ARR -0.035; 95%CI 0.794-1.147; NNT 28.6)
- Patients discharged from hospital: 6/35 [17% in AED] vs 7/53 [13% in manual defibrillation] (RR 0.955; ARR 0.039; 95%CI 0.794-1.147; NNT 25.6)

Summary of Sweeney, 1998 (LOE 2):
- Patients assessed 627, enrolled 243 in whom cardiac arrest was bystander witnessed and of cardiac origin (133 in control group and 110 in AED group)
- Patients achieving ROSC: 18/133 [13.5% in control] vs 12/110 [10.9% in AEDs group] (RR 1.044; ARR -0.037; 95%CI 0.946-1.151; NNT 27)
- Patients discharged from hospital: 7/133 [5.3% in control] vs 5/119 [4.2% in AEDs group] (RR 1.008; ARR -0.007; 95%CI 0.952; NNT 142)
- No differences in neurological outcome: 6 of the 7 patients resuscitated in the control group were discharged with pre-arrest neurological status and one had moderate disability. 3 of the 5 patients resuscitated in the AED group were discharged with their pre-arrest neurological status, one had moderate disability and one severe disability

Summary of van Alem, 2003 (LOE 1):
- Patients enrolled 469 (243 in the AED group vs 226 in the control)
- Patients had ROSC: 139/243 [57% in AED group] vs 108/226 [48% in control] (RR 0.820; ARR 0.094; 95%CI 0.677-0.993; NNT 10.6)
- Patients survived to hospital discharge: 44/243 [18% in AED] vs 33/223 [15% in control] (RR 0.961; ARR 0.033; 95%CI 0.887-1.042; NNT 30)
- Patients admitted to hospital: 103/243 [42% in AED group] vs 74/223 [33% in control] (RR 0.862; ARR 0.092; 95%CI 0.748-0.994; NNT 10.8)

Summary of Walters, 1990 (LOE 2):
- Patients assessed 572, enrolled 398 (186 in AED group and 212 in Control group)
- Patients had ROSC: 7/186 [4% in AED group] vs 5/212 [2% in control] (RR 0.986; ARR 0.014; 95%CI 0.951-1.021; NNT 71)
- Patients admitted to hospital: 17/186 [17% in AED group] vs 30/212 [14% in control] (RR 1.058; ARR -0.050; 95%CI 0.986-1.136; NNT 20)
- Patients alive at 6 months: 5/186 [3% in AED group] vs 4/212 [2% in control] (RR 0.992; ARR 0.008; 95%CI 0.962-1.022; NNT 125)

In-hospital cardiac arrest
Five studies focused on the use of AEDs for treatment of in-hospital cardiac arrests (Destro 1996 LOE 4, Forcina 2009 LOE 4, Gombotz 2006 LOE 4, Hanefeld 2005 LOE 4 and Zafari 2004 LOE 3). Four of these studies (Destro 1996 LOE 4, Gombotz 2006 LOE 4, Hanefeld 2005 LOE 4 and Zafari 2004 LOE 3) supported the use of AEDs and showed improved ROSC and survival. Two of these studies, however, included fewer patients, less than 20 (Destro 1996 LOE 4 and Hanefeld 2005 LOE 4). The other two (Gombotz 2006 LOE 4 and Zafari 2004 LOE 3) included more than 500 cases of cardiac arrest. In one study (Gombotz 2006 LOE
4), in more than 60% of cases, defibrillation with the use of an AED was conducted by nurses alone, without a physician of the cardiac arrest team. The other study (Zafari 2004 LOE 3) reported increased survivals from 4.9% to 12%. In two studies (Gombotz 2006 LOE 4, Hanefeld 2005 LOE 4) the interval between the alarms to first defibrillation were reported when AEDs were employed was within 3 minutes. No cases of incorrect rhythm analyses or inappropriate delivery of defibrillation were reported.

Statistical summary of critical studies: Forcina 2009 (LOE 4); Gombotz 2006 (LOE 4); and Zafari 2004 (LOE 3):

Summary of Forcina, 2009 (LOE 4):
- 561 cases of in-hospital cardiac arrest. Of these, AEDs were employed in “AED mode” in 136 patients in whom cardiac arrest occurred in general wards and stepdown units.
- Selected cases for analyses: 130 in control group vs 136 in AED group
- Survival to hospital discharge in patients with initial VT/VF: 6/16 [37.5%] in control group vs 5/20 [25%] in AED group (p not significant)
- Survival to hospital discharge in patients with initial asystole/PEA: 18/114 [15.7%] in control group vs 18/116 [15.5%] in AED group (p not significant)
- Survival to hospital discharge in all patients: 24/130 [18.5%] in control group vs 23/136 [16.9%] in AED group (p not significant)

Summary of Gombotz, 2006 (LOE 4):
- 500 cases of in-hospital cardiac arrest in non monitored area and initially treated by nurse equipped with AEDs.
- 439 cases enrolled
- Patients had ROSC 256/439 [58%]
- Patients discharged alive from hospital 125/439 [28%]
- Patients alive 6 months 95/439 [22%]
- 73 patients with VF/VT, of which 47 defibrillated by nurse alone and 10 by other healthcare workers

Summary of Zafari, 2004 (LOE 3):
- 569 cases of in-hospital cardiac arrest; 141 received AED delivered biphasic shocks and 428 manual monophasic shocks.
- Patients survived to hospital discharge: 18/141[12.8% in AED group] vs 21/428 [4.9% in manual defibrillation] (RR 0.917; ARR 0.079; 95%CI 0.85-0.98; NNT 12.7)
- Patients with VF/VT were 17 fold more likely to die with monophasic manual defibrillation vs AED delivered biphasic shock (95%CI 2.9-98.7; odds ratio 17; p 0.002)
- No difference in neurological outcome at hospital discharge between the two groups.

General comments
All the studies showed that AEDs can be safely and often effectively used by nurses, police officers, firefighters, EMTs, ambulance service personnel as well as trained laypersons and volunteers.
In settings of out-of-hospital cardiac arrest, several studies have showed the efficacy of the use of AEDs with regard to the outcomes of CPR. The use of AEDs reduced the time to defibrillation and assured better ROSC. However, some studies have also showed no improvement in survival, probably related to other variables, such as the quality of CPR, which was not investigated, or the interruption in CPR. There are not enough studies that have investigated the effects of AED in out-of hospital cardiac arrest in accordance with the last 2005 guidelines which recommended less interruption for ventilation, and a single shock protocol for defibrillation. Further research is needed in this sense.
In settings of in-hospital cardiac arrest, studies have also reported reduction of the time to deliver the first defibrillation and improvement in survival. However, there are only few studies and some of them included a small number of cases. Further studies are needed.

Acknowledgements:
**Citation List**


Level 1 study, Good, Neutral. This is a multicenter randomized clinical trial including 7001 patients (3506 in the control group and 3495 in the AED group). This study included only patients with previous anterior wall myocardial infarction, and it was focused on the use of AEDs at home. It therefore excluded a greater variety of patients. AEDs were applied in 32 patients, 13 of whom were in ventricular fibrillation and 12 received shocks. There was an high proportion of unwitnessed events with no usage of AEDs in the emergency, rather than lack of device efficacy. No cases of delivery of inappropriate shocks were reported.


Level 3 Study, Good, Supportive. This is a comparison between a prospective cohort and an historical cohort. This study showed increases in survival after implementation by the EMS with AEDs fully operated by volunteers and laypersons. Neurological outcome also improved. However, this is not a randomized controlled study. There is a lack of important information, such as the time from the call to first defibrillation and also the results regard all the population of cardiac arrest, not only those in ventricular fibrillation. More interesting was that survival improved significantly in the urban area, where more witnessed cardiac arrests occurred.


Level 1 study, Good, Neutral. This is a randomized controlled trial including 321 cases of cardiac arrest, 163 of whom were treated by EMTs equipped with AEDs and 158 by EMTs with manual defibrillators. No improvements in survival were observed. However, when an AED was used the time for the delivery of the first shock was significantly reduced compared to manual defibrillation. Failure to deliver a defibrillation by an AED was reported in 6 cases because of operator’s errors, in 2 cases for mechanical malfunctions and in 2 for failure to identify rhythm. These errors, however, were not different in percentage than those observed when manual defibrillation was used.


Level 4, Fair, Supportive. The study was conducted in two non-intensive care wards. During the initial 8 months, there were only 4 interventions on VF. In the implementation phase, nine months, only 9 cases of VF were reported. The study supports the use of AEDs, however too few cases were included.


Level 4, Fair, Neutral. The study results more as a comparison between monophasic and biphasic defibrillation waveforms. The AED devices, in fact, were used in the AED mode only in the general wards and stepdown units. No significant differences were reported in survival to hospital discharge.


Level 4 study, Fair, Supportive. This is a retrospective study including 500 cases of in-hospital cardiac arrest initially treated by nursing staff equipped with AEDs. 73 patients had VF/VT cardiac arrest and more than 60% of these patients were defibrillated by the nurses alone. Chain of survival was strengthened by the introduction of the use of AEDs by nurses with increases from 12 to 47% in early defibrillation. The first shock was delivered within 3 min of the call.

Level 3 study, Fair, Neutral. This is an observational study investigating the use of AEDs by police and the impact on survival. The control group is a historical EMS response. Police responded first only in 6% of cases. No impact on survival was observed. However, the time from call to first shock was reduced when AEDs were introduced.


Level 1 study, Good, Neutral. This is a randomized controlled trial where outcome after use of AEDs by volunteer lay person was compared to outcome after volunteer lay person response included CPR only. Increases in survival were reported by the authors, however our analyses showed the p values were not statistical significant.


Level 4 Study, Fair, Negative. This is a one year uncontrolled prospective study. The study showed that after introduction of AEDs in Scotland, the number of patients in cardiac arrest who were presented to the Emergency Department increased dramatically, from 70 during the period 1981-2 to 297 in the period 1991-2. The survival, however decreased, from 22% to 13.1%. The AEDs guaranteed defibrillation in 62% of the survivors that in this study required defibrillation alone as treatment.


Level 4 study, Poor, Supportive. This study encouraged the use of AEDs during in-hospital cardiac arrest. 18 cases of VF were reported in the year observation, 16/18 had ROSC, 11/18 were discharged from the intensive care unit and 10/18 were discharged from the hospital. The time from the call to the delivery of the first shock was 2.1 min. The number of patients included was too small.


Level 4 study, Fair, Supportive. This is a retrospective study investigating the use of AEDs by fire departments (FD). Response time from call to ALS was about 2 mins. 109 patients were in VF/VT and all received defibrillation by FD equipped with an AED. 42 patients had ROSC and 22 survived to hospital discharge. There were no episodes of equipment failure or improper reading of ECG rhythms.


Level 4 study, Poor, Supportive. This is a non randomized study. This prospective study investigated the effects of AEDs introduced in the Tapey city metropolitan area. 633 patients were assessed and of those 635 were true cardiac arrests. Shockable rhythm appeared in 80 patients. 55 cardiac arrests were witnessed and 35 of those had ROSC and 2 survived to hospital discharge. 25 cardiac arrests were not witnessed and 6 had ROSC and only one survived to hospital discharge. With the use of AEDs, survival improved from 1.4% to 19% for VF arrests. Witnessed arrest had a better survival. The study lacks a control group.


Level 4 study, Good, Supportive. The most important data are that a continuous improvement in survival was observed over a 5 year period after the introduction of AEDs used by trained ambulance services.

Level 2 study, Poor, Neutral. This is an observational study over a two year period presenting implementation of EMS response by trained lay people and police officers in the use of AEDs. The time to first response significantly decreased, however, no impact on survival was observed.


Level 3 study, Good, Supportive. This is a prospective, interventional cohort study with historical controls. Police officers were trained to use the AEDs in a 4 hour program. 282 cases were eligible for the study. Police arrived at the scene before EMS personnel in 61% of cases and applied AEDs in 69% of patients. Patients to whom police officers applied AEDs and that were defibrillated had significantly greater ROSC and survival increased more than 10 times compared to the historical controls. The study, however, employed the earlier 3 shocks algorithm with longer interruptions in CPR. When EMS arrived, AEDs were employed in manual mode.


Level 3 study, Good, Supportive. This is not a randomized study but a comparison between EMS implementation with police AEDs program vs historical EMS response. Survival to hospital discharge was improved after police AED introduction. The time from call to arrival on the scene was significantly lower after introduction of police operated AEDs (4.7 mins vs 7.53). However, outcomes of victims in not VF/VT cardiac arrest did not improve.


Level 1 study, Good, Neutral. This study is the same thanstudy reported by Hallstrom, 2004. It is a prospective randomized investigation including 3413 patients (1591 in CPR-only group and 1822 in CPR plus AEDs group). No differences in neurological status at hospital discharge were observed. No inappropriate shocks were delivered with AEDs. PLEASE REFER TO HALLSTROM 2004


Level 2 study, Good, Supportive.


Level 2 study, Good, Neutral. This is a controlled, prospective multicenter study including 121 victims of out-of-hospital cardiac arrest. This study was not a real randomized study, since the randomization regarded the training program for the EMTs. The allocation of a patient to one of the groups was dependent upon the EMT arriving to the scene. This study employed an old 3-shock algorithm, which has been known to greatly increase interruptions in CPR. The study was not compared to the absence of AEDs. The study has its value in the point that it showed that the use of an AED by EMTs reduced the time to first shock and the time to ROSC. Finally, no cases of false treatment due to faulty handling of the AED.

Level 2 study, Fair, Negative. This is a retrospective cohort study. Although the time to defibrillation was significantly reduced after introduction of AEDs, survival and neurological outcome were instead decreased. Similar numbers of witnessed cardiac arrest, bystander CPR and arrival of EMS are reported. The old three-shock protocol was employed.


Level 2 study, Good, Neutral. Ambulance technicians identified correctly VF more frequently then AEDs. However, this study was conducted more than 20 years ago and the technologies are now significantly improved. Nevertheless, the time to first shock was more rapid when AEDs were employed.


Level 2 study, Good, Neutral. This is a non-randomized, prospective, controlled, crossover study, including consecutive cases of out-of-hospital cardiac arrest. Patients were divided based on the use or not of an AED during rescue by EMT responders. Again this study employed the three-shock algorithm with longer interruptions in CPR. The study focused on hospital discharge and neurological outcome. No differences in hospital discharge and neurological disability were observed. Interestingly, bystander performed CPR did not have an effect on survival. Perhaps the number of patients enrolled in the study was not sufficient to provide significant differences. From the power analyses, the authors indicated that to provide enough power to the study they needed 195 patients per group where only 110 and 133 were included in the AED and CPR-only groups. Finally, failure to defibrillate because of operator error was noted in 5 cases.


Level 1 study, Fair, Neutral. This is a randomized controlled clinical study including 469 patients with witnessed out-of-hospital cardiac arrest. This is a well powered study. No improvements in survival were observed, although improvements in ROSC were reported. The time from collapse to first shock was also reduced in the group using AEDs.


Level 2 study, Fair, Neutral. This study compared the impact on outcome of the use of AEDs by minimally trained ambulance service personnel in comparison with ambulance service personnel providing BLS only. No increases in survival were observed. The minimal greater ROSC and better neurological outcome observed in the AED group could be related also to the higher percentage of witnessed cardiac arrest by the ambulance crew.


Level 3 study, Good, Supportive. This study included 569 cases of in-hospital cardiac arrest (in which 141 were treated with AEDs). The study showed a significant increase in survival to hospital discharge from 4.9% to 12.8%. However, the study did not include only the variable AEDs but also compared outcomes versus patients treated with monophasic defibrillators. It has been recognized that biphasic defibrillators improve success of resuscitation. Moreover, there were differences in the population studied, with increases in BMI, ACE inhibitor treatments and beta-blocker treatment.