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**AEDs on Australian worksites:
A low cost proposal to save lives**

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Background

This paper has been produced in association with *The Electrical Trades Union NSW Branch* to investigate the need for defibrillators on live electric worksites.

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Authors

This paper has been written by the Mckell Institute Executive Director, Peter Bentley, and Mckell Institute Research Fellow, Sam Stewart.

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EVERY MINUTE COUNTS

A growing number of health organisations have been pushing for an expansion of Automated External Defibrillators (AEDs) across Australia. The rationale for this expansion is compelling. Currently in NSW, the median response time for an ambulance is 10.93 minutes,¹ but for individuals undergoing ventricular fibrillation, the odds of survival decrease by a worrying 10% for every minute that the individual's heart fails to be defibrillated.² For individuals suffering Sudden Cardiac Arrest (SCA) outside of a hospital setting, the overall survival rate is a concerning 6%.³ This is particularly concerning given that 75% of all cardiac arrests occur outside of a hospital setting.⁴

When sudden cardiac arrest occurs, most victims have an abnormal heart rhythm called ventricular fibrillation (VF). When the heart is in this state, it cannot beat in a coordinated fashion and blood does not circulate to the heart and the brain. First the pulse stops, then the breathing stops, then the victim loses consciousness, collapses and appears lifeless.

Ventricular fibrillation is a treatable irregular rhythm. In this state, electrical energy is present in the heart but it is chaotic. Another arrhythmia that can lead to SCA is ventricular tachycardia. This is a fast, regular beating of the ventricles that could last for only a few seconds or for much longer.

In people who have either of these arrhythmias, an electric shock from an AED can restore the heart's normal rhythm. Performing cardiopulmonary resuscitation (CPR) on someone having SCA can also improve his or her chance of survival. If the heart can be shocked quickly with a defibrillator, a normal heart rhythm may be restored. If this shock is delivered within minutes after collapse, many victims can and do survive.

Defibrillation Statistics:

Defibrillation's chances of restoring a pulse decrease rapidly with time



Source: Australian Defibrillators

GROWING SUPPORT

The unfortunate reality facing individuals suffering from ventricular fibrillation is that their chance of survival is heavily dependent on their proximity to an AED. That is why the Heart Foundation and the Australian Resuscitation Council believe that greater public proliferation of AEDs in places like shopping centres, schools and train stations is critical to facilitating prompt access to defibrillation during emergencies.⁵ It is also why Sports Medicine Australia has been advocating a wider rollout of AEDs within Australian sporting clubs,⁶ and why St John Ambulance has been offering discount defibrillators and free training to a range of community organisations.⁷

Governments too are increasingly acknowledging the need for a wider proliferation of AEDs throughout Australia. Though not a formal requirement, Comcare recently noted that access to AEDs within the workplace constitutes evidence of good practice in line with the Australian Resuscitation Council's guidelines.⁸ At the state level, the South Australian Coroner recently called on employers to better train staff in the use of defibrillators as a possible means of resuscitation following what may have been a preventable workplace death in Adelaide.⁹

In 2009-10, the NSW Government installed 104 fully monitored AEDs in 45 CityRail stations, 14 CountryLink stations, all CountryLink trains, the Emergency Response Unit, seven maintenance depots and other selected corporate locations.¹⁰ Since that deployment, the fully monitored AEDs have saved a total of 14 lives. Over 2,000 staff have also been trained in basic life support.

Defibrillator grants "seven lives" to railway station father of three

A Sydney electronics technician and father of three survived a cardiac arrest at Redfern railway station thanks to a Cardiac Responder state-of-the-art automated external defibrillator. Doctors told the 52-year-old he had died seven times during his ordeal. But swift action by a RailCorp employee means the man will celebrate his 53rd birthday with family next month.

When Finland-born Harri Paananen used to fix defibrillators some 24 years ago, he could not have known that one day they would save his life. But that's exactly what happened after he started feeling 'a bit crook' at work just before 11 AM on 30th April. Harri asked a workmate to drive him to nearby Redfern station so he could take the rest of the day off and see a doctor.

"When we got to the station the pain got so severe I had to sit down," Harri told Cardiac Responder. "A cleaner saw me and said: 'You don't look well'. He took me to the station manager's office where I met Tom (Baghdadi). I asked Tom if I could sit down. But the pain got worse and I said I needed to lie down. That's when things started to cloud over."

In fact, Harri died there on the floor of the station manager's office. But swift action by RailCorp station manager Tom Baghdadi saved Harri's life. When Tom had asked Harri if he wanted an ambulance, Harri, who had never been in a hospital in his life, said no. Then Harri's condition deteriorated before Tom's eyes. So Tom rang an ambulance anyway. About 10 minutes later, Harri had a sudden cardiac arrest.

According to official reports, Harri, by this stage, had no pulse and was not breathing. That was at 11:05. Tom and transit police officer Paul Philipp grabbed an automated external defibrillator from a nearby room, opened it and placed its pads on Harri just one minute later. Paul commenced CPR, and the AED quickly assessed the situation. By 11:07 it had given Harri his first automated shock. Paramedics arrived three minutes later.

Harri remembers very little of the ordeal.

Cardiac Responder, Success Story, 30 April 2010

SUDDEN CARDIAC ARREST IN THE WORKPLACE

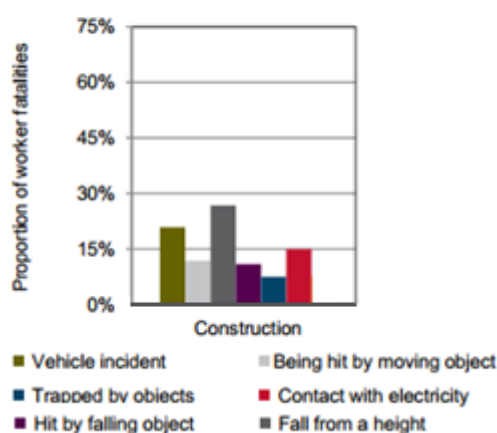
As governments, businesses and community organisations continue to roll out AEDs throughout public places of gathering, it should not be forgotten that ventricular fibrillation can easily occur in the workplace, particularly in those areas where workers are vulnerable to electric shock.

Between 1 July 2000 and 31 October 2011, there were 321 electrocution deaths reported to Australian coroners as identified and closed on the National Coroners Information System (NCIS) database.¹¹

In workplaces, Safe Work Australia recorded 117 compensated fatalities resulting from contact with electricity between the years of 2003-2011.¹² This figure only reflects the number of compensated fatalities however and not the total number of incidences in which electrocution and SCA was a possibility. In the 6 years between 2005-2011, Safe Work Australia recorded 730 'serious claims' for compensation resulting from electric shock.¹³ The category of 'serious claims' includes fatalities, a permanent incapacity or a temporary incapacity requiring an absence from employment of one working week or more.

In the construction sector, Safe Work Australia reports that some 15% of workplace deaths were caused by electrocution.¹⁴

Worker fatalities: Number by mechanism of incident
2003-04 to 2010-11 combined



Source: Safe Work Australia: Work related traumatic injury fatalities Australia 2010-11

However, whilst electrical shock is one way in which an individual can induce ventricular fibrillation, it is by no means the only context in which cardiac arrest can occur. SCA can be triggered by a range of factors though defibrillation remains a critical component in addressing all such occurrences regardless of their specific cause.

This paper also notes that cardiac arrest is already the leading cause of sudden death in Australia, ahead of prostate cancer, bowel cancer, breast cancer and road deaths.¹⁵ Whilst figures are not readily available for the incidence of SCA in the workplace, the total number of fatalities is likely to be significantly higher than is recorded for electrocutions alone.

SCA kills an estimated 23,000 to 33,000 people in Australia each year,¹⁶ and whilst precise figures are unavailable for how many of these occur on worksites, figures from the US Occupational Safety and Health Organisation show that around 4.5% of all cardiac arrests occur in the workplace.¹⁷

Were these numbers to hold true for Australia, this would imply close to 1500 cardiac arrests in Australian workplaces every year.

It is worth noting that SCA can strike just about anyone. Even a seemingly healthy person can suffer cardiac arrest without warning. According to the American Heart Association, as many as 50% of SCA victims have no prior indication of heart disease. For these individuals, cardiac arrest itself is the first symptom.¹⁸ The only definitive treatment for SCA is a defibrillation shock, an electrical pulse through the heart to restore a normal heart rhythm.

Given the significant number of individuals impacted by ventricular fibrillation and SCA each and every year, a strong case can be made that organisations whose employees face a higher than average risk of electric shock ought to provide access to AEDs in order to provide a safer environment for their workers.

Organisations that have already rolled out AEDs are now seeing the result. In 2008, St John Ambulance and the Department of Health and Ageing embarked on a trial in which 147 AEDs were installed across 98 different organisations. Throughout the trial period, these devices were used to contribute towards saving a total of seven lives.¹⁹

In another example, the Heart Foundation recently noted that the Melbourne Cricket Ground's first responder program has resulted in an 86% survival rate for cardiac arrest from first response to ambulance handover since defibrillators were installed.²⁰ This needs to be viewed in the context of a much lower 6% survival rate for individuals suffering SCA outside of a hospital setting.

Evidence shows that installing AEDs on worksites dramatically increases the protection available to the employees of those worksites. Members of the public would also benefit from a more widespread dispersal of AEDs within our community.



DEFIBRILLATORS FOR DISTRIBUTION AND TRANSMISSION WORKERS

For employees working on energy distribution and transmission networks, the case for AEDs is stronger still. Employees in these sectors are more likely to be working on or near exposed energised conductors or live conductive parts and as such face a higher risk of electric shock leading to ventricular fibrillation.

Overhead power line contact is one of the single largest causes of fatalities associated with mobile plant and equipment. Contact with live overhead power lines is a serious risk because any voltage that causes sufficient current to pass through the heart is potentially injurious or even fatal. Contact with live electricity can also cause serious burns arising from the discharge of electrical energy.

The risks associated with electrical hazards primarily arise from employees operating within close proximity to live conductors. It's worth noting that one doesn't need to have direct contact with a high voltage overhead power line to receive a fatal electric shock. For example, people often forget that electricity flows through the ground. In the event of a downed power line, simply being too close can kill.

Hazards associated with service lines aren't always immediately obvious. Risk can arise from deteriorated or broken down insulation, deterioration of earthing around exposed conductive parts that are required to be earthed, bare exposed live conductors, a voltage on the line that is higher than expected, or human error resulting in hand held tools or equipment coming into contact with exposed live parts.

Whilst safe working practices can reduce the risk of industrial incidents, they cannot completely remove that risk. For that reason, the case for a wider proliferation of AEDs amongst transmission and distribution companies remains strong.



Case study: How a defibrillator saved Matt's life

Last year while working on the NSW energy distribution network, Matt experienced an industrial accident that nearly resulted in his death. Matt recounted his experiences for this paper.

"Whilst working on the distribution network - live LV, I managed to create a 415v circuit between two phases. The path was created between my left thumb and my stomach - running through my heart. After being hooked up for what seemed an eternity, I passed out on the EWP - my heart had gone into Ventricular Fibrillation...."

...I was lucky that day to be working with a well trained crew who were able to slew the EWP away from the mains. They then provided compressions for 10 minutes until paramedics arrived with the AED. I was fortunate to respond to the treatment, and my heart was placed back into a normal rhythm...

...If it wasn't for the application of CPR techniques by colleagues, and the fast response time by paramedics, I would not have survived. If an AED was available on the truck, my heart could have potentially been placed into a normal rhythm in a reduced timeframe."

Matt was one of the lucky ones. The length of time between the initial accident and the final ambulance response was ten minutes. The survival rate at ten minutes is close to zero, and in Matt's case, the application of CPR was the key factor keeping him alive long enough to receive official help.

If the ambulance had arrived just one minute later, Matt would likely not be here to share his tale. More importantly, had Matt's workplace contained an AED, his colleagues could have stabilized his condition within minutes of the accident taking place.



HOW THEY WORK

Defibrillation consists of delivering a therapeutic dose of electrical energy to the affected heart through a device called a defibrillator. This depolarises a critical mass of the heart muscle, terminates the dysrhythmia, and allows normal sinus rhythm to be re-established.

AEDs are lightweight, battery-operated, portable devices that are easy to use. Rescuers attach adhesive electrode pads to the person's chest. Through these electrodes, the AED is designed to automatically analyse the electrical activity of the heart to determine if a "shockable" rhythm is present. AEDs are usually limited in their interventions to delivering high joule shocks for VF and pulseless VT rhythms and are most useful in scenarios in which a trained health professional is unavailable and unlikely to be available within the first few minutes of the emergency.

Each unit comes with instructions, and the device will even give you voice and visual prompts to let you know if and when you should send a shock to the heart. Many modern AEDs are able to operate fully automatically without any interaction required other than turning the machine on and placing the pads on the patient's chest. They are designed to be used by lay persons with no formal health training. AEDs are safe to use on children over the age of 1,²¹ as well as pregnant women and individuals with pacemakers.²²

An AED will not deliver a shock if the patient has a regular pulse. In the instance where an individual has a pacemaker, the AED will not deliver the shock if the pacemaker is functioning properly and appropriately regulating the heart. If the pacemaker is not properly regulating the heart, an AED can still be used to safely restore a regular heart rhythm to the patient.²³



PROVISION ALONE WILL NOT ENSURE THAT LIVES ARE SAVED

While there has been a recent proliferation of AEDs across Australia there has also been a lack of adequate instruction and safeguards. This means that there has likely been a number of otherwise preventable fatalities resulting from malfunctioning or poorly deployed devices.

A paper by a leading Occupational Health and Safety researcher, Dr. Don Dingsdag, highlighted the extent of this problem when it examined the international experience with defibrillators in countries that have already conducted a wider rollout of AEDs.²⁴

In 2000, President Bill Clinton mandated the roll out of defibrillators in all US Federal Government buildings. This set a new standard for workplace safety. Largely as a result of this rollout, public access to defibrillation is now a common consideration in the occupational health and safety standards of many American worksites.

However, the paper also noted that the proliferation of AEDs in America had led to some unexpected setbacks. A wide ranging examination of some 386,000 AEDs right across America found that just over one in five of those AEDs had become so defective through electrical, software and other problems that they could not effectively defibrillate a victim when required.

In Australia the situation is even worse. Not only do we not know how many defibrillators currently exist in Australia, we also have no idea how well maintained they are and whether they are even operating appropriately.

This is particularly concerning given a recent recall of faulty defibrillators by the US FDA during which Australian purchases had not been recalled despite being of identical make and model to the US devices.

The other issue of concern raised by Dr. Dingsdag surrounds the visibility of AEDs as well as the capacity for members of the public to access and use those defibrillators. In the Department of Health and Ageing trial discussed earlier in this paper, we heard how 147 defibrillators rolled out across 98 public and private organisations had contributed to saving 7 lives.

Whilst this certainly represents an improvement on what might have happened had there been no defibrillators at all, Dr. Dingsdag noted that the majority of lives saved during this trial were largely due to trained first aid responders rather than untrained staff or members of the public who may have been reluctant to use an AED.

Untrained staff or members of the public are significantly less likely to use AED technology if they are unaware of its availability or because the defibrillator itself is stored away in a locker or desk. Overwhelmingly, the cautionary note provided in Dr. Dingsdag's research is that it is simply not enough to just "roll-out" AEDs. The AEDs must be highly visible, well maintained, and most importantly, readily accessible by even the untrained staff or members of the public.

ARE THEY AFFORDABLE?

There are two options when considering a purchase of AEDs. One option is simply to buy the device as a stand-alone unit. For example, Medshop Australia sells the Phillips Laerdal Heartstart FRx for \$3750 online²⁵.

The other option is to procure a fully monitored program with self-checking AEDs. Given the issues identified with the broader roll-out of AEDs in America, there is a strong case for pursuing a fully monitored system which ensures that AEDs are appropriately maintained and functional for use.

Unlike stand-alone units, a monitored system is self-checking and comes with 24 hour monitoring, automatic maintenance and replacement of the AED as well as AED accessories. Initial training, annual training, regular drills and monitoring is all included in the cost of a monitored package, as are annualised capital costs, servicing costs, regular parts replacement and unscheduled replacements of the AED and its parts.

The Cardiac Arrest Survival Foundation recently commissioned a number of independent studies into the costs associated with an AED roll-out including both an independent cost benefit analysis prepared by PVE Actuarial Services Pty Limited which examined the operational costs associated with AEDs, and a quantified risk analysis conducted by Marcus Punch Pty. Ltd to determine the probabilities of failure for Cardiac Science defibrillators under both monitored and stand-alone deployment options.

The actuarial report concluded that a monitored system would cost an additional \$671 per year when compared with a stand-alone system. The costs associated with purchasing and maintaining a stand-alone system was estimated at an approximate \$5,334 per unit per year vs. \$6,005 for a fully monitored leased system.²⁶ However, whilst the monitored system was more expensive on immediately quantifiable costs, this difference in cost did not take into account any potential loss from death or any increased management risk placed on the organisation.

These factors were examined to some degree in the quantified risk analysis prepared by Marcus Punch Pty. Ltd. This analysis found that the probability of a top of the line monitored Cardiac Science defibrillator being in a failed state at the time of a deployment was as rare as 1-in-800.²⁷ However, when unmonitored Cardiac Science defibrillators were examined, the probability of being in a failed state at the time of deployment could be as high as 1-in-5 depending upon the degree of compliance to daily checking and inspection. This implies a risk of failure some 160 times higher for unmonitored devices than for monitored devices.

This is important given independent research that has estimated the potential financial loss due to a death resulting from a failure to use defibrillation to resuscitate a casualty as being in the order of \$500,000 to \$1,000,000.²⁸

This is significant. Given the costs associated with failed resuscitation as well as the significantly different probabilities of failure for monitored and unmonitored system, this implies an expected financial loss per demand for a monitored defibrillator of only \$600-\$1200 vs. a much higher loss of \$100,000 to \$200,000 for a stand-alone deployment.

For many organisations, the \$671 of extra cost per monitored unit per year is viewed as a sensible investment to mitigate the risk associated with device failure in a stand-alone AED should the device fail to be properly maintained. The cost is also considered acceptable given the reduction in liability and ongoing responsibility associated with the maintenance and checking of the AED units.

Given these findings, it is not surprising that many organisations opt for the fully monitored, self assessing program over the standalone models.

Qantas, Lang O'Rourke and RailCorp NSW have all opted for a monitored system largely because of the reduced requirements on their organisations as well as the reduced liability from workplace deaths and injury. As mentioned earlier in this paper, the roll-out of 104 fully monitored AEDs by RailCorp has already seen a total of 14 lives saved. Had these individuals been employees of the company and had the device been unmonitored and faulty, the cost and consequences could have been tragic.

It also needs to be remembered that organisations can face significant compensation costs in the event of workplace fatalities. Whilst many forms of SCA will not be attributable to an employee's workplace environment, this is less likely to be the case for instances in which an employee suffers from electric shock or electrocution.

In 2009/10, Safe Work Australia estimated that the median payout for 'serious claims' resulting from electric shocks was \$8700.²⁹ The median figure for 'serious claims' includes not just fatalities, but permanent incapacitation or temporary incapacitation requiring an absence from employment of one working week or more. The median cost of compensation for fatalities would undoubtedly be significantly higher than the median cost recorded in the broader 'serious claims' category, especially given the cost estimate of \$500,000-\$1,000,000 as calculated by Marcus Punch Pty. Ltd. As such, the cost to business of providing defibrillators is likely to be significantly lower than the compensation costs facing the company in the event of an otherwise preventable fatality.

A fully monitored defibrillator system leased for \$6000 inclusive of all costs per annum by a company which regularly deploys work teams of 10 or so employees, implies a per staff cost of \$600 per year or just \$1.64 per day, not including the costs to the company from any loss of life.

Given the 6% survival rate for individuals experiencing SCA outside of the hospital setting, this cost seems like a reasonable price to pay for any company serious about the health and safety of its workers. The costs are likely to be lower for those companies with larger or more populated workforces given the likelihood that any bulk purchase of AEDs would reduce the purchasing price of each individual unit.



THE AEDDR AND BEST PRACTICE GUIDELINES

Prompted by a lack of data surrounding the total number of AEDs within Australia or their respective conditions, the Automated External Defibrillator Deployment Registry (AEDDR) was established in 2012 as a non-legislative voluntary accreditation scheme.³⁰ The AEDDR is a non-legislative national policy body and voluntary accreditation scheme for the proper deployment of AEDs within Australian workplaces and public spaces.

As part of its function, the AEDDR established a working committee to develop new, national guidelines for the rollout of defibrillators in public places and worksites. The purpose of these guidelines was in large part to avoid the issues that had occurred in the American rollout.

The AEDDR 1410 guidelines development process included:

- an audit of AED deployment in workplaces and public spaces;
- consultation with industry stakeholders concerning technological issues, constraints and other factors that may impact on the adoption and certification of AEDs;
- establishing objectives based on extensive research and recommendations from relevant industry / regulatory bodies;
- consideration of relevant legislation and regulations;
- establishing benchmarks against which performance may be evaluated; and
- assessing the criteria against which current optimum workplace and public space conditions are measured.

The AEDDR 1410 guidelines represent a world's best standard for AED deployment and maintenance. The purpose of the AEDDR 1410 guidelines is to save lives. If a workplace chooses to provide defibrillator technology in line with these guidelines, it can then apply to receive an AEDDR 1410 Certificate of Conformance.

This Certificate confirms that any AEDs supplied to that workplace are firmly in line with the AEDDR standards on safety, reliability, effective capability and ease of use. The Certificate also confirms that associated training in the use of AEDs is of high-quality, effective, and delivered with sufficient regularity and efficiency so that users in workplaces and elsewhere are enabled to confidently save lives.

Given the depth of research, consultation and effort that has gone into establishing these guidelines, this paper strongly recommends that any organisation seeking to provide AEDs within their workplace do so in line with the AEDDR 1410 guidelines.

As the American experience proves, simply providing the defibrillator does not on its own ensure that it will actually be used. By complying with the AEDDR 1410 guidelines, Australia can avoid the situation where one in five defibrillators is faulty and where defibrillators go unused because they are neither visible nor accessible. Rolling out AEDs in compliance with the AEDDR 1410 guidelines will save lives.

IS TRAINING NECESSARY?

As has been stressed recently by the South Australian Coroner, the simple availability of an AED does not fully ensure that it will be used in an emergency situation. The Coroner's call for wider training was issued following the recent death of a South Australian on a workplace in which an AED was present but not used.³¹

Despite the simplicity of operation, individuals not trained in the use of AEDs are often hesitant to employ them despite their clear life saving capabilities. A recent Department of Health and Ageing trial found that very few untrained staff or members of the public actually use the devices even when the devices are present.³²

Evidence would suggest that the cost of training in AED use is remarkably low especially if a previously first aid-trained employee is to undertake the training. For example, St John Ambulance Victoria offer a full-day Advanced Resuscitation course for \$175 which can be conducted at a workplace upon request,³³ while the Australian Red Cross has a 3-4 hour Advanced Resuscitation course for \$125 per person.³⁴ Both courses teach attendees how to use AEDs, further heightening employee awareness of the simplicity of these devices.

Many companies already provide first aid training to employees as part of their routine operations. Ensuring that such programs contained a component on AED utilisation would be a relatively easy and affordable change for those companies. Such training programs would be particularly useful for companies whose employees are in regular contact with electrical infrastructure and wiring.

The AEDDR 1410 guidelines also provide advice to companies with regards to training of staff in the use of AEDs.

Finally, it should be noted that a fully-monitored system will always come with the initial and ongoing training included in the cost of that program. For example, Cardiac Responder provides \$2,170 worth of initial training, annual training, regular drills and daily monitoring at no additional cost to the organisation as part of its fully-monitored package.

CONCLUSION

Long ambulance response times have given individuals experiencing SCA outside a hospital setting an abysmal 6% chance of survival. In locations where AEDs currently exist, survival rates have reached a much more promising rate of 86%.

Based on the low cost of both the device and the training, a strong case can be made for increasing the availability and accessibility of AEDs throughout all Australian workplaces. There is a particular urgency for the roll out AEDs on worksites in which employees face potential exposure to live electricity such as in those organisations that operate within the energy transmission and distribution sectors.

The Heart Foundation, St John Ambulance, The Australian Resuscitation Council, Sports Medicine Australia, Comcare, the South Australian Coroner, the Cardiac Arrest Survival Foundation, and numerous unions have all called for a greater availability of AEDs across Australia, as well as enhanced training for staff in the use of defibrillator technology. Qantas, Lang O'Rourke and NSW RailCorp are already rolling out fully monitored systems and seeing the results in the number of lives saved.

The long term cost to business of providing portable defibrillator technology is negligible, particularly in light of the significantly higher compensation claims that arise from preventable fatalities in the workplace. This remains true even for workplaces employing smaller teams of workers.

Given that cardiac arrest is the leading cause of sudden death in Australia, the case for a wider proliferation of AEDs amongst Australia's working population is strong. If organisations do purchase AEDs for their workplace, it should be done in compliance with the AEDDR 1410 guidelines.

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