

STATEMENT

A GUIDE TO AUTOMATED EXTERNAL DEFIBRILLATORS

This document is designed to provide information about Automated External Defibrillators (AEDs) and how they can be deployed in the community to help resuscitate an out of hospital cardiac arrest patient. It is based on *A Guide to Automated External Defibrillators* published by Resuscitation Council (UK) and British Heart Foundation (December 2013).

Summary

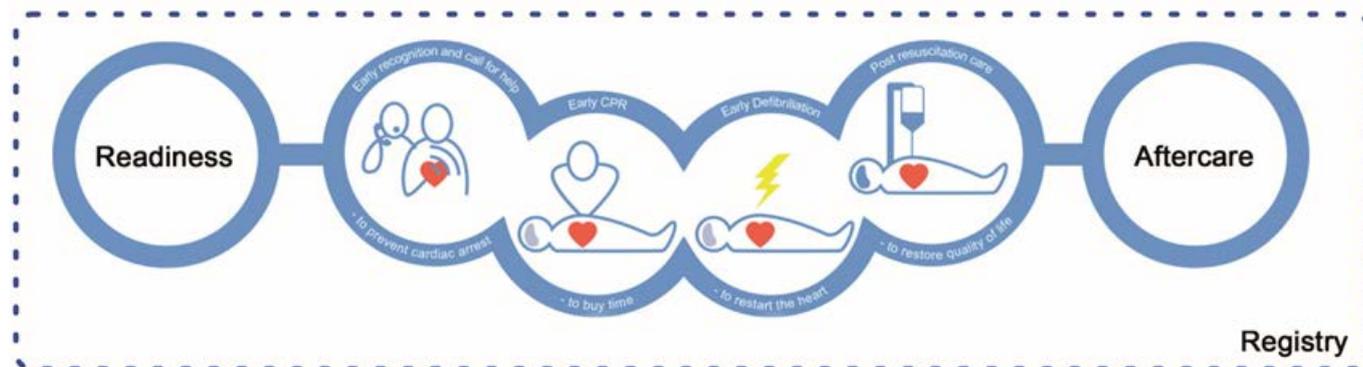
1. Out-of-hospital cardiac arrest (OHCA) is a significant public health issue. In Australia more than 30,000 OHCA's occur every year, with fewer than 10% surviving to leave hospital (Ambulance Victoria, 2016). However, with immediate resuscitation more lives can be saved.
2. In cardiac arrest the heart is no longer pumping, blood flow stops, the casualty loses consciousness and will not be breathing normally. This person will die, unless within a short period of time blood flow is restored. Immediate cardiopulmonary resuscitation (CPR) will restore some blood flow.
3. For a short period of time, the non-pumping heart may have an abnormal rhythm (ventricular fibrillation (VF) or ventricular tachycardia (VT) which may be "shocked" by defibrillation (a type of electric shock) back to a normal pumping rhythm
4. Rescuers (professional, trained layperson or untrained person) cannot tell by looking at a casualty whether the casualty has a "shockable" rhythm or a "non-shockable" rhythm (where defibrillation will have no benefit for the casualty).
5. One of the functions of an AED is to determine whether the casualty has a "shockable" or "non-shockable" rhythm.
6. The time to defibrillation is a key factor that influences survival. For every minute defibrillation is delayed, there is approximately 10% reduction in survival if the patient is in cardiac arrest due to VF or VT, (shockable rhythms).
7. CPR alone will not save a person in VF/VT, so a defibrillator should be applied to all casualties as soon as available so that a shock can be delivered if required.
8. The development of easy to operate AEDs has led to defibrillation being included in basic life support teaching. AEDs can accurately identify the cardiac rhythm as "shockable" or "non-shockable" and provide verbal and visual prompts of the next steps (e.g.. shock advised or no shock advised, and continue with CPR).
9. Many OHCA patients can be saved if persons nearby immediately recognise they are in cardiac arrest, call Triple Zero (000) for an ambulance, perform CPR and use an AED. Each of these stages "is a link" in a "chain of survival" that provide the best chance of survival. Minutes count and members of the public along with first responders represent the front line in resuscitation from OHCA. More information in section 2 and section 3.
10. AEDs are easy to use, compact, portable and very effective. They are designed to be used by lay persons; the machines guide the rescuer through the process by verbal prompts and visual prompts. They are safe for the casualty/victim and will not allow a shock to be given unless it is required. They are designed to be stored for long periods without use and require very little routine maintenance. Many models are available directly from the manufacturers or through medical equipment companies. More information in Section 3 and section 13.
11. In Australia AEDs have been installed in many busy public places, workplaces, or other areas where the public might have access. The intention is to improve early access to defibrillation. This strategy of placing AEDs in locations where they can be used by a lay person is known as Public Access Defibrillation (PAD).

More information in section 4. Separate information is included about AEDs in the workplace (section 8) and schools (section 9). Information on training is contained in section 11.
13. In Australia, there are very few legal barriers to PAD. A rescuer / person who has acted appropriately to help a patient who has suffered cardiac arrest would not be liable regardless of the outcome. More information in section 6.

14. There are a number of factors to consider when contemplating purchasing and installing an AED, some of these considerations are discussed in sections 5 and section 7. These decisions can also be made with the assistance and guidance of the state ambulance service which can provide advice relating to AED purchase, installation and other practical information.
15. AEDs should be placed or stored where they are most likely to be needed; they must be accessible with a minimum of delay. All persons working at the site need to be aware of their purpose and location, and the steps to be taken should someone suffer cardiac arrest. This will include calling Triple Zero (000) for an ambulance service and activating the organisation's emergency response plan: ie, to commence CPR on any casualty who is unresponsive, and not breathing normally and to get the AED as soon as possible, apply the pads and follow the AED's prompts. More information in section 5 and section 12.

1. Introduction

Defibrillation is one crucial stage in a sequence of events that need to occur for the resuscitation of a patient with OHCA. This sequence, or 'chain of survival', starts by facilitating *readiness* in the community to enable early response to an OHCA. This includes training the community in CPR and AED use, having publically available AEDs, and having a tested emergency response plan in the case of an OHCA. The *readiness* stage assists with the early activation of the next four stages to help improve chances of survival; *Early recognition and calling Triple Zero (000)*, *early CPR*, *early defibrillation* before advanced life support and *post resuscitation care*.



Early defibrillation supported by the increased availability of AEDs is an important development in the treatment of OHCA. Time to defibrillation is a crucial factor in survival. AEDs are now widely available and increasingly used by persons, who often have little or no training, to restore a normal ("pumping") heartbeat in a victim of OHCA.

The crucial determinant of survival is the time between collapse and the use of the AED to deliver a shock. The strategy, therefore, is to have an AED installed at a place where it might be needed so that it can be accessed quickly by someone nearby, taken to the person who has collapsed, and used before the arrival of the ambulance service. This arrangement is known as Public Access Defibrillation (PAD).

In this guide we explain the background to defibrillation and describe some important practical aspects of setting up an AED program or PAD scheme. The information will help those considering establishing an AED program in any public place. Public places include the workplace, school, fitness centre, or a transport, shopping or sports facility. Similarly the information will be relevant to those wishing to make an AED generally available by placing one in a prominent place in their local community. It is not intended as a guide for the purchase of an AED for use in the home.

2. Background

OHCA is a major cause of death in all developed western countries. In Australia, there more than 30,000 cases of OHCA every year, with around 1 in 1,000 of the population suffering OHCA. Currently, less than 10% survive to leave hospital.

Most cases of OHCA are due to an abnormality of the heart's electrical rhythm called ventricular fibrillation (VF) or ventricular tachycardia (VT). The heart stops beating properly, it ceases to act as an effective pump, and the circulation of blood stops. Death is inevitable unless the condition is recognised promptly and defibrillation is carried out. Defibrillation is the use of a controlled electric shock that stops the chaotic rhythm of VF/VT and allows the normal, organised, electrical rhythm of the heart to re-start. This can allow the pumping action of the heart to return.

The major factor limiting the number of people who survive OHCA is the ability to provide defibrillation within a critical time. Conditions for defibrillation are optimal for only a few minutes after the onset of VF/VT, although this period can be extended if a rescuer provides effective CPR. CPR by itself cannot restore a normal heart rhythm but it can "buy time" until a defibrillator is available and used. For details about this see <http://resus.org.au/guidelines/>. For the patient in VF/VT, the chance of survival falls by around 7 - 10% with every minute that defibrillation is delayed. Therefore, the key to early defibrillation is the use of an AED by a person near the cardiac arrest patient.

The term 'heart attack' is often used to refer to cardiac arrest, but this is incorrect. A heart attack (or myocardial infarction) occurs when an artery supplying the heart itself with blood becomes blocked. This usually causes chest pain and leads to damage to the muscle of the heart. A heart attack may cause cardiac arrest, but this is by no means inevitable.

These risks of permanent heart damage and cardiac arrest are reasons for emphasising the importance of calling Triple Zero (000) immediately for anyone with a suspected heart attack, so that they can receive treatment to reduce the damage to their heart and reduce the risk of cardiac arrest. As soon as a heart attack is suspected, the nearest available AED should be brought to the scene as a precaution in case the patient does subsequently suffer a cardiac arrest.

There are many causes of cardiac arrest, however as soon as a person has collapsed, is unresponsive, and stops breathing normally, they require immediate resuscitation.

3. The Automated External Defibrillator

All that is required to use an AED is to recognise that someone who has collapsed may be in cardiac arrest and attach the AED's two adhesive pads (electrodes) to the patient's bare chest. These pads allow the AED to monitor the heart's electrical rhythm and will deliver a shock if it is needed. The AED will provide verbal prompts and some models also provide visual prompts on a screen.

The AED will analyse the heart's electrical rhythm and if it detects a rhythm likely to respond to a shock (a rhythm such as VF/VT), it will charge itself ready to deliver a shock. Some devices then deliver the shock automatically without needing any further action by the rescuer; others prompt the rescuer to press a button to deliver the shock (these are often referred to as 'semi-automatic' AEDs or SAEDs). The AED will then prompt the rescuer to give the patient CPR for two minutes. After two minutes, the AED will again prompt the rescuer/s not to touch the patient while it checks the heart rhythm to determine if another shock is required. The AED will continue to provide prompts as required. These should be followed until advance life support (i.e. paramedics) arrive and are ready to provide further treatment.

Modern AEDs are reliable and will only shock a patient when it is required. They are safe for both the patient and the rescuer, and present minimal risk of a rescuer receiving a shock. Care should be taken not to touch the person during shock delivery. There are no reports of harm to rescuers from attempting defibrillation in wet environments.

AEDs require minimal routine maintenance or servicing; most perform daily self-checks and display a warning if they need attention. Most AEDs currently offered for sale have a minimum life-expectancy of ten years. The batteries and pads have a long shelf-life, allowing the AED to be left unattended for long intervals. More details are given in section 9.

These features of AEDs make them suitable for use by members of the public with little or no training, and for use in PAD schemes.

As well as having an AED on site (and people prepared to use it) it is also vital that as many people as possible learn CPR. This includes learning how to recognise cardiac arrest, call 000 (Triple Zero) and performing CPR (chest compressions and rescue breaths). Providing CPR helps maintain the blood flow and oxygen supply to the brain and other vital organs, it can also contribute to helping restore an effective heart beat during defibrillation.

In a case where no AED is available, the rescuer should continue with CPR until advance life support providers are able to provide treatment. All rescuers should perform chest compressions, and if a rescuer is trained and willing to give breaths they should do so. For more details see <http://resus.org.au/guidelines/>.

4. AED programs

The use of AEDs by lay people who were not health professionals has seen many successful PAD programs established across Australia in recent years. One such program was introduced in Victoria as a government-led initiative (Public Access Defibrillation Pilot Program, 2002). This initiative placed AEDs in airports, railway stations, and other public places where the ambulance service records showed that OHCA occurred most frequently. Staff working in these places were then trained in CPR and how to use the AEDs in their workplace.

These programs have been effective in Victoria with 69% of patients surviving when first defibrillated by a public AED, this compares with a 48% survival rate when the first shock is provided by Paramedics (Ambulance Victoria, 2016). Similar results have also been experienced in other states and territories. With the growing public awareness and acceptance of AEDs, and their increasing availability, AEDs are increasingly being installed in public locations. Funding for these devices have been provided in a number of ways, which include and are not limited to; government grants, community fundraising, financial institutions, benevolent organisations and charities.

5. Establishing an AED program or PAD scheme

Is an AED needed here?

This question may arise because:

- a) Someone has placed one in a similar location or organisation.
- b) A cardiac arrest has occurred at the location and treatment had to wait for the arrival of the ambulance service. Often there is a feeling that the event might have been managed more efficiently if an AED was available.
- c) An approach is made by those promoting the purchase and deployment of AEDs.
- d) Employers are considering their obligations within the Health and Safety legislation.
- e) Occupiers of premises (including sporting and recreational establishments) are considering their civil law 'duty of care' to visitors and users of their facilities.

In general, the more likely it is that an AED will be used, the more worthwhile it is to install one. Unfortunately there is no agreed criteria to base definitive advice on whether or not to provide an AED in any specific location, however consideration of the following points should help make a decision:

- Cardiac arrest affects predominantly middle-aged and older people (more men than women). Some younger people (including athletes and elite sportspeople) suffer cardiac arrest or sudden cardiac death; this is much less common but may attract understandable public attention.
- People with underlying heart disease (particularly ischaemic heart disease, in which the coronary arteries are narrowed) are particularly vulnerable.
- The greater the number of people present in or passing through any one place the greater the risk of cardiac arrest occurring there.
- Cardiac arrest often occurs during exertion. The stress of travel is also a recognised precipitant, but in many other cases there is no recognised trigger.
- The purpose of installing an AED is to deliver a shock as soon as possible after a cardiac arrest - if possible within five minutes at the most. Delays in fetching the AED or obtaining a code to unlock a cabinet may reduce the chance of success. Therefore, AEDs should be easily accessible and not locked away in cupboards and drawers.
- Although untrained members of the public have used AEDs successfully to save a life, the majority of successful AED use has been by trained people (albeit people with modest training) who were nearby. It is essential for people on site who are willing to use an AED to be trained in their use.
- In a workplace situation, it will be sensible to train first-aiders or 'appointed persons' in the use of an AED. However, it is encouraged that untrained members of staff are made aware of how easy it is to use an AED in case a trained member of staff is not available during a cardiac arrest emergency. They should also be made aware that they cannot hurt the patient as the AED will only shock the person when a shock is likely to be effective.
- The ability to perform CPR is a vital skill that increases survival, and can buy time until the AED can be used.

These points should be considered and are supported by the fact that the PAD schemes have been shown to save lives as they enables early defibrillation prior to ambulance arrival.

By considering each of these points in any individual situation, a practical decision about whether or not to install an AED can usually be made.

6. Legal issues

In Australia, 'Good Samaritan' legislation protects volunteers and lay people who go to the assistance of others. Whilst many people are concerned about the legal situation of those who attempt to resuscitate someone, it is very unlikely that a potential rescuer could be held liable. Having decided to assist, a rescuer is expected to display a standard of care appropriate to their training (or lack of training). No 'Good Samaritan' or volunteer in Australia has ever been successfully sued or held liable for consequences of rendering assistance to a person in need. Indeed, legal protection is provided. (Australian and New Zealand Council on Resuscitation, 2015). Rescuers acting as good Samaritans are protected in law via a number of different laws in different states.

Furthermore in Australian law, for someone to be held liable for negligence it would have to be shown that their intervention had left the patient in a worse situation than if there had been no intervention. In the circumstances under discussion (i.e. someone who will die following a cardiac arrest) it is very unlikely that this would arise.

7. Working with the ambulance service

People who want to install an AED need access to help and guidance, for example on exactly where to place it, how to make sure that it is most likely to save a life, and how to arrange training and support. The state ambulance service is a ready source of expertise on the provision of resuscitation services and can offer practical advice about the potential value and effectiveness of an AED in any situation, and advice about training in CPR and the use of AEDs. Contact should be made with the state ambulance service to assist with community education.

Many state ambulance services train community first-responders and equip them with AEDs and other basic equipment, so that they can respond to local medical emergencies before ambulance arrival. They are, therefore, well aware of the challenges facing all users of AEDs and any organisation that installs an AED.

The protocols used in ambulance control rooms aim to maximise the contribution that those present at the scene of an emergency can make before the ambulance arrives. The call-takers will encourage, and where required instruct, bystanders to perform CPR and to use an AED if available. The call-taker may know the location of the nearest AED if it has previously been registered in the state ambulance services AED database. We encourage all owners of AEDs to register these devices with their state ambulance service so that the AED can provide maximum benefit. This can include use of the AED outside the specific premises where it is situated.

8. AEDs in the workplace

The aim of installing AEDs in the workplace is to protect the workforce and also protect members of the public. Concentrating on the workforce, the incidence of cardiac arrest in the workplace in Australia is not known accurately, but in the USA (population 312 million), 400 deaths from cardiac arrest are reported to the Occupational Safety and Health Administration each year http://www.osha.gov/dts/tib/tib_data/tib20011217.pdf

The Institution of Occupational Safety and Health (IOSH) commissioned a survey of 1,000 business decision-makers across the UK and found that 513 did not have AEDs in their workplace. Almost two thirds of the negative responses came from medium to very large companies. It appears, therefore, that whilst almost half the companies surveyed did have AEDs available, many did not. While there have been no similar studies undertaken in Australia, it could be assumed that similar results may be found, making it even more critical to promote the installation of AED's in workplaces and other public locations.

Employees who have had first aid experience make ideal potential AED rescuers. Employees who are currently designated "first-aiders" will have undertaken the nationally recognised Provide First Aid (HLTAID003) or Provide Advanced First Aid (HLTAID006). Both of these courses include familiarisation in the operation of an AED. Many organisations require employees or members to have a current Provide Cardiopulmonary Resuscitation (HLTAID001) qualification.

9. AEDs in schools

Fortunately cardiac arrest in school-age children is rare, but when it does occur it is a particularly tragic event. Several cases have received wide publicity, and specialised charities provide valuable information to health professionals and to the public to increase awareness and promote knowledge on the subject, as well as promoting research and improving recognition and treatment of the underlying causes. The precise incidence is not known as there is no national registry of such events in children, and post-mortem examinations do not always identify the cause (many of the cardiac conditions that cause OHCA in this age group are not detectable after death).

A study to investigate the causes of cardiac arrest at schools in Seattle (population 1.5 million), a city with the best data collection for 'out-of-hospital' cardiac arrest in the world, reported 97 cardiac arrests over a 15-year period. Cardiac arrest occurred at 1 in 111 schools per year. This represented 2.6% of all cardiac arrests treated outside hospitals over the period. Twelve arrests occurred in students, 33 in teachers and other staff, and 52 in other adults not employed at the schools; thus almost 90% of the arrests occurred in adults rather than pupils. The estimated incidence of cardiac arrest in students was 0.18 per 100,000 students per year and in teachers and other staff 4.51 per 100,000 staff members per year. No particular part of a school was found to be a high-risk area but 6 of the 12 student cardiac arrests occurred during exercise; other reports have mentioned a predominance of athletes among student patients of cardiac arrest.

An AED in a school is likely to be used very infrequently, and is more likely to be used on an adult than a pupil. However, an undoubted advantage of having AEDs in schools is that the students will become familiar with them and can learn about their purpose; this could be incorporated into classes on first aid, including training in CPR. School-age children have been shown to be capable of using AEDs in simulated cardiac arrest scenarios, and all school children should be taught emergency life-saving techniques.

10. Obtaining an AED

Several manufacturers supply AEDs directly to the purchaser or through subsidiary medical equipment sales companies. An internet search will reveal many models and options, making choice confusing. Most of the AEDs currently aimed at basic-level responders are suitable for community AED schemes. Some models are designed for use by more highly trained responders (and have additional features like ECG screens), but these are not appropriate for basic-level responders.

The state ambulance service may provide recommendations (usually based on compatibility with the models they use). Important differences between models include the cost of buying the AED itself, the cost and shelf-life of batteries, the cost and shelf-life of the electrode pads, the duration of manufacturer's guarantee, and the after-sales services provided. It is important to ensure that the AED has been approved by the Australian Therapeutic Goods Administration (TGA). All these factors should be considered when making a choice. It can be useful to ask others about their experience with a particular AED before going ahead with a purchase.

The purchase of more than one machine usually reduces the unit price, and such discounts should be sought when several AEDs are purchased. Large organisations (e.g. a supermarket chain) buying many devices should consider a formal competitive procurement exercise as substantial savings can be made.

A number of community and philanthropic groups also provide donated or subsidised AEDs. Alongside government schemes, this can provide a valuable opportunity for community groups to access AEDs either free-of-charge or at a greatly subsidised rate.

11. Arranging training for responders

As the crucial factor in the resuscitation of someone in VF/VT is to provide a shock from an AED with the minimum of delay. Time should not be wasted if trained staff are not immediately available. Untrained people have used the devices successfully to save life and a lack of training (or recent refresher training) should not be a barrier. Provided someone is willing to use the AED they should not be inhibited from doing so.

There are advantages of having a core number of appropriately trained personnel and training people to use an AED, a core group of responders can be achieved quickly without major cost. Providers of CPR and AED education and training include the state ambulance service, first aid organisations (e.g. the Australian Red Cross, St John Ambulance, Life Saving Victoria) and private training companies. Choice of training provider will depend on what is available locally, the numbers being trained, and the pre-existing level of expertise of the trainees.

Increasingly, on-line or distance-learning programs are being offered and may be used more widely in the future, particularly for refresher training. As a minimum standard, it is recommended that responders complete the HLTAID001 Provide Cardiopulmonary Resuscitation, however it is again stressed that an AED may be utilised by untrained personnel simply by following the device prompts.

12. Installing the AED

It is imperative that the AEDs location is promoted within the particular setting so that those willing to use the device know where it is kept and how to access it quickly. No barrier should be put in the way of anyone accessing the AED it when it is needed; **it should not be locked away and inaccessible.**

Where there is concern that an AED in a public place may be at risk of theft or vandalism, protective security measures (i.e. locked cabinet that requires a PIN code or key) can create delays in accessing the device in the case of a cardiac arrest. Therefore, it is recommended that AEDs are not kept in locked cabinets. If a security measure is installed, it should be accompanied by a reliable process that minimises delay in accessing the device when required.

Most AEDs located in public places are kept in protective cabinets; the standard sign for an AED should be used to show where it is stored <http://resus.org.au/guidelines/aed-signs/>. Various types of cabinets are available offering different levels of security and weather-proofing. With many, the door is alarmed so that when the AED is removed an alarm and/or a strobe light is activated, but local circumstances will determine the need for these features.

In the workplace, it is vital that all employees know that there is an AED present, where it is located and its purpose. Installing the standard sign for an AED nearby will help. Equally important is that everyone knows exactly what they should do to raise the alarm in the event of accident or sudden illness. Organisations with AEDs should consider having a formal policy or emergency management plan to facilitate this.

AEDs should be located as close as possible to their most likely place of use. This will usually be determined by the layout of the building or venue and by the number of people at potential risk in each place. Security considerations may play an additional role. Within most established PAD locations and programs in Australia, it was decided to place AEDs no further than a two-minute brisk walk from the places that they were likely to be used, and this precedent could act as a practical guide. This may also indicate that more than one AED might be considered necessary for a site.

Many state ambulance services maintain an AED Registry that registers locations of AEDs in locations across the state. This process is not mandatory, however registering your AED is encouraged so that the ambulance service can link AEDs in the community to out of hospital cardiac arrest patients. The registry holds information about the specific location and availability of the AED, including the hours it can be accessed. This information can then be provided to a rescuer by the Triple Zero (000) call taker in the case of a cardiac arrest.

13. Maintenance

AEDs require little maintenance. If the AEDs pads have been used, they require immediate replacement. Expired batteries and AED pads and other consumable items (e.g. shears, towel and plastic gloves) should be replaced in line with their expiration dates (usually 3-5 years). In all cases the manufacturer's recommendations should be followed.

All currently available AEDs perform regular self-checks and if a problem is detected it will be indicated. In most cases they show this by a warning sign or light visible on the front of the machine, or by an audible alert much the same as a failing smoke detector battery. Those owning or maintaining an AED should have a process in place for it to be checked regularly and frequently (ideally daily) and for appropriate action to be taken when necessary. If this task is delegated to individuals, allowance must be made to ensure that the checks are not neglected during absence of staff on holidays or sick leave etc. Some manufacturers provide a replacement AED while one is removed for servicing, and the arrangements for this should be clarified and agreed during the process of buying the AED.

14. Event reporting and debriefing

When an AED is used, the electrocardiogram showing the heart rhythm and details of any shocks given are recorded on an electronic memory contained in the device. This information should be downloaded immediately after the event as the record can provide crucial information that may be needed to ensure that the patient receives the best treatment following the cardiac arrest. The downloading of this information may be done by the state ambulance service, or in conjunction with the AED manufacturer.

The process is usually straightforward with modern devices (merely connecting the AED to a computer), but details of how this is done should be clarified when purchasing an AED. Special software is usually provided by the manufacturer. The need to have this at a location should be decided at the outset, preferably in conjunction with the state ambulance service.

Debriefing for anyone involved in a resuscitation attempt, regardless of the outcome, is important. Arrangements for this should be made by those responsible for the medical supervision of the AED program. In most cases, the state ambulance service (who will already have been involved with the incident) will be able to advise.

References

- Ambulance Victoria. (2016). *Victorian Ambulance Cardiac Arrest Registry: Annual Report 2014-2015*. Ambulance Victoria, Department of Research & Evaluation, Melbourne.
- Australian and New Zealand Council on Resuscitation. (2015, November). *Guideline 10.5 - Legal and Ethical Issues related to Resuscitation*. Retrieved April 10, 2016, from Australian Resuscitation Council: <http://resus.org.au/guidelines/>
- Resuscitation Council (UK) and British Heart Foundation. (2013, December). *A Guide to AEDs*. (D. M. Colguhoun, Ed.) Retrieved April 10, 2016, from Resuscitation Council (UK): <https://www.resus.org.uk/publications/a-guide-to-aeds/> Scottish Government. Out of Hospital Cardiac Arrest, A Strategy for Scotland. 2015
- ANZCOR Guideline 7 Automated External Defibrillation in Basic Life Support - January 2016
- ANZCOR Guideline 8 Cardiopulmonary Resuscitation - January 2016
- ARC AED Signs – July 2008 - <https://resus.org.au/guidelines/aed-signs/>