Do automated external defibrillators have a place in lifeguarding / lifesaving?

Anthony J Handley MD FRCP

Chief Medical Adviser RLSS UK
Honorary Medical Adviser ILSE
Honorary Secretary, Medical Committee ILS
Honorary Consultant Physician & Cardiologist, Colchester General Hospital, England

ABSTRACT

Basic life support and defibrillation are the two interventions shown conclusively to improve outcome from cardiac arrest. The sooner a defibrillator is used, the greater the chance that the victim will survive. To reduce delay, first responders can be equipped with automated external defibrillators (AEDs), that are simple, safe, and effective.

Deciding whether to equip lifeguards with AEDs will depend, amongst other considerations, on cost-effectiveness. This, in its turn, will depend on how often a cardiac arrest is likely to occur at the facility.

It has been suggested that placement of an AED is justified if cardiac arrest is predicted to occur once in 5 years. Relating this to a survey of UK leisure centres, this is likely to be the case if the facility has 140,000 or more clients a year.

INTRODUCTION

Cardiac arrest occurs when the heart goes into an abnormal rhythm that results in failure of its pumping action. Commonly, this is a fast, uncoordinated, irregular rhythm called ventricular fibrillation (VF). If left untreated, VF will gradually fade away, and the heart will stop beating altogether (asystole). The two interventions that have been shown conclusively to improve the outlook for a victim of cardiac arrest are basic life support (BLS; cardiopulmonary resuscitation) and defibrillation, the application of a controlled electric shock across the heart. Defibrillation will only work in the case of VF, which is known as a shockable rhythm. The sooner that a defibrillator can be used, the greater is the chance of success. Minutes count. BLS will prolong the time during which the defibrillator is effective but, after about 15-20 minutes with no treatment, the victim is almost certain to die.

Defibrillators

Emergency medical service (EMS) vehicles are usually equipped with defibrillators, but there is inevitably a delay before the EMS is called, further delay in getting to the victim, and delay before the defibrillator can be used. For these reasons, much has been done to encourage community first responder schemes. These aim to get an automated external defibrillator (AED), operated by a non-healthcare professional, to the victim in advance of the EMS. Such community programmes can either consist of AEDs provided at places of high risk for cardiac arrest, such as airports, leisure centres, or highly-populated areas (‘fixed’ AEDs), or brought to the scene by first responders who are alerted by the EMS (‘mobile’ AEDs). An example of a successful fixed AED scheme is that supported by the UK Government. Over 4 years and 172 uses of the AEDs, almost 30% of victims of VF left hospital alive (Davies et al 2005). In contrast, a mobile AED scheme in a town in Italy was compared with the results of the EMS alone. A total of 354 cases of cardiac arrest were treated. Where the EMS alone attended, only 3.3% of victims survived, compared to 10.5% when a first responder arrived beforehand.

Looking at these figures, it may be thought obvious that fixed AEDs are more efficient. The problem is that, by their very nature, they are fixed and can only be used if a victim collapses in the near vicinity. This is why they are sited where such events are most likely to occur. On the other hand, mobile AEDs can be used for a far larger number of victims. Although the chance of survival for a given victim is higher when a fixed AED is available, overall far more victims are saved by mobile AEDs.

This difference is reflected in the cost-effectiveness of the two types of community first responder scheme.

Cost-effectiveness

In order to be able to compare costs, a value has to be given to human life. Just to count the extra years gained when a victim of cardiac arrest is saved, is too simplistic, not least because it does not allow for the resulting quality of life. Although a large proportion of victims who are saved by an AED go on to enjoy a full and worthwhile life, some do not: brain damage and disability are not unknown. To allow for this, a calculation known as quality-adjusted life years (QALYs), is used. A QALY is one extra year of life in perfect health. On the other hand, if the survivor is judged to have, say, a quality of life only half what it would otherwise have been, he or she will have to survive for two extra years to gain one QALY. This system is not the only one used for the calculation of cost-effectiveness, but it is probably the best known.

Using QALYs, health economists can compare the cost of various medical interventions, and decide which ones can be offered within a cash-limited health service. Some examples of the cost of one QALY for a number of common medical treatments are given in the table. To put this in some sort of context, the National Institute for Health and Clinical Excellence (NICE) in the UK is the body charged with recommending what treatments should be made available for National Health Service (NHS) patients. As a (very) rough rule, a figure of €44,000 is considered the upper limit of cost-effectiveness. A first responder scheme using fixed AEDs has been estimated as costing €60,000 for each QALY, whereas a mobile scheme costs €36,500 for each QALY.

Table: Examples of the cost of one QALY for some common medical treatments

Quality-adjusted Life Years	
Blood pressure drugs	**€ 9,500**
Pacemaker insertion	**€ 11,000**
Hip replacement	**€ 11,500**
Coronary bypass surgery	**€ 13,500**
Heart transplant	**€ 80,000**

The International Liaison Committee on Resuscitation (2000 a, b) suggested in their Guidelines 2000 that placement of an AED would be cost-effective if (a) the call-to-shock time for the EMS was greater than 5 minutes, and (b) the call-to-shock time for the on-site or mobile AED was less than 5 minutes, and (c) it was predicted that the AED would be used at least once every 5 years.

It must be born in mind that these calculations, though made very carefully with the best data available, are only approximate. However, it can be seen that on grounds of cost, first responder schemes are effective.

AEDs for Lifeguards

So, what about lifeguards being equipped with AEDs and acting as first responders? The Medical Committee of ILS has produced a statement on the use of AEDs by lifesavers and lifeguards, approved by the ILS Board of Directors. The following extracts are of note: 'It is appropriate for some … lifeguard services to investigate AED use', and, 'This … should include … frequency of cardiac arrests … [and] cost benefit analysis'.

Are AEDs required to treat victims of drowning? Ventricular fibrillation is reported as being rare in cases of drowning (Bierens et al 2002), with most heart rhythms having deteriorated into asystole by the time equipment is available to record the rhythm. Other reports, however, have suggested that VF is not as rare as many think, occurring in 10% of drowning incidents in children (Mogayzel et al 1995). From personal experience, in all of the last 4 medicolegal cases seen, VF was present when the paramedics arrived on scene. Nevertheless, it has to be accepted that an AED will only occasionally be effective in cases of drowning.

What about the other clients at leisure centres? Are they sufficiently liable to suffer cardiac arrest to warrant purchase of AEDs? Do we know the cost-benefit of AEDs when used by lifeguards? The problem with the ILCOR formula is knowing how to calculate whether an AED will be used at least once in 5 years. There are no published data on this, but a survey was carried out by the author on the incidence of 'collapse' at 106 leisure centres with swimming pools (hence lifeguards) in the UK (Handley 2001). There were over 25 million clients attending the centres each year, with 58 incidents requiring some form of resuscitation. Of these, 22 were judged not to have suffered a cardiac or respiratory arrest, leaving 36 incidents in which an AED, if available, would reasonably have been used. Three of the cases were drowning incidents, the remaining 33 being cardiac events or stroke. This equates to one incident requiring CPR for every 700,000 clients. Using the ILCOR formula, it can be estimated that installing an AED and training lifeguards to use it is cost-effective if the centre attracts 140,000 or more clients a year.

CONCLUSIONS

In conclusion, it can be said that it is, indeed, appropriate for some lifeguard services to be equipped with AEDs. It is likely that they will be used only occasionally in the management of drowning, but there are a few cases where defibrillation is appropriate and the presence of an AED may well determine whether the victim lives or dies. Formulae exist to calculate the cost-effectiveness of the placement of AEDs, with one use in 5 years being a simple, approximate, guide. Leisure centres admitting 140,000 or more clients a year may well be those that should seriously consider obtaining at least one AED, and training its staff to use it. It is more difficult to calculate the equivalent number of clients at beach or other open-water sites.

Above all, AEDs are simple to use, effective, and safe. There is no doubt that they work for the victim whose life is saved!

TAKE-HOME MESSAGES

1. Be aware of the potential benefits and limitations of AEDs.
2. Be aware of the cost-benefit ratio for the provision of AEDs following risk assessment.
3. Be prepared to discuss whether the provision of AEDs may be appropriate where lifeguards patrol

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