

PE1707/A

British Heart Foundation submission of 11 January 2019

I'd like to take this opportunity to firstly thank the petitioner for bringing this important issue to the attention of the Petitions Committee and Members of the Scottish Parliament. Their journey to bring this petition forward is one that no one wishes to experience but unfortunately in Scotland is all too common.

Secondly, I'd like to thank the Committee for the opportunity to contribute towards the discussion on public access defibrillators in Scotland, their provision and use in incidences of out-of-Hospital cardiac arrest (OHCA).

This paper will look at three main areas raised by the petition and provide recommendations for the Committee's consideration;

1. The requirement for all new build or newly renovated or re-purposed buildings with a floor space of over 7500m² to have a public access automated external defibrillator (AED) fitted to the exterior of the building.
2. AED readiness
3. Bystander use of AEDs in incidence of OHCA

The British Heart Foundation is fully committed to helping improve survival rates from OHCA across Scotland, and the rest of the UK, through an evidenced based approach. We have worked, and are currently working, collaboratively with a wide range of partners including the Scottish Government, Scottish Ambulance Service, the Save a Life for Scotland partnership and most recently Microsoft.

I hope this paper is helpful in the Committee's considerations of this petition and we would welcome any opportunity to discuss with the members of the Committee further.

Recommendations on petition PE01707: Public Access Defibrillators

- The Public Petitions Committee of the Scottish Parliament should recognise the role this petition has played in raising the debate regarding public-access AEDs in Scotland and this should be commended.
- The Public Petitions Committee of the Scottish Parliament does not recommend to Scottish Government, or any other legislative mechanism, that a requirement be placed on all new build or newly renovated or re-purposed buildings with a floor space of over 7500m² to have a public access AED fitted to the exterior of the building.
- Any statutory mechanism related to AED location in Scotland should be based on evidence both national and internationally and the Public Petitions Committee of the Scottish Parliament should recognise that;

- There is a lack of evidence in Scotland in relation to;
 - Location of OHCA in Scotland
 - Location of AEDs in Scotland
 - The current proposed requirement is contrary to a large body of international evidence
- The Public Petitions Committee of the Scottish Parliament may want to revisit the issue of public-access AEDs in Scotland at a later date when national evidence is available via;
 - The British Heart Foundation, Microsoft and Scottish Ambulance Service, National Defibrillator Network and;
 - The findings of the Scottish Government funded PADs Modelling Analysis project
- The Public Petitions Committee of the Scottish Parliament may want to consider what role the Scottish Government, or other statutory bodies, may wish to play in creating a uniformed approach to the criteria and locations that the many partners who provide AEDs in Scotland use.
- The Public Petitions Committee of the Scottish Parliament may wish to comment regarding the registering of all public-access AEDs in Scotland with the Scottish Ambulance Service.
- The Public Petitions Committee of the Scottish Parliament may want to consider what role the Scottish Government, or any other statutory bodies, can play in raising awareness of AEDs and increase bystander willingness to use them in an emergency.

1. The requirement for all new build or newly renovated or re-purposed buildings with a floor space of over 7500m² to have a public access AED fitted to the exterior of the building.

It is widely held that the general approach to AED placement across the globe is failing. There are very few public programmes for the placement of AEDs and very little guidance available. Research has shown that [most AEDs are placed by private citizens fundraising or charities supplying them](#).

There have been a number of studies, [including the Stockholm Study](#), which have shown that the current approach to AED placement does not correlate to the location in which OHCA in public locations occur. This has led to an over-provision of AEDs in areas where fewer OHCA occur, therefore reducing the impact of the AED footprint.

We know for example that [the further the distance to an AED from the site of an OHCA](#), the less likely the AED is to be used and the 30-day-survival chances of the patient.

Currently in Scotland there is no public access data that has mapped the location of OHCA's to allow providers of AEDs to make better evidenced provision of AEDs. Following this there is still no comprehensive mapping of AEDs in Scotland which would allow us to better identify blackspots and over-provision in say, an urban city centre.

It should be noted however that the British Heart Foundation, Microsoft and Scottish Ambulance Service are working on a National Defibrillator Network that will allow Emergency dispatchers to sign-post bystanders to their nearest AED. The Scottish Ambulance Service is an early adopter partner in this work.

The Scottish Government in an answer to S5W-19905 also stated that "The Scottish Government has funded The University of Edinburgh Resuscitation Research Group to carry out the PADs Modelling Analysis project, to inform advice on where PADs should be located, designed to facilitate bystander CPR and PAD use."

Whilst we are not aware of the content of the project aforementioned any Government intervention in AED provision or location should consider the body of international evidence in this area and the potential outcomes of the funded project and the National Defibrillator Network. Combined these two projects may support the Scottish Government to [take an evidence based approach to AED location, ensuring that they are strategically placed](#) and any funds invested, both privately and publicly, have maximum impact.

BHF Scotland does not support the aim of the petition to make it a requirement that buildings with a floor space over 7500m² fit a public access AED. It is hard to ascertain the distribution of buildings of this scale, however it is reasonable to assume that they are situated either in town and city centres, or out of town facilities such as retail parks and industrial estates.

Such a measure will undoubtedly increase the number of AEDs in Scotland however it is highly likely that it will disproportionately see these AEDs located in town and city centres or see many AEDs located in parts of the country that see relatively low footfall outside office hours.

1. AED readiness

AED readiness and accessibility are major issues in relation to increasing use in incidences of OHCA. [These are identified as two main of the main barriers by Smith et al.](#)

In [a recent study in Denmark](#) they authors showed that nearly 1 in 5 AEDs were unavailable after normal office hours as they were locked in office buildings or shops. [Other studies](#) have shown that nearly 25% of AEDs are unmaintained or AED guardians have no plan in place to keep the AED maintained.

BHF Scotland supports the position that all public access AEDs should be registered with the Scottish Ambulance Service; should be made available 24 hours per day/7 days a week; and held in an unlocked cabinet. BHF Scotland recognises the work Scottish Ambulance Service does in supporting communities who have installed public-access AEDs.

2. Bystander use of AEDs in incidence of OHCA

As detailed in the petition document an AED was on site when Jayden Orr had an OHCA, however no one used it. Unfortunately [use of AEDs in incidence of OHCA in a public location is very low](#) with international studies concluding use in just 0.15%-4.3% of cases.

There are a number of barriers identified by international evidence for this [in this incidence an AED was onsite so we will discuss the [capability and motivation](#) of bystanders rather than [location and accessibility](#) of AEDs, however both are discussed below.]

In Smith et al's global literature review [the following barriers were identified](#) as reasons not to use an AED;

- not knowing how the device worked (40-85%)
- not being comfortable using it (72%-84%)
- fear of causing harm to the patient (14-88%)
- legal liability (4-38%).

With McDonough et al reporting that “most” respondents in one cohort would feel more comfortable waiting for someone who was more competent in AED use to avoid causing more harm to the victim.¹

Smith et al further explored the impact of training in AED across the studies identified and noted the following;

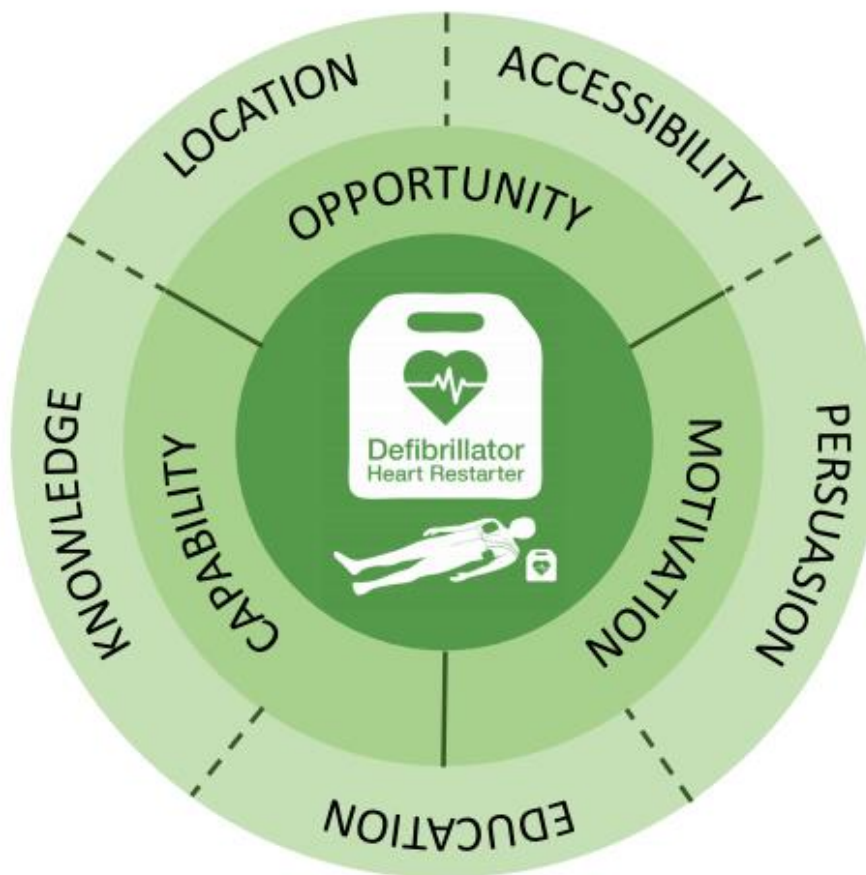
It is generally reported that previous training in CPR and AED use resulted in;

- **more people knowing what an AED is** (77% vs 46%)²;
- **when to use an AED** (79% vs 23%)³;
- the **location of the nearest public-access AED** (39% vs 14%²; 5% vs 0.3%⁴; 84% vs 5%³);
- **comfort levels in using an AED** (50% vs 14% without assistance and 85% vs 48% with EMS assistance)⁵;

- and who **stated they would use an AED** if required (42% vs 6%²; 3% vs 0.3%⁴; 25% vs 25%)³.

This should be a very important consideration for the Committee. Whilst we know the barriers are real, we also know that training can improve people’s perceptions. There are a wide range of organisations, both private and public, that provide CPR and AED training, including the BHF, in Scotland. However, **it may be worth considering the Scottish Government’s ability in [public health messaging to explore AED awareness in future](#).**

For



reference the following graphic is used in [Smith & Perkins](#) paper *Improving bystander defibrillation for out-of-hospital cardiac arrest: Capability, opportunity and motivation* and provides a good snapshot on the challenges facing increasing AED use in OHCA in public locations.

Out-of-Hospital Cardiac Arrest (OHCA) –

If a person has a cardiac arrest, they are unresponsive and unconscious. There are no signs of life – such as normal breathing. A cardiac arrest is the ultimate medical emergency, for every minute that a person is in cardiac arrest with no intervention (CPR or defibrillation), their chances of survival are reduced by up to 10%.

In 2011/12 the Scottish Ambulance Service responded to approximately 8,900 adult OHCA calls, 3,058 of these resulted in resuscitation attempts.⁶ More recently in 2016/17 there were 3455 OHCA's where resuscitation was attempted by the Scottish Ambulance Service.⁷

Basic Life Support & OHCA –

The International Liaison Committee on Resuscitation (ILCOR) have as their mission to “identify and review international science and information relevant to cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC) and to offer consensus on treatment recommendations. ECC includes all responses necessary to sudden life-threatening events affecting the cardiovascular and respiratory systems, with particular focus on sudden cardiac arrest.”⁸

In their 2015 International Consensus paper the following actions are recommended in relation to sudden cardiac arrest in an out-of-hospital setting (OHCA) before the arrival of emergency medical services¹⁴;

- i. Bystander contacts emergency medical service dispatcher
- ii. Dispatcher identifies emergency as OHCA and instructs bystander to begin compression-only CPR
- iii. Bystander CPR delivered until EMS arrives
- iv. Use of Automatic External Defibrillator [AED] by layperson & healthcare provider alike

In 2015 the Scottish Government published ‘Out-of-Hospital Cardiac Arrest: A strategy for Scotland’¹¹ in response to poor survival rates, as low as 5%¹¹, from OHCA's in Scotland. The national strategy sought to maximise the impact of all parts of the ‘chain of survival’, with specific focus on the pre-emergency medical services or bystander intervention.



There is significant evidence regarding the role of CPR and AED use by bystanders in increasing survival from an OHCA.¹⁴

However our current approach to public access defibrillation in Scotland is incoherent at best and failing.

Automated External Defibrillators [AED]-

Automated external defibrillators (AEDs) allow the delivery of an electric shock to victims of out-of-hospital cardiac arrest (OHCA). They are easy to use, accurate, and can be used safely and effectively by those with no prior training.⁹ When used by a bystander they are often referred to as public access defibrillators [PADs].

We know that the use of AEDs play a significant role in improving outcomes from an OHCA. A number of studies have shown that the majority of cases of OHCA arise from ventricular fibrillation.¹⁰¹¹ Survival after these cases is determined primarily by the length of time from the moment of cardiac arrest to electrical defibrillation.¹²

Pollack, Brown et al showed in their 2018 paper *Impact of Bystander Automated External Defibrillator Use on Survival and Functional Outcomes in Shockable Observed Public Cardiac Arrests* that patients shocked by a bystander compared to those shocked by arriving EMS were;

- significantly more likely to survive to discharge (67% versus 43%)
- be discharged with a favourable function outcome (57% versus 33%)

They also showed that the benefit of a bystander shock increases progressively as emergency medical services response time became longer.¹³

Using an extrapolation of the data gathered in the study they were able to estimate that 5.2% of all OHCA's that occur annually in the US are shockable, observed by a bystander and occur in a public place. Using the outcome of the study if 100% of these OHCA's were shocked by a bystander before EMS arrived then 19% would survive with good neurological outcomes.¹⁹

The authors of this study concluded, along with others¹⁴¹⁵¹⁶, that "Bystander automated external defibrillator use before emergency medical services arrival in shockable observed public OHCA was associated with better survival and functional outcomes. Continued emphasis on public automated external defibrillator utilization programs may further improve outcomes."²¹

Given the weight of evidence in the use of AEDs before the arrival of EMS and better survival outcomes, why then is AED use very low, with studies reporting that it is used in only 0.15–4.3% of OHCA's?¹⁵

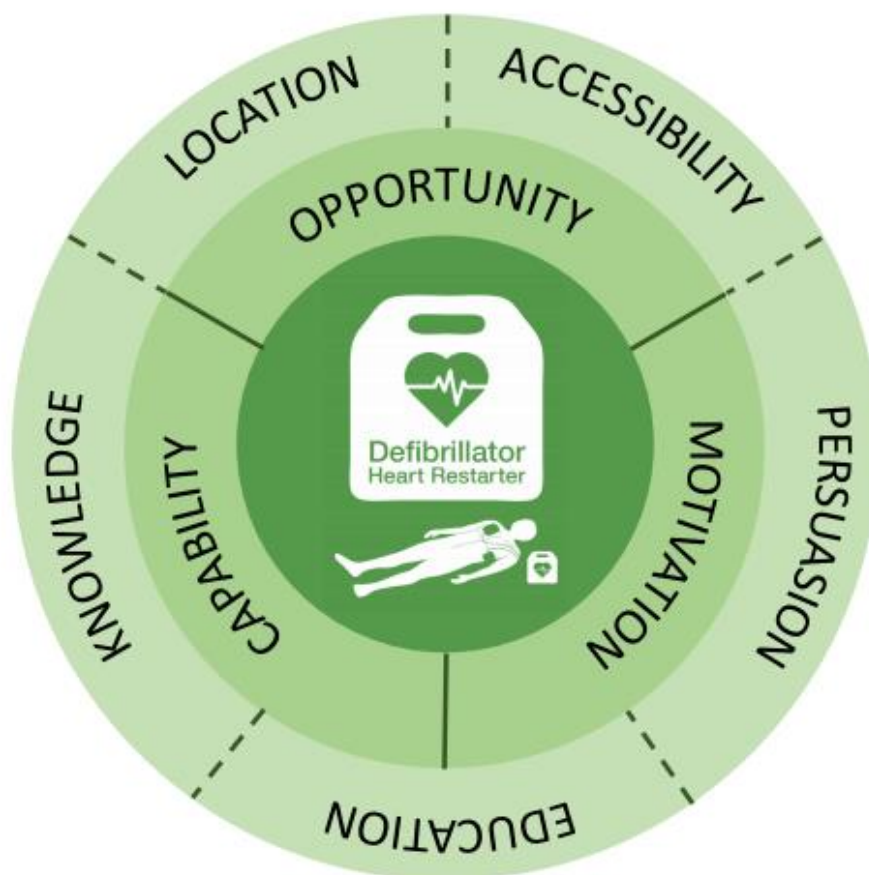
Barriers to AED use in OHCA –

Given the weight of evidence in the positive role AEDs play in improving survival rates and positive outcomes from OHCA and the reported low incidence of use it is important in any discussion in relation to AEDs to understand the barriers to their use.

A 2017 paper published in the European Heart Journal, reviewed 70 studies into AED use in OCHA and the barriers and facilitators that affect this.¹⁵ The following categories were identified from the study;

1. Knowledge and Awareness
2. Acquisition and Maintenance
3. Training Issues
4. Medicolegal Issues
5. AED Locator Systems
6. Human Factors
7. Willingness to Use
8. Availability and Accessibility
9. Registration and regulation
10. Dispatch-Assisted AED use
11. Demographic Factors

These can be further categorised into three main barriers illustrated by the figure below¹⁷;



Opportunity (accessibility and location) –

A number of studies have shown that the provision of public access AEDs is often due to charity or fundraising (68%¹⁸ & 58%¹⁹ of all public-access AEDs) rather than private purchase or statutory provision.

A wide array of reasons for not buying an AED can be found in academic literature including;

- 32-38% citing cost²⁰²¹²²
- 7-51% concerns about liability²³²⁷²⁸
- 24% never been considered²⁷
- 33% local EMS response was good enough²⁸
- 11% a hospital was nearby²⁷

Maintenance and replacement plans have also been shown to be a barrier to accessibility of AEDs when an OHCA occurs. In one study 24% of AEDs were not maintained²⁵, 18% had no formal maintenance plans in place and 24% had no formal plan for replacement.²⁶

When OHCA occur only a small proportion of those will happen in a location where it is suitable to place an AED for public use, estimates of this range from 17-26% of OHCA across a number of studies.²⁴²⁵²⁶ In one study in Philadelphia 70-80% of AEDs were within 3 min walk of an AED²⁷ and others Public-access AEDs were deemed to be in poorly accessible areas in between 18-59% of cases or not available all of the time. Out-of-hours there is a substantial reduction in AED availability reported as 34% in one study.¹⁵

Simulated OHCA scenarios have demonstrated that EMS dispatch assistance resulted in a shorter time to AED retrieval and defibrillation²⁸, and correct use of an AED in 62%²⁹ and 79%³⁰ of cases. This is compared to another study³¹ which have looked at AED locator software accessible by mobile phone and showed it made “no impact on the time taken by bystanders to locate a nearby public-access AED and to it bring it to an OHCA system.”¹⁵

In a 2017 paper on the probability of bystander defibrillation Sondergaard et al³² made two important observations regarding public-access AEDs. The authors studied 12,253 OHCA from Denmark where resuscitation attempts were made. They cross referenced the location of the cardiac arrest with the location of AEDs in the area. The first observation they made was that nearly 1 in 5 cardiac arrests occurred within the vicinity of an AED then was not accessible due to opening hours or availability of the AED. This is a sizeable reduction in out-of-hours AED accessibility that represents an important missed opportunity for many OHCA victims.²³

The second major finding from the paper related to distance from OHCA site to AED location and the impact this had on the likelihood of it being used and 30 day

survival. The study immediately ruled out 20% of OHCA as they occurred where an AED was sited more than 2km away.

Of the remaining cases they found that the median distance was 800m. The chance of the AED use diminished with distance from the OHCA incidence. 31% of OHCA saw an AED used where an AED was immediately available (0m), 12.5% if route distance was 100m and 5.9% if that distance increased to 200m. The chance of 30-day-survival decreased also with AED distance - 28.2% at 0m, 22.2% at 100m and 17.1% at 200m.³⁸

In total, fewer than 5% of OHCA occurred within 100m of an accessible AED (and fewer than 10% within 200m), although there was a significant increase in this figure (1.2% to 8.5%) across the study period. Increasing the opportunity for AED use by reviewing the location and accessibility might add value to current approaches. OHCA and AED registries can be used to identify areas of high cardiac arrest incidence to help planners to more effectively position AEDs and increase their utility.²³

The Stockholm Study³³

A 2017 paper reported a study conducted in the Swedish capital of Stockholm. The authors studied OHCA between 1 January 2012 and 31 December 2014, of which a total of 804 OHCA occurred in public locations in Stockholm County and in December 2012 there were a total of 1828 AEDs registered.

The study showed an incidence rate of 47% occurred in residential areas whilst 43% occurred in non-residential area, however fewer AEDs were present in the residential area than non-residential (29% vs 69%) and in a residential area the median distance was 100m greater than the distance travelled in non-residential areas.

A Canadian study reported similar findings when categorising public OHCA incident locations and AED installation sites as either in or outside the downtown area. The study reported that the downtown area had a greater AED coverage of public OHCA than outside the downtown area (49% vs 17%), but at the same time 80% of the public OHCA occurred outside the downtown area.³⁴ This indicates a tendency for AED installations in commercial areas of the urban environment.

The study observed a significantly lower median distance between public OHCA and AEDs in non-residential areas compared with residential areas. A distance of 100 metres to the nearest AED is assumed an 'upper limit' for defibrillation within the early critical 3–5 min.³⁵³⁶³⁷ The previously mentioned Canadian study showed a 60% lower median distance between public OHCA and AEDs in downtown areas.

The study concluded that residential areas need to be considered priority targets for AED installation and that looking at area rather than location, using geodata tools

such as UA and GIS, can contribute to identifying these areas. We also believe that international guidelines need to take geographical location into account when suggesting locations for AED installations.

Capability and Motivation –

Poor knowledge of AED locations and impressions of difficulty and fear of using one are among the most common reasons for low AED use in OHCA's.²³

There is a wide body of literature that shows awareness of AEDs ranges from 15-89%¹⁵ by geography with one longitudinal study, which observed the impact a nationwide policy on bystander CPR in South Korea, showing increased awareness over time from 6% in 2007 to 31% in 2011.³⁸

Several studies have shown there is limited knowledge about public-access AEDs and how to find them. Few people (5-22%) were able to locate their nearest public-access AED.¹⁵

In their literature review of global studies Smith et al¹⁵ showed, “willingness of laypeople to use public-access AEDs varied markedly between 12% and 87%. Between 3% and 30% indicated willingness to retrieve a nearby AED. A study in England showed when asked specifically about retrieving and then using an AED just 2% indicated willingness. Reasons for not being willing included: not knowing how the device worked (40-85%) or not being comfortable using it (72%-84%), fear of causing harm to the patient (14-88%) and legal liability (4-38%).”

McDonough et al reported that “most” respondents in one cohort would feel more comfortable waiting for someone who was more competent in AED use to avoid causing more harm to the victim.¹

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It is generally reported that previous training in CPR and AED use resulted in;

- more people knowing what an AED is (77% vs 46%)²;
- when to use an AED (79% vs 23%)³;
- the location of the nearest public-access AED (39% vs 14%²; 5% vs 0.3%⁴; 84% vs 5%³);
- comfort levels in using an AED (50% vs 14% without assistance and 85% vs 48% with EMS assistance)⁵;
- and who stated they would use an AED if required (42% vs 6%²; 3% vs 0.3%⁴; 25% vs 25%)³.

Knowledge of how to use an AED increased willingness to use in both those under 60 years of age (91% vs 42%) and over 60 years of age (87% vs 24%). Further, an increasing number of previous CPR training sessions resulted in greater willingness to use an AED³⁹.

Smith & Perkins²³ conclude that “[m]otivating bystanders to use AEDs requires education and persuasion. Although bystanders can use AEDs effectively without prior training, even brief training may reduce the time to first shock. Consideration should be given to including AED familiarisation as part of major CPR campaigns. AED signage is useful for helping bystanders to find an AED but might also play a role in motivating bystanders to use the device. The current internationally recognised AED sign may deter some bystanders from using an AED but an alternative sign, which is designed to empower bystanders to use an AED, has been launched in the UK. Evaluation of whether or not this facilitates more bystander defibrillation is awaited. Proximity to an accessible AED will remain a key determinant of whether or not bystander defibrillation is attempted and is also associated with patient outcome.

It is important that we find ways to make AEDs more accessible and more strategically located, as well as implementing strategies to enhance the opportunity, capability and motivation for successful bystander defibrillation.”

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³ Koźłowski D, Kłosiewicz T, Kowalczyk A, Kowalczyk AK, Koźluk E, Dudziak M, Homenda W, Raczak G. The knowledge of public access to defibrillation in selected cities in Poland. *Arch Med Sci* 2013;9:27–33.

⁴ Brooks B, Chan S, Lander P, Adamson R, Hodgetts GA, Deakin CD. Public knowledge and confidence in the use of public access defibrillation. *Heart* 2015;101:967–971.

⁵ Bogle B, Mehrotra S, Chiampas G, Aldeen AZ. Assessment of knowledge and attitudes regarding automated external defibrillators and cardiopulmonary resuscitation among American University students. *Emerg Med J* 2013;30:837–841.

⁶ Scottish Government: Out-of-Hospital Cardiac Arrest: A strategy for Scotland; <https://www2.gov.scot/Resource/0047/00474154.pdf>

⁷ Scottish out-of-Hospital Cardiac Arrest Data Linkage Project 2015/16-2016/17;

<https://www.gov.scot/publications/scottish-out-hospital-cardiac-arrest-data-linkage-project-2015-16/>

⁸ Hazinski MF, Nolan JP, Aickin R, Bhanji F, Billi JE, Callaway CW, et al. Part 1: Executive Summary: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*. 2015;132(16 Suppl 1):S2-39.

⁹ Smith CM, Lim Choi Keung SN, Khan MO, Arvanitis TN, Fothergill R, Hartley-Sharpe C, et al. Barriers and facilitators to public access defibrillation in out-of-hospital cardiac arrest: a systematic review. *European heart journal Quality of care & clinical outcomes*. 2017;3(4):264-73.

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¹² Valenzuela TD, Roe DJ, Cretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model. *Circulation* 1997;96:3308-3313

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