Introduction

This document seeks to establish guidelines for locating AEDs at Massey University. It firstly details the role AEDs have in reviving a person who suffers from cardiac arrhythmia, and components of a community AED programme.

The balance of the document applies three models to determine the number of AEDs that should be applied within Massey University. Two of the models use people numbers as the starting determinant, while the third is based on time taken to reach an AED. The models are imprecise, but have a reasonable degree of congruency.

AEDs described

AEDs are highly accurate, user-friendly computerised devices with voice and audio prompts that guide users through the steps of operation. They can recognise an abnormal heart rhythm that can be treated with defibrillation, and initiate the shock, or will advise the user to initiate cardio pulmonary resuscitation (CPR) should no shockable rhythm be detected.

Not all arrhythmias can be treated by AEDs. Those who have developed the cardiac rhythm disturbance of ventricular fibrillation (VF) or pulseless ventricular tachycardia can be treated by delivery of an electric shock with a defibrillator. Both these arrhythmias do not provide sufficient blood flow required to sustain life to vital organs. The victim needs CPR to maintain blood flow to the heart and brain until a defibrillator is available, and often requires CPR in the first minutes after defibrillation until the heart is able to pump blood effectively (Aufderheide et al, 2006).

The New Zealand Resuscitation Council guidelines detail the chain of survival from a sudden cardiac arrest for adults, including:

- early recognition of cardiopulmonary arrest
- early activation of trained responders
- early cardiopulmonary resuscitation (CPR)
- early defibrillation when indicated
- early advanced life support

For each minute that passes between collapse and defibrillation, survival from witnessed sudden cardiac arrest (SCA) from ventricular fibrillation falls 7% to 10% if no CPR is provided. When bystander CPR is provided, the fall in survival is more gradual and averages 3% to 4% per minute from collapse to defibrillation. Small studies of lay rescuer AED programmes in public places have shown a 49% to 74% survival rate from witnessed VF SCA when immediate bystander CPR is provided, and defibrillation occurs within 3 to 5 minutes of collapse (Hazinski et al, 2005).
However, AEDs cost about $3000 to purchase, need maintenance, have a finite life, and need to be supported by trained users. This document seeks to identify criteria for location of AEDs so that immediate help is reasonably obtainable, without over purchasing AEDs.

**Essential elements of community AED programmes**

The American Heart Association identifies four essential elements for an AED programme as:

- A planned and practised response; typically overseen by a health care provider.
- Training of anticipated rescuers in CPR and use of the AED
- Linkage with the local Emergency Management Services system
- Process of continuous quality improvement, including a plan for on-site AED maintenance and readiness-for-use checks.

Daily checks for each AED would need to be completed and recorded by a person responsible. It would be necessary for the AEDs to be stored in secure cabinets, preferably with an alarm linked to the University’s security system so that when the AED is removed and a follow-up call is not made to Security advising of the need for back-up assistance and ambulance direction, the Security van is deployed immediately to determine why the AED has been removed from the cabinet.

**Models for location of AEDs at Massey**

1. **Where there are more than 250 adults over 50 years age for more than 16 hours/day (AHA guidelines)**

In the Public Access Defibrillation randomised trial in North America (2000), sites with a history of at least one out-of-hospital sudden cardiac death every two years, or where at least one out-of-hospital sudden cardiac death is predicted (sites having >250 adults over 50 years of age present for >16 hours a day) were provided with an AED lay rescuer programme (AHA Guidelines, 2005). As the University operates in the main to 8 hours per day, sites with over 500 adults over 50 are assumed to be eligible.

<table>
<thead>
<tr>
<th>Region</th>
<th>Permanent staff</th>
<th>Fixed term staff</th>
<th>Internal students</th>
<th>Extramural staff</th>
<th>Possible max</th>
<th>AEDs required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>204</td>
<td>557</td>
<td>288</td>
<td>1</td>
<td>1049</td>
<td>2</td>
</tr>
<tr>
<td>Palmerston North</td>
<td>847</td>
<td>2227</td>
<td>395</td>
<td>2036</td>
<td>5110</td>
<td>10</td>
</tr>
<tr>
<td>Wellington</td>
<td>193</td>
<td>499</td>
<td>110</td>
<td>47</td>
<td>802</td>
<td>2</td>
</tr>
</tbody>
</table>

On this basis some 14 AEDs would be recommended within the University, located as detailed in the above table.
2. Exposure hours

The formula used to determine higher risk locations in the PAD trial described by Wagner and Lawrence has been given as follows:

1. Take the number of individuals at a particular location
2. Multiply this number by the percentage of individuals aged 50 and over
3. Multiply this number by the average number of hours spent at the location each day
4. Multiply this number by:
   a. 350 if the location is residential (or a commercial site operating 7 days a week)
   b. 250 if the location is non-residential (or a business site operating 5 days a week)

This number equals the number of exposure hours. If the number exceeds 500,000 there is a statistical probability of one sudden cardiac arrest every five years at that site.

<table>
<thead>
<tr>
<th>Region</th>
<th>Possible max number individual &gt; 50</th>
<th>Assume 8 hrs/day</th>
<th>Times 250</th>
<th>AEDs required if used once every 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>1050</td>
<td>9202</td>
<td>2300k</td>
<td>5</td>
</tr>
<tr>
<td>Palmerston North</td>
<td>5110</td>
<td>40.8k</td>
<td>10220k</td>
<td>20</td>
</tr>
<tr>
<td>Wellington</td>
<td>800</td>
<td>6400</td>
<td>1600k</td>
<td>3</td>
</tr>
</tbody>
</table>

The exposure hours basis would suggest a total of 28 AEDs within the University.

3. USA, Federal Occupational Health guidelines

Federal Occupational Health guidelines for Public Access Defibrillation (2001) suggest all considerations for determining the appropriate number, placement, and access system for AEDs be based on an optimal response time of three minutes or less, and assessment of the level of risk in a facility’s environment. Response time should be calculated based upon how long it will take for a lay rescuer with an AED walking at a rapid pace to reach a victim.

The table below attempts to estimate the walking time across each campus. A limitation is the time taken to move between floors within a building. People are clustered in groups so locations would need to be strategic rather than averaged by the table formulas.

| Dimensions of campus sites in walking minutes (does not include within building travel) |
|---------------------------------|---------------------------------|----------------|----------------|
| Region                          | Campus                          | Size (mins)    | AEDs required to be within 3 mins |
| Auckland                        | East precinct                   | 5*5            | 1              |
|                                 | Otehe Rohe                      | 9*5            | 2              |
|                                 | SHORE                           | 3*3            | <1             |
|                                 | Albany precinct                 | 2*2            | <1             |
Based on estimate walking distances 25 AEDs would be required. This calculation takes no account of AEDs that may be held by neighbouring activities on campuses located in inner cities, or time to ascend or descend multi level buildings.

**Summary**

Despite the crude basis for each model, there is reasonable congruence using either population numbers and time to reach an AED.

The models also suggest account needs to be taken of historical mortality due to cardiac arrest. In the last three years, no deaths attributed to a cardiac event have been notified as occurring on Auckland, Palmerston North, or Wellington campuses. There have been instances of morbidity. Given this history a lower number of AEDs may be appropriate.

An integrated model would be to locate AEDs within 3 minutes of substantive at-risk population concentrations. Substantive at-risk concentrations would be areas where, say, people over 50 years of age (staff and students) gather, or elevated cardiovascular activity occurs.

It is recommended each region develop a business case to locate AEDs based on these guidelines.

**References**


