THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

Report by - PATRICK GLEESON – 2006 Churchill Fellow

To examine overseas private and government funded Public Access Defibrillation (PAD) projects and assess their suitability for the Australian environment.

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Signed: Patrick Gleeson Date: 5 October 2007
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INTRODUCTION

Every year across Australia more than 22,000 people suffer an Out of Hospital Cardiac Arrest (OHCA). Whatever the initiating event, many of the victims’ hearts will stop their normal rhythmic beating and instead quiver chaotically. With no effective blood supply, the victim quickly loses consciousness and within minutes suffers irreparable systems failure and subsequent death. The definitive treatment for those who have suffered this type of cardiac arrest is to be shocked by a defibrillator.

Until relatively recently defibrillators were large, expensive pieces of equipment that required specialised training and a degree of clinical judgement to be used safely and effectively. To maintain an OHCA victim’s viability until a defibrillator and trained personnel could be sourced, the technique of Cardio Pulmonary Resuscitation (CPR) was developed. This technique then became the cornerstone of the system approach known as the Chain-of-Survival. This model promotes rapid recognition of the person who has suffered a cardiac arrest, the early implementation of CPR, early defibrillation and then early advanced medical care.

Even if high quality CPR is applied to an OHCA victim immediately, their probability of survival decreases by approximately 10% for every minute that defibrillation is delayed. As emergency services take time to travel to victims, and as every passing minute results in additional mortality, new approaches to providing rapid defibrillation have been sought. Advances in defibrillator technology have resulted in machines that are now ‘smart’. These machines require little maintenance, when activated they provide step-by-step voice directions and they automatically analyse the victim’s heart rhythm to determine whether a shock is the appropriate treatment. These machines, which have only fully ‘come of age’ in the last several years1, are simple to use and less expensive than older models.

To decrease the critical time from collapse to shock, trials and programs are being run worldwide that place semi-Automatic External Defibrillators (frequently abbreviated AED) in ‘public’ locations. These Public Access Defibrillation (PAD) programs vary in their training and accreditation requirements.

In Australia the most widely accepted approach to Public Access Defibrillation is the Directed Training model. This model requires that all participants must learn CPR, and those that will utilise the defibrillator must undergo additional training to become accredited in the machines use. This is the most conservative and expensive PAD approach. Other approaches are more liberal in their participation requirements, with the ‘fire extinguisher’ model being at the opposite end of the scale to the Directed Training model. The fire extinguisher model, as the name implies, does not require any pre training. Under this model, AEDs are placed in strategic locations and are available for any member of the public to access when required.

PROBLEM STATEMENT

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1 For our purposes, this is defined as the first AED to be licensed in the United State for ‘over the counter’ sale without requiring a medical prescription.
There are problems with the Directed Training model. The model fails to take account of the advances in defibrillator technology. These advances have seen untrained 6th graders consistently operate modern defibrillators safely and efficiently.2 These same children would be unlikely to possess the physical strength, endurance or coordination required to perform CPR and would thus be excluded from the direct training model. Many of those not excluded from CPR training will prove to be incapable of effectively performing the technique only weeks after successfully completing the CPR course. As few as 10% of CPR trainees will be capable of effectively performing the technique 6 months after having demonstrated proficiency.3 In one study only 15% of respondents said they would definitely perform mouth-to-mouth on everyone that required it; even with relatives or friends only 74% of those asked said they would definitely provide ventilations.4 Australia’s emergency services take 8 to 10 minutes to respond to and OHCA.5 Even if you suffered a cardiac arrest near someone who is physically capable of CPR, is willing to perform it and can remember how to do the technique effectively, the most likely result is that they will extend your viability to just before the ambulance defibrillator arrives.

Programs that provide rapid defibrillation, with or without CPR, continue to have remarkable success. A Defibrillation program at the Melbourne Cricket Ground is continuing to achieve survival rates of 70%.6 Similar results are being achieved at Chicago’s O’Hare and Midway airports where AEDs have been placed in unlocked cabinets for complete public access. At these venues, most of the bystanders that have used the AEDs to save lives were untrained travellers.7 The concept of providing untrained bystanders access to AEDs was reaffirmed in Australia by the Eclipse PAD statement in Canberra in 2002.8 In Piacenza, Italy, 1285 volunteers were trained in AED use without the traditional accompanying CPR tuition. During 1999 to 2001 the study area’s resuscitation rate doubled and the survival rate was tripled. At the 6 monthly retaining courses only 16 of the original 1285 trainees (1.2%) failed their reaccreditation.9

By default Australia continues to use the Directed Training approach to Public Access Defibrillation. The requirement that every participant learn CPR and that many receive formal tuition in AED use is time consuming and, for many small businesses, prohibitively expensive. Currently to participate in PAD a small business

3 www.resus.org.uk/pages/faqAED.htm
5 Michael F O’Rourke, Surviving cardiac arrest, MJA 2002 177 (6): 284-285
would need to commit to many thousands of dollars expenditure and many hours of lost productivity. The benefits of Public Access Defibrillation are analogous to those of wearing seat belts in that wide scale adoption will improve survival rates even though a particular participant may never experience direct benefit. The low utilisation rate of individual PAD units will make it challenging to promote participation to return-on-investment focussed businesses. It is likely that once other disincentives are removed, the participation rate will become a function of the cost of participation. Lowering the cost of setting up and maintaining a PAD program is likely to be one of the most important factors in attracting and retaining Australian business participation. Given that AEDs will need to be purchased at the market rate, it is only the training and training related costs that are amenable to rationalisation. PAD models that require less training, and thus make it cheaper for individuals and business to participate, are successfully operating in other countries.

What lessons have been learnt by those running these programs that could maximise the number of lives saved in Australia through PAD projects? In some centres, such as New York, legislation has been used to mandate PAD participation by selected groups. Would this be a feasible approach to use in the Australian environment?

Australia has high quality medical and research professionals but a comparatively low number of cardiac arrests when compared to the United States and United Kingdom. There have been a number of Australian PAD studies, and there are a number of PAD programs operating in Australia. In the rapidly advancing and changing field of Public Access Defibrillation, it is difficult to know which studies, models or approaches would maximise the number of lives saved by Australia’s PAD efforts. There is a high opportunity cost if Australia is using a suboptimal PAD approach, in terms of lost lives, and this loss will continue while waiting for definitive overseas evidence to be generated. This Churchill project will review, from an Australian perspective, international sites that deal with large numbers of OHCA and the use of alternative approaches to dealing with OHCA.
EXECUTIVE SUMMARY

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Project Description
To examine overseas private and government funded Public Access Defibrillation (PAD) projects and assess their suitability for the Australian environment.

Overview
Out of Hospital Cardiac Arrests (OHCA) kill tens of thousands of Australians each year. Providing defibrillation in the first few minutes after a person collapses can be life saving. Traditional defibrillators were heavy, dangerous and difficult to use but modern defibrillators can be safely and effectively operated by untrained 6th graders. Public Access Defibrillation (PAD) programs reduce the critical time from collapse to defibrillation by putting defibrillators in public places and private homes. Ideally everyone would be trained to do CPR and use a defibrillator but this training is expensive and time consuming. The purpose of my fellowship was to examine
overseas PAD projects and assess their suitability for use in the Australian environment. The specific elements of other PAD programs examined included: the required level CPR and defibrillator training, legislative initiatives (looking from the ‘end user’ perspective), the use of alternative responders such as police, fire and civilians, current research initiative and possible future trends.

Highlights
A cross section of different PAD programs were reviewed. Seattle, Washington has one of the best survival rates from OHCA's in the world. Dr. Graham Nichol, the medical director of Seattle’s program, explained the elements that he thought were crucial to Seattle’s success. Professor Joseph Ornato is internationally recognised as one of the leading experts in the field of emergency cardiovascular resuscitation and is the medical director for Richmond’s pre-hospital care system in Virginia. Professor Ornato was generous with his time and support and provided an overview of the emergency care systems in operation in the USA. Professor Ornato, who was directly or indirectly involved with several of the major PAD projects in the USA, also provided a summary of the current research (including some yet to be published) and possible future directions for PAD. In the United Kingdom Claire O'Neil and Joanna Smith explained the lessons learnt from developing one of the largest community based defibrillation programs in the world. John Wright, a senior manager of the Northern Ireland Ambulance Service, spent a day explaining and demonstrating the problems they experienced with their PAD program. Dr Aschieri and Dr Piepoli explained the advantaged and pitfalls of their innovate and impressive Italian PAD project that does not require PAD participants to learn CPR.

Findings
1. To a much greater degree than seen in Australia, the reviewed overseas pre-hospital response systems pursue short response times to OHCA’s. This includes using alternative responders such as Police, Fire and civilian services. The overriding principle is to get a defibrillator and a trained person on scene in the shortest possible time.
2. In the rapidly evolving field of Public Access Defibrillation, legislation based on emotional lobbying doesn’t result in the best resource allocation and inhibits innovation.
3. There are differences of (expert) opinion about CPR training. There is mounting evidence that pre-shock CPR is physiologically advantageous for a person suffering OHCA. This finding must be tempered against an individual community’s willingness and ability to accept CPR training as this can influence whether CPR training provides the best return on investment.
4. In-home defibrillator uptake is growing. As prices decrease, uptake will increase but currently defibrillators are too expensive to be included as part of a standard first aid kit. Legislation should not hinder in-home defibrillator uptake.
5. The UK experience demonstrates that even with a huge injection of funds the numbers of lives saved in the short term by Public Access Defibrillation programs are modest.

The findings of this study will be disseminated by the following means:
1. Two articles are planned. The first will be targeted at a national ambulance specific publication and the second to a more general national care publication. Ambulance services have an opportunity to play a leading role
in encouraging and supporting PAD projects across Australia. Australian ambulance services are also ideally placed to undertake PAD research within Australia.

2. The findings of this study will be presented to senior clinical staff of Rural Ambulance Victoria (RAV). RAV has a history of actively encouraging paramedical research and supporting appropriate pre-hospital care trials. As a respected provider of ambulance services, RAV’s PAD initiatives resulting from this study are likely to influence other Australian pre-hospital care providers.

3. A conference presentation is currently being prepared.

**PROGRAMME**

**Pre Departure**

**Dr Jerry Potts, PhD**  
Director of Science  
American Heart Association  
Dr Potts provided introductions to key senior clinicians who otherwise may have been unavailable.

**Mr Mike Bell**  
Vice President  
Emergency Cardiovascular Care Programs
American Heart Association
Mr Bell sent publications and other information relevant to my project that assisted in preparation and understanding of the U.S. resuscitation approach

Ms Diane M. Canova
Executive Director
Sudden Cardiac Arrest Association
Ms Canova provided contact details for people who had been resuscitated by PAD programs who were willing to share their experiences.

USA:
Seattle – 1 week

Dr Graham Nichol
A Cardiologist, General Surgeon, and Internal Medicine Doctor in Seattle
Dr Jerry Potts describes Dr Nichols as the leader of the second generation of Seattle’s resuscitation pioneers

Mr Craig Peterson
Senior manager strategic relations
Philips medical systems

Ms Paula Lank
Interim VP, Regulatory Affairs
VP, Clinical Research and Clinical Affairs
Physio-Control, Medtronic

Mr Craig Edwards
Global Marketing – Senior product planner
Physio-Control, Medtronic

Ms Linda Del Monte
Clinical Marketing Manager
Physio-Control, Medtronic

Seattle – continued

Mr Cam Pollock
Vice President – Global Marketing
Physio-Control, Medtronic

Washington DC - 1 week  (Note: Due to weather related flight cancellations, only 2 working days were available in Washington DC)

Professor Joseph P Omato MD
Professor and Chairman
Department of Emergency Medicine
Dr Jerry Potts describes Professor Ornato as a pioneer in emergency cardiovascular care and the lead principle investigator on the national PAD Trial.

New York – 2 weeks

5 interviews with end user groups including public school (vice) Principals (n = 3) and Health Centre operators (n = 2) who are required by law to participate in Public Access Defibrillation. The results of these interviews have been de-identified and aggregated.

UK:

London – 1 week

Claire O’Neil
Emergency Life Support Project Manager
Heart Save Community Resuscitation Program Manager
British heart Foundation

Ms Joanna Smith
Community Defibrillation Officer for London
Paramedic London Ambulance Service

Onsite review of London Ambulance Communications Centre and Major Incident Control room and their operating procedures

Belfast – 1 week

Mr John Wright
Area Ambulance Service Manager
Northern Ireland Ambulance Service

Mr Andrew Watterson
Clinical Audit Officer
Northern Ireland Ambulance Service

Belfast continued

Dr David McManus
Medical Director
Northern Ireland Ambulance Service

Mr Shaun Graham
Paramedic - Rapid Response Unit
Northern Ireland Ambulance Service
Onsite review of Northern Ireland Ambulance Service communications centre and their operating procedures

**Italy:**

Piacenza – 2 weeks

**Dr D Aschieri**
Dr Aschieri is a cardiologist at Piacenza Hospital

**Dr Massimo Piepoli**
Dr Piepoli is a cardiologist, holds a PhD in Cardiology, is a Fellow of the American College of Cardiology, was an honorary senior lecturer at the cardiology depart of Imperial College of Science Technology and Medicine, London and is widely published in the leading medical journals.

**SCOPE**

It became clear during the early interviews that viewing PAD projects in isolation would overlook “tweaks” use by other pre-hospital resuscitation systems that could quickly and cheaply be introduced into Australia’s emergency response systems. Ultimately it is the outcome of any resuscitation approach that is the valuator of the effectiveness of the program. For this reason the scope of the interviews, and ultimately the project, was expanded to include those issues that adjunct and abut PAD efforts.
REPORT

A number of different reporting formats were considered. A summary of the major points made by the key interviewees has the advantage of being able to be used as source materials for other research projects. It is for this reasons that the major points made during the key interviews are reported. Some points have been de-identified. This was done either at the request of the participant or on the judgement of the researcher. These points are made at the conclusion of the interview summaries.

Seattle USA

Both Philips and Medtronic are major manufacturers of AEDs. Both have offices in Seattle and both agreed to interviews. A confidentially agreement was signed with Medtronic prior to undertaking a tour of their manufacturing facility.

Interview with Craig Peterson – Senior manager strategic relations Philips medical systems. These are taken from interview notes, the interview was not recorded. Interview Tuesday 3 July 2007 start time 1200 hours finish 1330 hours.

A majority of Philips AEDs units are distributed to homes through the internet site Amazon.com.

The greatest obstacle to in-home uptake is market forces that determine the current unit price. The price results from current technology and manufacturing limitation. Mr Peterson used the analogy of early mobile phones. Early mobile phones were very expensive but some people valued the utility for the given price enough to make the purchase.

Mr Peterson then responded to a question regarding alternative responders to OHCA and particularly of AEDs in police cars. He said Rochester now has the same survival rate as Seattle. It was found that the survival rate of a system was capped if only using ambulance emergency responders. In Seattle they have many times more police than ambulance or fire people and so they have put AEDs in every police car and trained the police officers to use them. The first person saved by an AED in Rochester was saved by a police officer. Mr Peterson made the point that the best service to respond to any cardiac arrest is the one that is closest. (related issues: Dr Nicol’s comments about Seattle’s Police AEDs and Piacenza’s use of police as primary responders)

Seattle ambulance paramedics are very well trained and use evidence based protocols. The paramedics understand the importance of good evidence gathering and are involved with the studies. This gives the paramedics a degree of ‘ownership’ of a project and a vested interest in doing good science. This is an important factor in Seattle’ pre-hospital system being able to generate reliable data.
Currently the average consumer is faced with the dilemma of whether to spend (US)$1500 on a flat screen TV that they will use every day or an AED that they will likely never use. The TV wins most times.

Mr Peterson emphasized that the relatively low number of AEDs sold results in their high price which consequently results in the lower quantity demanded. He sees a stimulus as being needed to increase the number of units sold to drive down price to increase the quantity sold.

There is likely to be a disparity in AED distribution in the early uptake as only the very wealthy are not put off by the current high cost of AEDs. This was the same with the early mobile phone uptake.

An inexpensive AED does not yet exist

Interview with:
Paula Lank – Vice President Clinical research and Clinical Affairs
Craig Edwards – Global Marketing – Senior Product Planner
Linda Del Monte RN BSN – Clinical Marketing Manager
Cam Pollock – Vice President – Global Marketing
These are taken from interview notes, the interview was not recorded. Interview Thursday 5 July 2007 start time 1300 hours finish 1515 hours.

PAD programs need a champion. The perception of those in the industry is that successful programs have a strong dynamic leader. *(Related issues: Piacenza’s experience when the project leader left for 12 months).*

The cost of each successful PAD resuscitation is estimated to be US$50,000, compared to US$30,000 for a kidney transplant.

Programs are normally the result of a reactive response rather than proactive thinking. It is possible to use statistics to rally support, educate and inform.

One reason for the reactive response is that it is expensive to participate and impersonal. With a kidney transplant you can see the person suffering because they need the treatment whereas with PAD you can’t see anything till it is too late.

Media efforts need to centre on personalising the benefits of PAD by putting a human face on the lives saved. This is done by showing the people that have been resuscitated getting back to a productive life. Some places run annual survivor benefits.

The perception of some is that those who suffer a cardiac arrest are very old ‘do not resuscitate’ types and so their cardiac arrest is just a ‘neo Darwinist’ mechanism that may be ‘for the best’. People of all ages suffer cardiac arrests, many are old and some are young.

Inaction on PAD is normally a combination of apathy and lack of knowledge. Expanding duty of care is now becoming an issue in the USA.
You need people that can rally the community to start and maintain PAD projects.

Training in schools is also increasing awareness of PAD and AEDs. Now ex-students know about PAD and the benefits it offers and thus community expectations are slowly starting to change.

Seattle paramedics are highly trained and there is not many of them. This increases the frequency of their skill use and reduces the problems associated with skills maintenance. This system requires a much greater use of alternative responses such as fire and police.

65% of people in Seattle know how to do CPR.

Interview with Dr Graham Nichol. These are taken from an audio recording that was transcribed into dot points. Interview Friday 6 July 2007 start time 14:15 hours, finish 14:45 hours.

There are issues with putting defibrillators in private homes. These issues include that patients arrest when their partner is not there or when they are away from their home and they don’t have their defibrillator, or that their partner gets flustered. Older studies about home defibrillators used older technology but were disappointing.

“You want something that is simple to implement and likely to produce a large improvement in outcomes. Bystander CPR is important, putting AEDs into public places or nominally, public buildings such as apartments, is sensible”. Dr Nichol is unconvinced that giving family members AEDs is ‘the way to go’.

There are simpler methods of training people in CPR which have great potential. One of these is the CPR Anytime kit by Laerdal. Dr Nichols was involved with initial setup of this kit and is continuing to study its effectiveness. Dr Nichols states that he has a vested (pecuniary) interest in these kits. With the DVD and manikin included in the kit, people can teach themselves the basics of CPR in 20 minutes at their home or workplace. This has been shown to be better than no training at all and is as good as traditional instructor lead training. Given that with the kit a person takes 20 minutes to learn CPR instead of the traditional 4 hours, people are more likely to participate.

Currently they are in the process of testing a version of the kit that teaches compression only CPR so as to get people over the barrier of not doing anything and in part because people don’t want to do ventilations.

In response to a question about where he saw the current ‘sweet spot’ for PAD, Dr Nichols replied that the biggest impact was in places where cardiac arrest where known to be likely to occur and where people were willing to use the AEDs. Dr Nichols stated that whenever he is in a public location and sees an AED he will ask
the person behind the nearest desk if they are trained to use the AED. He states that only about one third say they are trained to use the device.

It is important to train people in the use of an AED even thought the devices are simple to use. This is to get people ‘over the hump’ of remembering to get and apply the device and to understand that it’s a life saving device.

Rate of bystander CPR is 45% to 50% for all cardiac arrest in Seattle. This figure has been steady for some time and has been built up over the last 30 years. In the Seattle area 800,000 people have been trained in CPR.

The CPR Anytime kit is distributed outside the USA by Laerdal. They are considering partnering with an insurance company and going for mass CPR training. This has been done in Denmark where they trained 20,000 people in one day.

Dr Nichols states that the biggest barrier to people starting CPR is having to do something messy and the time it takes for learning the skill. He states he is bias.

When considering alternative PAD models Dr Nichols states that he has no doubt that lay defibrillation works if it is applied. He sees the challenges as being what happens when the AED is not immediately available, the cardiac arrest is not recognised and when someone does not remember to go and get the device.

“If you are going to implement a broad lay defibrillation program, integrating it with the emergency medical system is critical.”

“The challenge is that if I know CPR I can always do something whereas if I only learn defibrillation I can only do something when I have a defibrillator. A big problem is that if I am outside my local area I may not know where the defibrillator is located. Having spent a lot of my career working on PAD that is a somewhat heretical statement but I have come around to the view that simpler methods of CPR given to more people are more likely to work”.

Dr Nichols then talked about the CPR Anytime kit. It took 3 years to develop. He said it is based on the belief that simpler is better, in part because people can remember it, in part because ventilations interrupt compressions and in part because people don’t want to do ventilations. Currently a kit is under development that will teach compressions only. This kit should be released in 6 to 8 months.

Dr Nichols states that for the untrained rescuer calling for assistance, in his opinion, it is better to instruct them in compression only CPR because of the extra time it takes for the dispatcher to teach the rescuer how to apply ventilations. On this question there are many conflicting studies that are difficult to interpret.

In Seattle they have 78 paramedics that service 600,000 people (1:7,700 ratio). The paramedics must achieve 12 ETT placements per year. They have a very close relationship with the medical director and have a close quality assurance program. Their initial training program is 2000 hours which is at least 50% more that elsewhere.
The paramedics spend a longer time on-scene but he isn’t sure which components are more important to their success. As medical director Dr Nichols states that the paramedics knows what they are doing, are confident and are very good at what they do.

Police might go on medical calls but they rarely go to cardiac arrests. Dr Nichols though that the police may have used their AEDs on only 2 occasions in last 5 years. He states that Defibrillators being place on police cars was a strategic decision rather than a care decision.

Based on the dispatcher’s questions, if a person is ‘really sick’ they get a medic unit which is staffed by paramedics. If the call does not sound genuinely life threatening then an aid car is sent that is staffed by fire-fighters. These fire-fighters are trained as emergency medical technicians (EMT). EMTs can ask for a medic unit at any time or ‘code green’ the medic unit. If the patient is critically ill the medic unit will treat and transport the patient. If the patient is not critically ill the medic unit will treat the patient and hand the patient off to an AMR which is a private basic-life-support-only transport service. This frees up the medics to go back into service quickly. This is one reason they can operate with so few paramedics.

Richmond USA

Interview with Professor Joseph Ormato. These are taken from an audio recording that was transcribed into dot points. Interview Friday 13 July 2007 start time 13:00 hours, finish 13:45 hours.

Richmond city is approximately 100 miles South West of Washington DC. It has a population of 250,000 in the metropolitan area and 750,000 people total. The city covers 62 square miles.

The Richmond Ambulance Authority and Richmond Fire Service provide primary response to the Richmond city area. It uses a model that is unusual in the USA which is called the modified public utility model. They have a fire department that provides the primary response, with all fire fighters trained to EMT basic with defibrillation level. Richmond has had AEDs in all fire units since the 1990s.

Ambulances complete 55,000 runs per year. They admit 4,000 level 1 trauma cases per year and approximately one quarter of these are penetrating trauma. They receive 4 to 6 major gunshot wounds per day. Richmond is one of 3 sites used by the US military to train their paramedics. They open a chest every 2nd day.

The Ambulance tier is all advance life support paramedics. Most US cities tier their ambulances with Basic Life Support (BLS) and Advance Life Support (ALS). Thus Richmond is unusual in this respect. Of the top 200 cities in the US only about 20 use
all ALS ambulance. The high ratio of procedures to paramedics means that the paramedics are able to maintain their skills. In Professor Ornato's opinion, in centres with lower job rates, it is better to tier the ambulance service so that the fewer paramedics do enough procedures to maintain their skills.

Richmond has 80 ALS paramedics for the city. At any time they have 12 to 15 ALS ambulances on the street covering the 62 square miles. These ambulances do both emergency and non-emergency transports which is unusual in the USA. Richmond has a legal monopoly on the provision of ambulance services. This provides the revenue that allows them to provide the 'high performance' services.

Less than 10 US cities use the Seattle model of ambulance primary response with private ambulances then transporting. The more common model is that the fire department provides primary response and transport. Most cities have private ambulances that do the non-emergency transports.

The city of Richmond bystander cardiac arrest CPR rate prior to 2000 was 20%. In 2000 they switched their CPR pre-arrival instructions and omitted mouth-to-mouth. One of the reasons they did this was that they have very short ALS response times; 90% of cases in 8 minutes or less. The fire department gets on scene in 5 minutes or less. Prior to 2000, when still providing pre-arrival instructing to do mouth to mouth, only about 4% of people were getting to chest compressions because they refused to do ventilations or it took too long for them to follow the instructions. By the time they were commencing chest compressions, the fire department would arrive. "Now 50% to 51% of people are pumping on the chest when the fire department arrives". The omission of pre-arrival ventilation instructions has made a dramatic difference. A paper of these results was published in JAMA.

The Richmond system now considers the Autopulse\textsuperscript{10} as the standard of care. Prior to the Autopulse, Richmond's survival rate for OHCA was 2.7% (that's inclusive of all OHCA including witness, unwitnessed, VF and Asystole). This rate jumped to 9.7% with Autopulse use so the survival rate tripled with Autopulse use.

With the exception of witnessed arrests, Richmond used the Autopulse very early. The Autopulse was the first priority and was used for 2 or 3 min of CPR before defibrillation or even looking at the patient's cardiac rhythm.

Professor Ornato is co-chairing a US$50 million dollar USA & Canadian Resuscitation Outcomes Consortium (ROC). The consortium is funded for 5 years. It has been running for 2.5 years and has just starting the first trials. It is likely to take another year before results are seen but the data is being periodically monitored so that if one strategy is outstandingly better they can terminate the trial.

The first ROC trial is a complex factorial design trial to test whether CPR first, or shock first, is better. This trail is designed to definitively answer the question of whether everyone should be doing 2 minutes of CPR before shocking (if it is not a witnessed

\textsuperscript{10} A device that provides mechanical external chest compressions
arrest). ROC is comprised of 11 USA and Canadian cities or regions which generate between 12,000 and 18,000 cardiac arrests per year. ROC is designed to develop level one evidence.

Professor Ornato was the Chair of the PAD trial steering committee. He states that there is not definitive data on all aspects of PAD but that some factors are known. High risk public locations can be calculated using a mathematical formula (described in the first PAD methods paper) and consist of areas that have 500 or more people over 50 years of age for more than 16 hours per day, 7 days per week (or the equivalent). Thus an athletic venue that has 500,000 people for a couple of times a week would qualify. The post PAD trial experience for sites that meet the age and number of hours per week criteria look as though the strategy of PAD does offer improved survival and most that survive have decent neurological outcomes. It is more difficult to determine whether PAD is ‘value for money’. PAD is not as cost efficient as haemodialysis (US$25,000 per year). The domain for PAD was something like US$50,000 to US$100,000 per life saved. This is more than is normally considered a cost effective intervention.

In response to a question about alternative models Professor Ornato stated that a few years ago he would have warmly embraced the notion of a model with no CPR training and only AEDs. He also said that 10 years ago he would have strongly argued that it would have made perfect sense. He is less certain today because of the diminishing prevalence of VF as the initial presenting rhythm, which he states is running at approximately 20% to 25% in most US cities. He also states that there is a high likelihood that a brief period of CPR before defibrillation, for a patient that has been in cardiac arrest for more than 2 or 3 minutes, may be the best strategy. The validity of these beliefs will be addressed by the ROC trials. In response to further questioning Professor Ornato stated that immediate defibrillation may not be optimal under all circumstances but it is far better than nothing. He thought that it is not optimal to have a rescuer that cannot do a brief period of quality CPR first. There is no question that witnessed arrests should be defibrillated immediately, as occurs with the airport and casino models. If someone arrest in a public place and a defibrillator is within 3 minutes then Dr Ornato did not consider CPR “all that important”. This is not the case if the rescuer has to respond to a cardiac arrest because it is unlikely that they will arrive within 3 minutes. Under these conditions it is not optimal to rely on defibrillation alone.

Professor Ornato said that they had considered local lay persons equipped with an AED responding in their own cars or bicycles to cardiac arrests. They dismissed this approach quickly for 2 reasons. The first was concerned about liability issues if someone was injured. The second was a related issue of having lay people responding in close proximity to police, fire and EMS vehicles all heading to the same address. The possibility of killing or injuring these volunteers was considered to outweigh the benefits. In Indianapolis there is a trial of community groups responding with AEDs to isolated communities.
Professor Ornato did recount that in New York City they did PAD assessments with local responders. In New York City they have a very large series of apartments called Co-op City. They are blocks of apartments that go on for mile after mile and all look the same, especially at night. In some cases a single building was enough to be a pad site. They randomised these blocks against each other. In the active randomised group, one individual (not always the same person, they might have a roster) was given a pager and an AED. If an arrest call was received the individual in that block would be paged and sent to the particular apartment. There was no benefits shown with this model. These sites only accounted for 3% or 4% of all of the included PAD sites but they failed to show benefit.

Given that in most cities 80% of cardiac arrests occur in the home and only 20% occur in a public places and only half of those are witnessed, then the total numbers of people that will benefit from PAD are small. In an article published in the New England Journal of Medicine Professor Ornato wrote the end section estimating the number of lives that would be saved in the USA per year by PAD. Out of the third of a million that die from OHCA each year, their estimates were that only about 3,000 more lives would be saved by PAD programs even when they were fully implemented. This is because a majority of arrests occur in the home. The conclusion reached was that PAD is not going to solve the problem of OHCA. PAD does provide a niche for particular locations that have high volumes of OHCA but it is not the main stream way of making a major impact on the burden of OHCA.

Early ROC results (that have yet to be published) show that for the high risk PAD sites, they are seeing benefits in the same order of magnitude as was seen in the PAD trail. This results in about one additional life saved per day for the USA and Canada by the limited PAD applications that have already taken place. Of these results Professor Ornato commented: “That’s not 300,000 lives saved per year, but it is something. So is the glass half full or half empty?”

**New York USA**

New York was one of the US cities that enacted legislation requiring schools to have an AED available and all fitness centres and gymnasiums (unless specifically exempted) to have an AED and trained staff available. The acceptance and impact of legislation to enforce PAD participation on the end users was the main focus of these interviews.

None of the participants were keen to be recorded or have their institution or business identified. The following are aggregated points taken from notes.

**Schools**

A New York State law was passed in 2002 that requires public schools and charter schools to have an AED and at least one staff member trained to use it. This legislation resulted from the 'fervent' lobbying by the mother of a 15 year old boy who died as a result of a cardiac arrest he suffered while playing basketball.
All schools approached were within 15 miles of New York City (Manhattan)

- The legislation was in the form of an “unfunded mandate” meaning that the schools had to fund the purchase and associated training to meet the legislative requirements.
- The federal government has provided part of the funding through the “Safe Schools Healthy Students” program and other grants have been secured but meeting the legislative requirements is “difficult” (also used “burden”).
- One senior school officer drew an analogy between those that wanted defibrillators in schools and those that want religion in schools. He said the defibrillator proponents based their arguments on emotion and not a needs analysis.
- Fulfilling the requirements results in cuts in other areas. VP suggested that it may not be the optimal use of funding. He has discussed the issue at state level and suspects the legislation was prompted by emotion rather than a clearly identified need.
- The cost of maintaining the AED program is approximately US$3,000 per year. Initial setup costs were high but were offset by grants.
- The training isn’t a major problem. The school already runs regular CPR sessions and so the AED training was incorporated into these refresher programs.
- Without legislation schools are unsure if purchasing an AED would open them to liability if it is used incorrectly or training isn’t right (this is despite the established ‘Good Samaritan’ Law). Legislation means that you don’t have to worry about liability for having the machine.
- Locating the AEDs is an issue. The Administration block is always staffed during office hours but is a long way from the sports facilities. This school has long distances between the cafeteria, gymnasium and classrooms.
- One of the schools has 8 AED units and has 30 trained staff members. The units are stored in locked cabinets and those that are trained have a key that opens all of the cabinets.
- All schools had written protocols and policies for the use of the AED(s). All had input from local EMS service or medical direction.
- There is an established reporting format for incidents where the AED is deployed.
- Two of the schools had not had a deployment of an AED. One school had two deployments, in both instances the patient had not suffered a cardiac arrest and no shock was delivered.

**Fitness Centre**

Health clubs with 500 or more members must have an AED and at least one person who can operate the device in attendance during business hours.
All Health Clubs approached were located in New York City.

- All of the centres visited had the AED prominently displayed (even those that chose not to be interviewed).
- Surprisingly the legislation doesn’t require staff to start resuscitation if they see someone collapse, it only requires that the equipment and training be available.
- Machine purchase is “just another cost” that has to be covered.
- Both centres stated that they would have participated even without the legislation.
- One said that by making it a requirement it removed the ‘prestige’ of having the machine. “Now it’s nothing special!”
- Neither thought that having the machine encouraged more people to visit the establishment
- There has been no deployment of an AED at either centre.

London UK

In 2004 the British Heart Foundation (BHF) was awarded a total of £21 million by the Big Lottery Fund to fund heart related projects. £6 million of this money was used to set up a program in England for defibrillators in the community known as the National Defibrillator Program. This funding supported the purchase and maintenance of 2,300 AEDs and the funding of Community Defibrillation Officer positions that would assist in training and coordination. The National Defibrillator Program now represents the largest community based defibrillation program in the world.

Interview with:

Claire O’Neil - Emergency Life Support Project Manager
Heart Save Community Resuscitation Program Manager
British heart Foundation

These are taken from an audio recording that was transcribed into dot points. Interview Tuesday 31 July 2007 start time 10:00 hours, finish 11:00 hours.

BHF is the 4th largest charity in the UK and funds cardiac projects, research and encourages prevention (through heart care) and heart save.

BHF has supplied AEDs in the past and built a resuscitation capacity in the community through Heartstart UK, teaching people resuscitation at no cost to the participants. After 20 years of this work in the community the Lottery funding spring boarded their efforts. The funding was “pump priming” as BHF already had the
related history, experience and infrastructure to execute the grant requirements. The funding was important because it allowed a system approach to PAD rather than just supplying the machinery and then forgetting it. It also funded the Defibrillation Officers which ensured a single point of contact for related matters and a coordinated and maintained effort.

The ambulance services did apply for some of the funding and so the Defibrillation Officers are imbedded in the ambulance service. The period of the grant ended after 3 years in September 2007.

There are now over 7,000 AEDs nationally, including the lottery funded units, that have gone into place over the last 20 years.

It was considered that every AED would need a compliment of training.

BHF did a survey and found that only 1 in 10 households had someone that knew CPR. Most of those learned CPR as a result of work place requirements and training.

The high risk areas that received the AEDs were identified by the local ambulance service. Community groups could also apply for an AED.

As a result of the rollout more people and organizations are becoming aware of PAD. Shopping centre managers are seeing that their competition have a unit prominently displayed and are making enquiries as to how they can participate. BHF encourages people to talk to their local ambulance service about their PAD programs so the ambulance service is aware of the programs that are operating.

One of the advantages of having a partnership with the ambulance service is they have an established audit path which was used to track the success of the program.

BHF considers that the program was successful. Ms O’Neil considers that partnering with the ambulance service was the key to developing an integrated community resuscitation program rather than just giving out machines that may have soon been forgotten. This also improved governance and established independent fundraising so the program is now self sustaining.

The program was seen to have given the ambulance service a good public relations boost for the 3 years the program was operating.

There are to date 20 survivors from the program. (note: approximately A$750,000 per life saved). There have been over 220 from BHF’s own funded programs.

The development of the infrastructure has allowed the program to continue even after the grant money has finished. BHF is now concentrating on prevention of cardiac problems.

BHF has consistently used ‘success stories’ from their PAD programs to lobby other groups and organisations to participate. This includes leisure centres and shopping centres. BHF has discussed pursuing legislation but it is a low priority and is outside of the organisational objectives.
After the Lotto funded program there is now someone in the ambulance that people can ring to find out about PAD. In the past there wasn’t anyone, or it was a part time role.

The community defibrillation officer role is a full time position and this is genuinely required considering the training that is required. Some places now have thousands of responders.

The ambulance service has cut response times in rural areas because of the program. The community responders have contributed between 2% and 10% of meeting the statutory requirement of ambulances having to respond to a category A calls within 8 minutes. Demand is rising 6% to 7% as the population is getting older. In rural areas they will respond the trained layperson who has a defibrillator. These trained laypersons may have a vehicle. The layperson units are normally self funding but because they are now contributing to the response time requirement some Trusts are giving them funding. (See the notes from John Wright’s interview for a description of this mechanism).

All of the original 31 community officers are still operating.

The Department of Health ran a ‘Defibrillators in Public Places’ program in 1999. This program put out 800 AEDs in airports and railway stations.

Studies by BHF say that each life saved by pad cost about £20,000. It is anticipated that as the price of AEDs drop, the cost per life saved will also drop.

Interview with:

Jo Smith  - London Ambulance Service (LAS) Paramedic
         - London area Community Defibrillation Officer

These notes are taken from an audio recording that was transcribed into dot points. Interview Thursday 2 August 2007 start time 12:00 hours, finish 13:15 hours.

To clarify some of the points made by Ms O’Neil regarding the London Ambulance Service structure and function, questions were asked regarding the LAS operational arrangements.

Under the dispatch system Category A calls are those that are considered potentially life threatening, such as patients suffering difficulty in breathing or chest pains.

LAS was 32 regions but has now been reduced to 12 regions. All 12 regions follow the same JRCLC (Joint Royal College Liaison Committee) guidelines so everyone in the UK should be doing the same thing but there may be some local variations. An example of this is that all other areas administer pre hospital thrombolytics for ST elevation MI but since April 1 last year all London ambulances now take patients 24/7 to a catheter lab for primary angioplasty and so don’t use thrombolytic treatment. In the last few years they have taken over 1,000 patients straight to
angioplasty. Other UK ambulance services may or may not be participating in this initiative.

In answer to a question about the different levels of ambulance response Ms Smith answered that the aim is to have a paramedic and an EMT on all urgent calls but sometimes only two EMTs can be sourced. EMTs deliver only basic drugs. Rapid response units are manned by an EMT or paramedic and are targeted to Category A calls. Emergency Care Practitioners (ECP) are now really doing out-of-hours GP work. ECP are given more assessment training, more drugs and are able to refer directly to specialist centres. This reduces emergency department congestion and eliminates the patient having to wait in the emergency department. ECPs may arrange a district nurse visit, or may direct the patient to a particular ward in the hospital. ECP can take blood and urine samples at home which also reduces emergency admissions. The ECPs go out on mainly ‘green’ calls where they can treat them at home or refer them to somewhere other than the accident and emergency department.

EMTs do a 15 weeks course and are on probation for a year. After 2 years they can apply to be a paramedic which requires a further 6 week residential course and then 4 weeks in theatre. Paramedics do not practice RSI. The Helicopter medical practitioner does perform RSI.

Emergency ambulances go to green and red calls. If a call sounds like a non-ambulance case then the Clinical Telephone Advice (CTA) system is used. If an ambulance crew attends a call and it turns out not to require transport then the crew can leave the patient at home with paperwork and advice, can refer the patient to a GP or can call out an ECP to see the patient.

Questions were then directed towards the PAD project.

Community Defibrillation Officer (CDO) positions were funded, one for each of the 32 Trusts and the purchase of 2,300 AEDs.

In the UK PAD programs are meant to have medical direction but it is not a legal requirement and so there will be some not under medical direction. The Ambulance communications centre knows where every AED in London is located and have a contact number for all of these sites so that if a call comes from a member of public who is unaware of the AED at their location, the communications officer will direct them to the AED. If it is not a flagged site the communications officer would not routinely tell the person to activate an AED if one was available.

LAS is only relatively new to PAD and didn’t have anything to do with it before the national lottery funding came in.

Greater London Authority said that UK wide 27% of people know CPR. In London this figure is given as 21% but Ms Smith states she thinks it might be lower given the high rate of people coming in from the EU.

In London 67% of OHCA are having CPR performed on arrival of the ambulance and this has been consistent for the last few years. The LAS has an information department that maintains these sorts of figures.
BHF are trying to map where all AEDs are in UK.

The Lotto fund provided London with 119 AEDs but the program also took over the 298 AEDs that were from “Defibrillators in Public Places” program that was run by the Department of Health in 2000. These additional AEDs were mainly located in busy transport hubs like Heathrow airport and train stations.

Some fire services in the UK do respond to OHCA but London fire services do not. All London fire services now have AEDs but will not respond on the ambulance service’s behalf. They only have the units so that if they go to a fire call and someone has an OHCA, they can provide treatment. The City of London police have been given 8 AEDs (included in the 119 total) and they now respond within the city to any Category A calls. LAS has trained about 60 police officers to use the AEDs and will have trained about 100 by the end of the year. They are also exploring the possibility of them carrying oxygen.

Under the government requirements, the response time is considered to be from the time of call to when someone walks in the patient’s door with an AED. “This response time is considered paramount in our system”. The responder does not have to be ambulance or even an emergency services worker, just someone that knows how to use an AED.

London Authority has just purchased 70 AEDs for their custody suites. LAS provide the medical direction but the Authority provides its own training.

In-home AEDs have not been considered part of the program. They have placed AEDs in some schools with children identified as ‘at risk’ with complaints like ‘long QT’ syndrome and hypertrophic cardiomyopathy. The teachers were trained as part of the scheme.

The UK is participating in the Dispatcher Assisted Resuscitation Trial (DART) and so all callers are directed to do CPR with or without ventilations depending on the double blind card direction.

In London in 1999 the OHCA survival rate was approximately 4%, this is now up to 10.9% and they are hoping that the next audit, which will include patients treated with the new CPR guideline of 30 compressions to 2 ventilations and one shock will improve the survival rate. Ms Smith states that in the last 2 years they have had 25 survivors that have walked out of hospital. Ms Smith states this is a survival rate of approximately 40% but that it is “not a huge number of people”.

A tour was then undertaken of the LAS communications centre and the major incident control room.

An example of two major differences noted between this centre and those seen in Australia are:

1. The communications room (major incident room) was equipped with 2 large flat screen TV units. It was found in the early stages of major incidents that television networks were providing vision of the event before the first on-scene
ambulance crews could provide the communications centre with a detailed description of the event (because they were busy assessing and treating patients and hadn’t fully comprehended the event’s scale). The televisions in the communications centre allowed the communication staff to glean information about the event that could be used to anticipate resourcing requirements and gave the communications staff an early overview of the event. This was believed to have improved the handling of major incidents.

2. The AMPDS ambulance call taking software requires that the caller first be asked the callers location so that if the call is inadvertently terminated, an ambulance can be sent to the address. Anecdotal evidence from a number of communications staff suggested that distressed people firstly wanted to convey what was wrong at the scene before they wanted to give an address. This was seen as a natural reaction by people under stress that they wanted to convey the ‘urgency’ of the situation. An in-house trial was conducted and it was found that by asking the caller what the problem was, before asking them the address of the incident, saved an average of 20 seconds per call. Under the AMPDS system an ambulance is dispatch even before the call is complete and so the average 20 second time saving may not directly impact on response time, however in a busy communications centre, the saving of this time increases the number of calls that can be handled by the available communications staff.

Northern Ireland Ambulance Service (NIAS)

In the 1970’s the Northern Ireland Ambulance Service was one of the first to trial the concept of Mobile Intensive Care ambulances under the direction of cardiologist Dr Frank Partridge. It was against this background of innovation and ground breaking trails that the author became aware of a trial being run by Professor Frank Kee in Northern Ireland. The purpose was reported as “… to study the effects of large numbers of publicly accessible Defibrillators with people trained in their use, on the outcome from out-of-hospital cardiac arrest. These volunteers attend calls for suspected cardiac arrest or chest pain only. The study is not designed to specifically address the impact of basic life support (BLS) though some volunteers have been trained in CPR.”

Professor Kee was in Portugal during my visit to Northern Ireland but I did correspond with Dr Andrew Hamilton who is a cardiology research registrar and was the project manager for the trial.

Dr Hamilton reported that as part of the trail they had trained 800 lay volunteers including 200 police officers to use AEDs. They then supplied individuals with an AED and a pager for a week at a time. The pager was linked to the ambulance service control room and when an arrest occurred the volunteer travelled to the scene and attached the AED to shock the patient as required. The program ran from January

2005 to April 2006. Dr Hamilton stated that they had detailed results and that they planned to publish these soon.

Given the relevance of the Northern Ireland trial, of supplying lay people with defibrillators without the traditional CPR training, it was decide to review the Northern Ireland Ambulance Service and its member’s experiences with the trail.

**John Wright - Area Ambulance Service Manager**

(witnessed)

In the morning John Wright, a senior ambulance manager, received an automatically generated pager message that provided him with a summary of the service’s response times for the previous day. This allows the manager to monitor his team’s response times and follow up any emerging problems. This was a powerful indicator of the importance the service and department place on ambulance response times and validates Jo Smiths comments of response times being considered of paramount importance in ambulance operations.

(from written notes)

The Northern Ireland Ambulance Service receives about 36,000 emergency calls per year.

NIAS experience is that fixed AED units are not used (note that this is the same experience as Piacenza)

The Northern Ireland Ambulance services 1.7 million people with 650,000 in Belfast. There is a 150,000 cluster to the north east of Belfast and 100,000 cluster to the North West. The rest “is populated by sheep”. They must reach 50% of category A (Cat A = Urgent) cases in 8 min and 95% in 18 minutes.

Belfast ambulance was once hailed as being ‘leading edge’ and ‘ground breaking’ but is now “conservative”. This is related to funding and medical direction.

(From recording)

The response standards for NIAS are that they have to make 50% of Category A calls in the Eastern areas in 8 minutes and 95% in 18 minutes. These requirements were computed on the basis of the population per hectare (population density). In the other 3 ambulance areas they have to make 50% in 8 minutes and 95% in 21 minutes. NIAS use to be measured on an average but the new response standards now require that they be measured on all calls service wide. It will no longer be averaged out with other NIAS areas.

NIAS tries to task the emergency fleet with only urgent calls so that they can meet their response time targets. Mr Wright reiterated again that **Response times are the key** and that even the matter of transport is a secondary issue that can come later. One report revealed that 30% of the people that are transported by ambulance in the UK didn’t need to go to hospital.
The NIAS also do ‘doctors urgents’ which are medical practitioner requests for ambulance transport. They do these transports because there is no other mechanism to deal with them. These calls come from medical people who decide that a patient has to go to hospital in a certain time frame, usually 1 to 2 or 2 to 4 hours. Thus the emergency fleet has to do the ‘doctors urgents’ calls as well as the 999 calls. The problem is that their performance is only measured on their response to 999 calls. Thus a call from a medical practitioner who is with a patient who is very sick and needs urgent transport will be overruled by a 999 call that is highly likely not to need an ambulance attendance.

With regard to other responding agencies, Police will include AEDS on all of their vehicles but they have only just started this effort. They already have them on their traffic branch fleet in Northern Ireland. Police cars in North and West Belfast have AEDs and participated in the trial which has finished but the police saw the value of the AEDs and have chosen to continue their involvement. The police have a 5 year strategy to place AEDs in all police cars. The hurdle is training. During the height of Northern Ireland’s troubles they had 14,000 policemen and now they have less but it is still a lot of people to train. They will start with the traffic branch because they are always out and about in fast cars.

They have a memorandum of understanding with the fire brigade and had a project planned. The fire station staff were keen to participate and had done some initial training but the fire brigade union in England took the fire brigade to court. The court ruled that the fire service could not make its staff participate in co-response.

A 19 year old Gaelic footballer suffered an OHCA and died. A trust was set up and has been providing dozens of AEDs but nothing else, no training, no first response and it doesn’t link to the ambulance service. “Now they have so many AEDs they don’t know what to do with them”. They have put them at all the Gaelic pitches (sports grounds), the service clubs and now they are putting them in the fire stations. Without ongoing maintenance the machines are likely to be forgotten and when required will not work.

In Northern Ireland AEDs were slow to appear. They appeared in the council golf clubs having been donated by Rotary or similar organisations. Mr Wright said that if you could find them now the batteries and pads would have been ‘finished’ 5 years ago. “They bought the units not understanding that that is only the first part in an important chain”. Nobody was responsible for the units. Mr Wright said sales people gave 15 minutes free tuition and then the unit was probably placed behind the bar which would have about 10 minutes from the 18th hole. Mr Wright doubted that NIAS ever received a call where someone deployed an AED before the ambulance arrival and he questions the value of fixed AED units.

The NIAS communications centre does not know the location of AEDs in Northern Ireland. Mr Wright said that BHF is working to provide a data base of where the units are located but he thinks this is of limited value. Mr Wright said: “The only thing that works is a formal agreement between the group that has the AED and the ambulance”. He said that every unit needs a pager and that pager has to be carried by someone that can and will respond. He stressed the need for an active response.
Mr Wright was on the steering group for the Northern Ireland Public Access Defibrillation (NIPAD) trial. Mr Wright said “Their project started off as a non CPR trial, it was research into the increased availability of AEDs impacting on death not on AEDs and CPR. Ethically it was difficult because we were giving an untrained person a pager and defibrillator and actively going to send them to a call. Highly trained ambulance professionals get nervous when attending a call on their own and we are sending untrained people with a defibrillator. What happens if they shock someone and get a rhythm back? What do they do then if the ambulance is 15 minutes behind them? We were anxious about this situation as were the nurses delivering the units to the volunteers and the volunteers themselves were asking for training. Eventually we did supply CPR training to those that asked. We still have grave doubts about supplying AEDs to those that haven’t been trained. “

Mr Wright said that you need a project champion to make PAD work and he gave examples of this.

Andrew Watterson - Clinical Audit Officer - Provided a copy of NIAS 2006 cardiac arrest audit

(from document provided by A. Watterson)

1 January 2006 to 31 December = 98,305 NIAS patient report forms. 789 were cardiac arrests. Resuscitation was attempted in 654 (83%) of cases. 276 (42%) were in VF and 276 were defibrillated. 56 (20%) had return of spontaneous circulation (ROSC), including CPR 77 (12%) had ROSC (14% is national average). 511 (78%) presented with non shockable rhythm. In 271 cases (34%) a bystander witnessed the arrest. In 327 (50%) bystanders performed CPR. 458 (58%) of cardiac arrests were attended by ambulance within 8 min. Population served n = 1,685,267

Patient Care Records (PCRs) are scannable. The crew fills in a sheet in pen and then it is scanned. They are looking at electronic PCR

Dr David McManus – Medical Director NIAS
(From notes)

Dr McManus considers the biggest problem with witnessed OHCA is that the cardiac arrest is not recognised.

Dr McManus said that Professor Kee saw CPR as a confounding variable and so removed it to clarify the effect of increasing the number of AEDs. A confounding variable is “A factor that distorts the true relationship of the study variables of central interest by virtue of being related to the outcome of interest but extraneous to the study question...”12 and “A variable that is not controlled in a research investigation. In an experiment, the experimental groups differ on both the independent variable and the confounding variable.”13

A difficulty with CPR in any study is that given the stress of providing CPR, bystanders might not accurately recall or report whether they started CPR, if they do they may not or may not be able to accurately report when they started, whether it was

12 www.research-nurses.com/methodology_terminology.html
13 highered.mcgraw-hill.com/sites/0072523425/student_view0/chapter8/glossary.html
interrupted, compressions alone or with ventilations and the rates used. These are all factors that could potentially impact on the study outcome but cannot be accurately accounted for in the study.

**Shaun Graham - Paramedic on Rapid Response Unit**
(from notes)

NIAS is not using Morphine but are instead using Tramadol. Protocols have been the same all over the UK since 2005. Rapid Response Units work 0800 to 2000 hours because of safety, funding and staff availability issues.

The communications centre staff now have to use a predictive analysis program which predicts where the next call is likely to occur. The program then recommends where vehicles should be moved if there is no vehicles available in that area. It logs compliance by the communications staff as to whether they followed the recommendations.

When first started AMPDS was used to send rapid response units to every ‘red’ call. Shaun said on one shift he was sent to 13 calls and was cancelled off 9 of them within 30 sec. He said that this was a problem because if he was driving at the time he would already have turned on lights and sirens, disrupting traffic, and then turned them off again within sight of that same traffic.

**Piacenza, Italy**

Interview with:

Dr Daniela Aschieri and Dr Massimo Piepoli

These are taken from an audio recording that was transcribed into dot points. Interview Thursday 16 August 2007 start time 15:00 hours, finish 15:45 hours.

In Italy for a medical emergency you call 118. Calls from Piacenza city and surrounds go to the Piacenza ambulance call centre. 118 is a dedicated ambulance telephone number. No instructions are given by the call taker regarding CPR.

In Italy they have 5 different types of police. PPV have distributed AEDs to all of them in Piacenza. This totals 9 cars in the city and 15 in regional areas. Police should be dispatched to everything that may be an OHCA. All 118 “blue codes” should be given to police cars that the communications centre know are near the event. The communications centre also knows the locations of the other fixed AED units and will call the place with the unit if the OHCA is there. For example if someone from the pool calls, the ambulance dispatcher will call the pool telephone.

Police should be dispatched on all blue codes but in the last 2 years they have been dispatched very few times. Police are “very happy” to participate in the PAD project. The fire services don’t participate. The cardiologists have been having major problems with 118 dispatches. From 1999 to 2003 the 118 call centre dispatched 100 blue codes every year. From 2003 to 2006 they only dispatched 2 or 3 blue codes
per year which is a dramatic drop. The major reason for this given by Dr Aschieri is that the chief of the 118 call centre is not interested in the project. They see this as a cardiologist’s project and a ‘turf war’ has resulted. Dr Aschieri stayed at home for one year on maternity leave. During this time there was no attention paid to the 118 call centre performance. The project should have gone on without supervision but without the ‘project champion’ few 118 calls were passed onto the police and consequently no lives were saved during this time. Dr Aschieri is the project champion and when she went away the project ceased to operate.

There are 2 or 3 factories that have privately owned AEDs. The dispatch operators are aware of the location and have telephone contact numbers but these would not go to an event outside the organisation’s grounds.

Under the Piacenza model Fixed AEDs are not responded to a private address. Police intervene in a majority of cases. In 5 years only one person survived because of a fixed placed AED. This happened in the main square and an off duty fireman knew the location of a fixed AED unit and so ran and got it.

A majority of ambulance staff are voluntary. Training is provided by the 118 organisation and all have only Basic Life Support. All have AEDs and can use them. Only one ambulance in the city has medical staff and one in the rural area has medical staff. These can meet other ambulances en-route to the hospital. Response times for ambulances are “very good” taking 7 or 8 minutes for most cases. But this is not good enough because of the additional time taken for members of the public to call for help. In the city this is about 1 minute and in rural areas it is about 2 minutes because they are different populations with different traits. It may take longer for them to recognize that it is a cardiac arrest.

The problems with the 118 system are making them consider changing the call number for OHCA to 113 so as to bypass the 118 problems. They are monitoring this year’s number of blue codes by month. There were 2 in January, 6 in February, 4 in March and 7 in May, these numbers “not good but not bad”. Since the beginning of the year they have saved 2 people which is “not good”. If 118 does not change their practice the Piacenza group may decide to get people to call 113 for OHCAs. We then discussed the things that have changed since the group published their paper. AED training has been reduced from 4 hours down to 2 hours. Police still only do AED tasks as they refuse to do Basic Life Support and they won’t accept other training. Response time of police is about 5 minutes. Ambulance response time is about 7 minutes so by the time police shock someone who has suffered an OHCA the ambulance is already arriving.

It has not been possible to change the existing AEDs to the new international guidelines. (? This is because of the machines being designed to give 1 minute pause rather than the instruction to start CPR). So all lay responders and police give 3 shocks and 1 minute pause.

No prescription is required to purchase an AED. Most people ring the PPV to get advice about purchasing an AED and so they give advice, register the phone number and address and give them training. There are 38 AEDs in the city. Of these 13 are mobile, 3 are in ambulance vehicles and 21 are in fixed places. 2 are in life cars (with medical responders).
They see the main advantage of their program as being that they focused on AEDs and made it easy to learn and remember.

They fostered enthusiasm in the initial program by describing it as an experimental project, so everyone including the police and media gave them support because they were excited and saw it as groundbreaking.

Regarding the project’s funding, the cardiologists said that if participants need assistance with their machine or replacing battery, pads etc the cardiologist’s organization (which is a charity) pay for it. The 118 organization pays for the police supplies. They also have an agreement that the emergency department pay for half the cost of the consumables.

They regularly have fund raising events, plays etc and receive funds from private people.

The relationship with the media is current and strong. TV, radio and newspaper all still run ads as a public community service. The media are very interested in (and also proud of) the project.

One of the survivors regularly arranges fund raising along with other survivors. They help to keep interest strong. They are very motivated to let others know about the project.

The project is still cost effective but is having problems.

Efforts are moving towards providing in-home AEDs for those that see them as a good insurance. These are not aimed at high risk patients, just those that want them and can afford them.

**De-identified comments**

Medical insurance companies covering the AED purchase price is seen as the point when in-home uptake rates will increase dramatically. The medical insurance companies will demand high quality evidence that in-home AEDs will save lives before they will consider funding their purchase.

The HAT trial run by Dr Gust Bardy (who incidentally was a member of the Piacenza study group) has raised several concerns as to whether it will be able to provide reliable evidence of the usefulness of in-home AEDs. These concerns related to the inclusion criteria and the number of participant that would be enrolled.
CONCLUSIONS

A majority of those that die from out of hospital cardiac arrests do so in private homes, not in public places. Ironically most PAD research has examined the effectiveness of defibrillators in public places. Much of Australia’s PAD research treats in-home and public-place defibrillation as mutually exclusive domains. In the United States it is likely that public PAD projects and in-home defibrillator demand are related. Throughout the United States there are Defibrillators prominently displayed in many public buildings, shopping centres, airports and railways stations. Many USA schools teach CPR and the importance of early defibrillation. This exposure to defibrillators, in-school education about their importance and the intuitive sense of protection provided by an in-home defibrillator may be stimulating the desirability of having a home defibrillator.\(^{14}\) One major factor limiting widespread home defibrillator uptake is the current high cost of the machines. The price of these machines is unlikely to rapidly decline but will reduce over time as the market for these types of defibrillators matures. The rate of this price decline is likely to be indirectly influenced by publicised research results reporting the effectiveness of in-home defibrillators. The long term outcomes of these complex interactions are difficult to accurately predict.

The high cost of defibrillators is only one factor that contributes to the expense of setting up and maintaining a public place defibrillator program. The major cost in establishing and maintaining a public defibrillation program is the initial and ongoing training cost. All of the pre-hospital cardiac resuscitation experts that were interviewed thought ongoing education was an important part of any successful resuscitation strategy. None thought that a program of simply distributing defibrillators into public places would be optimally effective. There were widely varying views about the level and content of the required training. Those from the USA and UK took the view that if people knew CPR they would always be able to start assisting a victim of OHCA even if they didn’t have a defibrillator available. The Piacenza group’s view is that CPR without immediate defibrillation does little to improve survival rates and adds an unjustified level of complexity and expense to the required training program. Both views offer programs that improve OHCA survival rates and both approaches save more lives than having no PAD program.

The USA has mandated PAD programs in major public building and New York State has required PAD programs be established in public schools and health clubs. Several of those in the New York school system that were interviewed questioned the ratio of costs compared to benefits of the well intentioned legislation. One senior school officer said that funds were diverted from other high priority programs to cover the cost of the defibrillator program. Others had reservations about the legislation but stopped short of openly criticising its value. These surprising findings have forced a revision of this author’s views about increasing PAD participation through legislation. In Australia there are facilities that should introduce PAD programs. An example of this can be seen when comparing the survival rates of OHCA victims at major Melbourne sporting complexes. As a direct result of a rapid

\(^{14}\) Amazon CEO said: “The most-wished-for product in the health and personal care category is the Philips HeartStart Home Automated External Defibrillator”. See: [http://daily.stanford.edu/article/2005/2/14/amazonCeoSpeaksOnCampus](http://daily.stanford.edu/article/2005/2/14/amazonCeoSpeaksOnCampus)
response defibrillation program, 70% of those that suffer an OHCA at the Melbourne Cricket Ground survive. At a nearby major sporting complex, that does not have a defibrillation program, there has not been a single OHCA survivor. To avoid having to inflict this author’s moral and ethical viewpoint on the complex problem of weighing the end user’s ability to pay against the community’s need for defibrillation services, a Milton Friedman type position has been adopted. This viewpoint defers matters of resource allocation to the market mechanism which, in effect, shifts the decision to introduce PAD back to individual site managers.

Finally, it became apparent that PAD cannot be viewed in isolation and must be seen as part of a pre-hospital emergency care response. The primary response agency has a responsibility to ensure they provide an adequately trained rapid response service to OHCA calls. Medical and paramedical organisations should take an active role in promoting appropriate PAD programs within their communities.

**Specific Findings by Category**

**Ambulance Related Findings**

- In both comments and observed happenings, it is clear that the international trend is a fundamental belief, and an almost fanatical devotion to minimising emergency service response times. This type of focus has not been observed in Australian response systems.
- In both England and Northern Ireland this focus on response times has resulted in gaming but has also resulted in consistently low response times even under trying conditions.
- The DART trial will hopefully provide level one quality evidence regarding whether compressions alone or compression and ventilations are the best advice to give to a non-trained OHCA rescuer. The current expert opinion is that compressions alone are the best advice to give an untrained OHCA rescuer.
- A majority of the sites reviewed utilise a multiple agency response to OHCA. This typically involves Police or Fire services as the first responder and then the ambulance service as the secondary responder.
- High quality research, including projects that get ambulance crews to collect the data, are an important part of discovering what works in the local environment.
- All experts that were interviewed believe that relating any program with the emergency services is one of the keys to success.

**Public Access Defibrillation**

- PAD remain expensive when compared to other life-saving medical interventions. This situation is likely to change as the AED market matures. The cost of the machines is seen as the greatest obstacle to high in-home uptake.
- PAD projects need a strong dynamic leader to be successful.
- Media is a useful tool to motivate and inform people of the advantages of PAD. People may not know the benefits and risks associated with having or not having PAD.
- In the UK the total number of lives saved by PAD remains low even after a sizable injection of funds.
• Early home uptake is likely to be inequitable with only the wealthy being able to afford to participate. Competing wants will limit home uptake until the cost of AEDs reduces.

• The current expert opinion is that increasing the number of machines without having a ‘commitment’ to get over the ‘hump’ or training of some type is less likely to be a successfully strategy than providing some type of training.

• The home market for AEDs is growing and most home use AEDs are now purchased over the internet.

• There is division about the benefits of having PAD in private homes.

• USA experts think at least with CPR you can do something even without an AED, they are concentrating on making learning CPR faster and easier. Piacenza experts think that CPR without an AED isn’t effective so it is more efficient to teach only AED use.

• All experts believe training, whether with or without CPR is important. Some have only come this conclusion relatively recently and have moved away from a ‘no training’ model.

• Given the lack of level one evidence that is directly applicable to each Australian environment and the diversity of views, some degree of expert judgement regarding the appropriate level of training for each situation and group is required.

• Even though modern AEDs are simple to use, the current consensus is that potential responders should receive training before using an AED. The problem is that potential responders to OHCA can include anyone and there is no consensus on what level of training is adequate.

Legislation

• Legislation clarifies participants expected duty of care and the components that are required in a program.

• Legislation increases the participation rate

• An unfunded mandate requiring schools to participate in PAD diverts funds from other school programs. This may not be the optimal use an individual school’s funds given their particular circumstances.

• In the United States, duty of Care is expanding to include PAD, this is becoming an issue for venues and centres that have high footfall rates.
RECOMMENDATIONS

1. As a general principle, legislation should not be used to force organisations or groups to participate in PAD.

Legislative initiatives mandating PAD participation have, in some cases, resulted in suboptimal resource allocation. An unfunded mandate requiring New York public schools to have defibrillators and trained staff resulted in funds being diverted from other high value programs. Efforts to encourage PAD participation should focus on educating, encouraging and supporting organisations that fall into the ‘high risk’ groups.

2. As a general principle, legislation should not be used to restrict organisations or groups from participating in PAD.

The dominant PAD model used in Australia is the Directed Training model. This model requires that participants learn CPR and are accredited in the use of an AED. The Directed Training model is expensive and thus discourages PAD participation. The Piacenza model has demonstrated that alternative cheaper models, such as those that don’t require CPR, can and do improve survival rates from OHCA. Legislation dictating a particular approach or training regime may inhibit local adaptations that account for the local environment and circumstances and may also stifle innovation and further research. Until high quality evidence is available, the most appropriate PAD model for a particular location is a matter of judgement that should be made in consultation with the local medical and emergency service authorities.

3. Legislation should not inhibit private uptake of AEDs.

There is currently little evidence supporting routine placement of in-home AEDs. This lack of evidence should not be construed as evidence of a lack of
effectiveness of in-home AEDs. The market for in-home AEDs is in a growth phase with ‘early adopters’ dominating the current uptake. Given the lack of supporting evidence, and lack of evidence suggesting that in-home AEDs may cause harm, market forces should be allowed to prevail.

4. Venues and places that frequently attract large crowds should be encouraged to carefully review their duty of care to provide PAD.

It is foreseeable that venues that frequently have high footfall rates will have clients that will suffer OHCAs. An example of this is sporting stadiums that frequently attract large crowds. There is evidence that demonstrates that a rapid response defibrillation program can reduce the mortality rate of people in these settings. Those that are attending these venues cannot reasonably provide their own defibrillation and so rely on the venue’s management to provide these services. Not addressing this foreseeable threat to their clients wellbeing would make the venue’s management morally, if not legally, liable for the resultant losses.

5. Untrained rescuers attending an OHCA and who call for help should be instructed to give chest compressions without ventilations.

This recommendation is not supported by evidence but is the view expressed by experts in the field of pre-hospital resuscitation. Ambulance Services using the AMPDS software will already be providing this advice to callers reporting a possible OHCA.

6. Australian emergency services responding to OHCAs should be aware that reducing response times is a focus of all overseas emergency services that were reviewed.

In the UK it was emphasised that people calling for assistance wanted help quickly. This principle has been fully embraced by the political forces and now permeates virtually every aspect of the ambulance service. It was suggested that funding, management promotion and daily operational decisions are influenced by changes in response times. In both the USA and the Piacenza region in Italy, response times to OHCA are 5 minutes or less. All of these systems rely on alternative responder models using Police, Fire and/or voluntary responders to achieve their short response times.