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Barriers and Facilitators to Public Access Defibrillation in Out-of-Hospital Cardiac Arrest – a Systematic Review

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Abstract

Introduction: Public Access Defibrillation initiatives make Automated External Defibrillators available to members of the public. This facilitates earlier defibrillation of out-of-hospital cardiac arrest victims and could save many lives. It is currently only used for a minority of cases.

Aims: To identify barriers and facilitators to Public Access Defibrillation.

Methods and Results: A comprehensive literature review was undertaken, defining formal search terms for a systematic review of the literature in March 2017. Studies were included if they considered reasons affecting the likelihood of Public Access Defibrillation and presented original data. An electronic search strategy was devised searching MEDLINE and EMBASE, supplemented by bibliography and related article searches. Given the low-quality and observational nature of the majority of articles, a narrative review was performed.

Sixty-four articles were identified in the initial literature search. An additional 4 unique articles were identified from the electronic search strategies. The following themes were identified related to Public Access Defibrillation: Knowledge and Awareness; Willingness to use; Acquisition and Maintenance; Availability and Accessibility; Training Issues; Registration and Regulation; Medicolegal Issues; Emergency Medical Services Dispatch-assisted use of Automated External Defibrillators; Automated External Defibrillator-locator Systems; Demographic Factors; and Other Behavioural Factors.

Conclusion: Several barriers and facilitators to Public Access Defibrillation deployment were identified. However, the evidence is of very low quality and there is not enough

information to inform changes in practice. This is an area that is in urgent need of further high-quality research if Public Access Defibrillation is to be increased and more lives saved.

(248 words)

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Keywords: Public Access Defibrillation; Out-of-Hospital Cardiac Arrest; Automated External Defibrillators; Barriers; Facilitators

Introduction

Automated External Defibrillators (AEDs) allow the delivery of an electric shock to victims of out-of-hospital cardiac arrest (OHCA) [1]. They are easy to use, accurate [2], and can be used safely and effectively by those with no prior training [3].

Population-level survival rates from OHCA between 2-11% have been reported internationally [4], but survival rates as high as 70% have been reported in victims of OHCA from a cardiac cause who were defibrillated within two minutes of the initial collapse [5].

Public Access Defibrillation (PAD) is the term given to the use of an AED by members of the public. This allows defibrillation to be performed more quickly, before the arrival of the Emergency Medical Services (EMS). PAD is very effective in select groups of OHCA victims. The only large-scale randomised controlled trial (RCT) of PAD was conducted across 24 sites in North America (The PAD Trial) [6]. In the intervention group, trained responders with access to an AED responded to a nearby OHCA. Survival was nearly double in the group that received CPR and PAD compared to the group that received CPR alone. A number of other studies have shown statistically significant and clinically relevant improvements in OHCA survival when PAD was used [5, 7-19].

However, the proportion of OHCAs in which PAD is used is very low, with studies reporting that it is used in just 0.15%–4.3% of OHCAs [8-10, 15, 17, 20-30]. Thus, a clinical

intervention of great efficacy has had only a limited impact on OHCA survival at a population level.

An understanding of the reasons why PAD is being used so infrequently is vital to increasing its effectiveness and improving survival from OHCA. The objective of this systematic review was to identify barriers and facilitators to the deployment and use of PAD by bystanders for victims of OHCA.

Methods

This systematic review was structured with reference to the PRISMA Systematic Review Checklist [31] and registered on the PROSPERO international prospective register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016035543)

This review considered all full-text English language articles published in peer-review journals, with no limit on publication date. Abstracts or reports of conference presentations were not included.

An initial scoping review of the literature was performed by two authors (CMS and SLCK). Key search terms were agreed and unstructured searches independently performed across PubMed and Google Scholar to identify papers related to barriers and

facilitators for a systematic review of the literature. Relevant papers were agreed by discussion between the two authors.

These key search terms were subsequently combined with relevant MESH subject heading terms related to PAD. A systematic search strategy was developed for MEDLINE (Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations March 06 and Ovid MEDLINE(R) 1946 to March Week 1 2017) and EMBASE (1974–2017 March 09) (Wolter Kluwers Health, http://ovidsp.uk.ovid.com) databases. Electronic databases were searched by a single researcher (CMS), from which further full-texts of potential interest were identified. The electronic search strategy is available in the Online Supplementary Material.

Following the electronic database search, more relevant articles were identified by: (1) Bibliography search of full-texts and (2) 'Related Articles' feature of PubMed (http://www.ncbi.nlm.nih.gov/pubmed/) and Google Scholar (http://scholar.google.co.uk).

Broad inclusion criteria were set. An article was included if it:

- Concerned reasons affecting the likelihood of PAD by bystanders in an OHCA;
- Presented original and quantifiable data

Articles were excluded if they:

- Were review articles, offered commentary or expert opinion;
- Related only to the acquisition of AED skills, without some qualification of how this might affect PAD in OHCA;
- Related to AEDs that did not have the potential for use in the public setting;
- Related to AED use by 'professional' first-responder groups (e.g., police, fire) or healthcare professionals (e.g., EMS)

Selected data about study characteristics were extracted onto a data collection tool that captured: study date and location; study design and key characteristics; main findings about barriers to PAD; and main findings about facilitators to PAD. Articles were classified thematically.

The topic of the systematic review meant that there was great heterogeneity in the articles included. Many of the articles were observational in nature, with many collecting data retrospectively, or surveys. Such articles represent low or very low-quality evidence and accurate estimates of the size of the effect of a barrier or facilitator to PAD cannot be assessed [32]. We consider that the risks of selection bias, information or detection bias, and response bias for surveys to be high in the majority of articles reported. This is considered in more detail in **Table S1** (Online Supplementary Material)

For these reasons, a narrative review has been performed. It was not possible to perform meta-analysis. Key limitations to the included studies are presented in the discussion section.

Results

The selection of articles for inclusion in this review is outlined in **Figure 1.** 64 articles were identified during the initial literature review [8, 20, 24-25, 33-92].

The electronic databases searches were conducted on 10th March 2017, returning 212 articles from MEDLINE and 293 articles from EMBASE. After removing duplicates there were 324 unique articles. 36 articles were selected for full-text review from the MEDLINE search, and 38 from the EMBASE search – 44 articles in total after removing duplicates. Three additional articles, not already included, were identified in MEDLINE [93-95]. These three articles and one more unique article [96] were identified in EMBASE. All four of these additional articles were included in the review. No additional articles were identified from bibliography and related-article searches.

In total, 68 articles were included [8, 20, 24-25, 33-96]. The articles were grouped into 11 core themes covering user and system characteristics. The key themes and findings are summarised in **Figure 2**. A more detailed analysis is presented in the text below and in the Online Supplementary Material (**Table S1**). The majority of articles were surveys or interviews, observational or other descriptive studies, or database reviews.

Knowledge and Awareness

Fourteen surveys [20, 34-44, 93-94] and two qualitative interviews [33, 96] reported on knowledge and awareness of PAD.

Overall awareness of the purpose of an AED ranged between 15-89% [20, 34, 36-43, 93, 96]. One longitudinal survey from South Korea reported that awareness increased over time, from 6% in 2007 to 31% in 2011 [94]. Knowledge about how to use an AED was less frequently reported (7-26%) [36, 39-40, 44, 96]. In two studies where survey respondents were questioned about a hypothetical scenario, just 6% [41] and 8% [93] spontaneously mentioned AED use as an appropriate treatment option.

There was limited knowledge about public-access AEDs and how to find them [33, 93]. Few people (5-22%) were able to locate their nearest public-access AED [20, 36, 39-40]. Standard AED location signs, designed to facilitate identification of a public-access AED, were recognised by 29% [37] and 40% [35] of respondents.

There was a belief by some people (19-40%) that AEDs could be used by members of the lay public, and not just by trained individuals or healthcare professionals [41, 44, 93].

Willingness to Use

Thirteen surveys [20, 34, 36-43, 48-49, 93], three qualitative studies [33, 47, 96], one before-and-after study [45] and one RCT [46] reported on issues that relate to willingness to use public-access AEDs for OHCA.

Willingness of laypeople to use public-access AEDs varied markedly between 12-87% [20, 37-43, 45, 48-49, 93]. 3% [36] and 30% [20] indicated willingness to retrieve a nearby AED. When asked specifically about retrieving *and then* using an AED in an English study, just 2% indicated willingness [36]. Reasons for not being willing included: not knowing how the device worked (40-85%) [37-39, 43, 45, 48] or not being comfortable using it (72% [40] and 84% [34]), fear of causing harm to the patient (14-88%) [39-41, 45, 49], and legal liability (4-38%) [38, 40-41, 43, 48-49].

One qualitative study reported that "most" respondents would feel more comfortable waiting for someone who was more competent in AED use to avoid causing more harm to the victim [96]. Qualitative interviews with laypeople trained in AED use revealed that they would be uncomfortable taking an AED to use in a distant location. Respondents cited a lack of clarity about their responsibility and potential liability in such a situation [47].

People were willing to obtain CPR and AED skills (88% [34]), and believed that such learning was relevant given the increasing number of public-access AEDs [33].

A Danish survey of laypeople before and after a mass education and media campaign about CPR demonstrated a statistically significant increase in the number of people indicating that they were "definitely" willing to use an AED on a stranger from 44% to 65% [45]. In Japan, more students and teachers indicated that they would "definitely" use an AED if required in 2014 [38] than in 2008 [43] (students 73% vs 12%; teachers 87% vs 35%). Willingness to use an AED increased in one US study from 71% to 83% if survey respondents were informed about legal liability protections for rescuers [48].

McDonald et al [46] conducted an RCT where a control group received a leaflet encouraging CPR and AED use, and the intervention group received the same leaflet with two additional "motivational" messages about CPR and AEDs. Both groups were laypeople with no previous experience of CPR. More people in the intervention group indicated that they would routinely check for a public-access AED (53% vs 37%, $p<0.03$) but there was no difference in the numbers reporting willingness to use an AED (40% vs 36%, p=ns).

Acquisition and Maintenance

Two observational studies [50, 52], five surveys [53-55, 57-58] and two qualitative studies [51, 56] reported on acquisition and maintenance of public-access AEDs.

Public-access AEDs were often acquired by donation or fundraising (68% [52] and 58% [53] rather than private purchase, and donation was a predictor of AED acquisition amongst college athletic departments in one study [58].

Several reasons for not obtaining an AED were reported: Cost (32-38%) [53, 57, 58]; concerns about liability (7-51%) [56-58]; not being thought necessary (13%) or not being considered (24%) [57]; lack of and/or attrition of responsible individuals [56]; there was a good EMS response locally (33%) [58]; and there was a nearby hospital (11%) [57].

One study reported that whilst 32% cited cost and 37% cited legal concerns as reasons not to obtain an AED, 55% thought affordability and 51% thought legal protection were good reasons to obtain an AED [58]. Strong lobbying from trade unions, previous OHCA and a belief that having one would mitigate risk were also influential reasons to obtain an AED [51].

Maintenance of AEDs was variable. One study reported that all but one of 206 AEDs were "operable" and ready for use [50], but many AEDs were not maintained (24% [53]) or had no formal plans in place for maintenance (18%) or replacement (24%) [54].

Availability and Accessibility

Twenty observational studies [25, 50, 59-65, 67-77] and three surveys [53-54, 66] reported on the availability and accessibility of public-access AEDs.

Only a proportion of OHCAs will occur in areas suitable for PAD – estimates of between 17-26% have been made [73, 76-77]. There is often a poor correlation between risk of OHCA by location and placement of AEDs [61, 63-64, 70, 72]. In urban areas 3-25% of OHCAs occurred within 100m of a public-access AED [25, 59, 62, 65, 67, 69]. In Philadelphia it was estimated that 70-80% of OHCAs would occur within 3 minutes walk of an AED [60].

Public-access AEDs were deemed to be in poorly accessible areas in between 18-59% of cases [50, 53-54, 66, 71] or not available all of the time. Out-of-hours there is a substantial reduction in AED availability [59, 68], reported as 34% in one study [68]. There was variation in the proportion of AEDs within 100m of an OHCA that were actually available for use at the time of the cardiac arrest (15-78%) [59, 62, 65]. In the PAD Trial, AED-related adverse events affecting AED availability were reported in 1.5% of cases [74].

Actual usage rates of public-access AEDs within 100m of an OHCA by bystanders were reported as 30% [65] and 0.6% [25]. In one residential trial site in the PAD Trial there was a PAD response (in the CPR/AED arm of the study) for only 25% of OHCA victims [75].

An analysis of temporal trends in Copenhagen between 2007-2011 demonstrated an increase in AED numbers, including in high-risk areas and an increase in OHCA coverage. Despite this, only 3% OHCAs in the time period occurred within 100m of an AED and only 9 had an AED applied before the arrival of EMS [67].

Training Issues

Ten surveys [20, 36, 39-40, 42, 48-49, 79, 90, 95], one observational study [78] and one qualitative study [47] reported on training issues affecting public-access AED use.

It was generally reported that previous training in CPR and AED use resulted in more people knowing what an AED is (77% vs 46% [20]); when to use an AED (79% vs 23% [39]); the location of the nearest public-access AED (39% vs 14% [20]; 5% vs 0.3% [36]; 84% vs 5% [39]); comfort levels in using an AED (50% vs 14% without assistance and 85% vs 48% with EMS assistance [40]); and who stated they would use an AED if required (42% vs 6% [20]; 3% vs 0.3% [36]; 25% vs 25%) [39]. 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 AED [95]. However, a study from Singapore found that CPR training was more widespread than AED training (11% had been trained in AED use vs 31% trained in CPR) [90].

Just one study, in high-school students, reported that prior AED training had no effect on willingness to use an AED (numbers not provided) [49].

In a written survey, greater training and knowledge were the most common reasons given that would increase willingness to use an AED [42]. Offering training increased willingness to use an AED from 71% to 91% in another study [48]. Successful use of an AED in

training and greater perceived self-efficacy in AED use were both positively associated with willingness to use an AED [79]. In qualitative interviews, in-situ scenarios rather than classroom-based training was felt to be more useful [47].

In the PAD Trial, volunteers who had actually responded to at least one medical emergency were more likely to have undertaken pre-trial CPR training and follow-up AED skills testing [78].

Registration and Regulation

Two observational studies [8,80] and one mixed-methods study [81] reported on registration and regulation of public-access AED.

In Stockholm (2006-2012), 72% cases of public-access AED use were with AEDs not previously known to the city's PAD programme [8]. In Washington state (2007-2009) 59% cases of public-access AED use were with AEDs not known to EMS [80]. In a mixed-methods study to identify as many PAD locations as possible in North Carolina (2001-2002), 18% were already known to EMS [81].

Prior registration of an AED in Stockholm's PAD programme did not have any effect on survival to one month in victims who received shocks from public-access AEDs (71% 'regulated' vs 70% 'unregulated') [8].

Medicolegal Issues

Only one article specifically examined the law around PAD and presented data on how this was being implemented [82]. The American Heart Association (AHA) has guidelines outlining 13 recommended elements for the successful running of a PAD programme. There was no jurisdiction in the USA that mandated all 13 of these elements. Whilst there is often civil immunity for rescuers who use AEDs, legal protections for those who set-up and medically oversee PAD programmes is more scarce.

EMS Dispatch-assisted AED use

Seven observational studies [24, 52, 62, 65, 80, 83-85], three simulation RCT [84, 86-87] and one other simulation study [37] reported on EMS Dispatch-assisted AED use.

AEDs, when available, were applied by members of the public after specific retrieval instructions from EMS in 4-41% cases [24, 52, 62, 65], variably defined as present within 100m and available for use [62, 65], an AED mentioned during emergency call [24], and the "nearest" AED [52]. EMS-assisted AED use, where reported, occurred in 0.07-5% of the total number of OHCAs in these studies [24, 62, 65]. Another study reported that from 58 OHCA when an AED was available within 0.1 mile, EMS notified the caller about the AED in just 3 cases, and there were no AED applications [80].

Simulated OHCA scenarios have demonstrated that EMS dispatch assistance resulted in a shorter time to AED retrieval and defibrillation [84], and correct use of an AED in 62% [37] and 79% [86] of cases. In a simulation RCT of adults over 75 years of age, those receiving EMS assistance over the telephone were more likely than those who received no assistance to correctly deliver an AED shock (91% vs 68%, p=0.001), although it took longer to do so (193s vs 148s, p = 0.001) [87].

Volunteer first-responder systems, in which nearby lay responders are notified by EMS via text-message of a nearby OHCA, have resulted in responders being first to apply AED in 9% [83] and 12% [85] of the total OHCAs in that system.

AED Locator Systems

One simulated RCT [88] reported that a web-based AED-locator software, accessible by mobile phone, made no impact on the time taken by bystanders to locate a nearby public-access AED and to bring it to an OHCA victim (mean 400s intervention groups vs 407s control, p = 0.92), despite a reduction in total travel distance (606m intervention vs 809m control, p = 0.019). The travel distances are worth noting as the actual distance to the AED in two simulated scenarios was just 120m and 170m.

Demographic Factors

Seven surveys [40-41, 48, 79, 90, 93, 95] and two observational studies [63,78] reported on demographic factors affecting public-access AED use.

Results from studies were variable. AED coverage was greater in areas where median household income and the proportion earning over $40,000 was higher although, contrastingly, there was also a slight increase in percentage unemployment (7% in 'high-access' AED areas vs 4% in 'low-access' areas). No racial differences were found [63]. AED knowledge was higher in North Americans compared to Europeans and 'Other' in one study [41]. Another reported that no demographic factor affected knowledge about an AED or the ability to identify one [40], and age and gender had no effect on either in a third study [93]. In Singapore, those who were male, under 35, spoke the Malay language, had A-levels or Diploma or who were currently employed were more likely to have been trained in the use of an AED [90].

Schober et al [41] reported that women and those under 25 and over 60 would be less willing to use an AED, but others reported that more people aged 17-29 or male was associated with willingness to use an AED [95] and two other studies reported no age or gender differences in future willingness to use an AED [48 79]. In the PAD Trial, age and gender had no effect on likelihood of having responded to an emergency, but ethnic minority status and formal education beyond high-school made it less likely that a person had responded [78].

Human Factors

Three qualitative studies [89, 91-92], one survey [90] and observational study [74] reported on human factors affecting AED use.

Rescuer-related adverse events in the PAD Trial were rare, with just 7 reported out of 20,396 volunteers trained [74]. Four of these were due to emotional stress requiring intervention. In interviews first volunteer first-responders activated by text message in Netherlands, 81% reported no stress after the event, and the other 19% reported mild stress only. Not being able to attach an AED was associated with the likelihood of experiencing mild stress [89]. People innately trust AEDs [91], and can develop an inbuilt resilience when responding with an AED [92].

However, people's beliefs about AED training differ from their actions. In Singapore 57% believed all adults should train in AED use, but only 4% had been trained themselves and held up-to-date qualifications [90].

Discussion

Main Findings

This review highlights a number of key barriers to Public Access Defibrillation. Few people know what an AED is, where to find one, or how and by whom one can be used. There is variation in the proportion of people willing to use an AED reported in studies,

but lack of confidence and fear of harm are common themes. Many organisations do not feel that they should obtain an AED or feel unable to do so. Only a minority of OHCAs occur in locations suitable for the timely deployment of a public-access AED. AEDs are often poorly accessible or have limited availability, and are often not known to EMS or those running PAD schemes.

Training increases awareness of AED function, comfort with and willingness to use one, but more people believe in the value of AED training than have actually received it. There are no consistent findings to suggest that any one section of society is more or less willing or able to use an AED.

The Wider Context

Capital investment and efforts to increase public-access AED numbers are commendable, but it is at least as important to maximise use of the resources that are currently available. Accurately locating and plotting OHCAs using geographical mapping software can target the best locations for existing or new AEDs [69, 97-98]. A common problem, though, seems to be that AED located within 100m of an OHCA are not always available for public use [62, 65, 68]. Many OHCAs occur outside of 'normal business hours', and many public-location AEDs are *not* available at these times [68]. Targeted location of AEDs will be most effective if combined with efforts to improve actual availability.

A focus on the fact that PAD is available and safe for all bystanders to use [1, 3], regardless of previous training, would also be of use. However, findings from this review indicate that prior training and experience affect willingness to use PAD in OHCA, and many other studies have reported that bystanders who do intervene often have some form of medical or first-aid training [9, 52, 99]. There must be a balance between emphasising that public-access AED can be used by untrained bystanders, but that widespread training is likely to contribute to increased PAD.

Increased survival has been demonstrated in victims who receive PAD before the arrival of EMS from 'public-place' AEDs compared to first-responder AED use [7-8, 14]. The effective coverage range of an AED (i.e. the distance from an AED that an OHCA can occur for its retrieval to be of potential benefit) has not been determined, although 100m [25, 62, 65, 69] and 500m [85] have been suggested in published studies. Determining the likely effective range of a public-access AED will help optimise their placement in the future.

There is a substantial potential for EMS dispatchers to provide telephone assistance to help bystanders locate and use AEDs, but this rarely happens at present. In addition, EMS-activated text-alert systems can direct lay responders to OHCAs to provide CPR and PAD [83, 85]: these and similar mobile phone app-based systems are likely to become more widespread in the near future. The future for cases of suspected OHCA is likely to involve a mixture of both of these approaches.

Strengths and Limitations

This was a wide-ranging review, collating a large amount of information about the possible reasons behind the low use of public-access AEDs seen in populations across the world. It provides an idea of what the main barriers are to successful AED deployment, and this will allow researchers to better consider the design of interventions to overcome these barriers.

The wide-ranging nature of the topic "barriers and facilitators to PAD" made choosing search terms for electronic database searches problematic. It was difficult to be inclusive whilst retaining a feasible number of articles to review. The approach used in this paper of an extensive literature review using the expert knowledge in our research group, later re-enforced by a search across electronic databases, was a good compromise. Doubtless, these problems, and the overlap with articles reporting on bystander CPR (with which PAD is likely to be intrinsically linked) mean that there are articles that we may have failed to include. This review did not consider conference abstracts or information in the grey literature, and so more information about this topic is likely available but not reported here. We have attempted to systematise what was essentially a narrative review, and so this paper represents the most comprehensive review of barriers and facilitators to PAD deployment in OHCA to date.

Much of the evidence can be considered of low quality. There was great heterogeneity in how the surveys reported in this review were performed (e.g. face-to-face, written, online; with open questions or semi-structured questionnaires). None of the

questionnaires were subject to any external validation, and all surveys are subject to response bias. Database and registry reviews are reliant upon the accuracy and completeness of the data recorded in them. The RCTs reported were small-scale, and all but one involved simulated OHCA scenarios.

Implications for Clinical Practice

PAD is a proven clinical intervention that is infrequently used, and so is an excellent target for interventions to increase its use. However, many of the articles were either observational in nature or surveys, and there was great heterogeneity in how studies were conducted. As such, they represent low-quality evidence [32].

This review, then, highlights weaknesses in much of the work done to highlight barriers and facilitators to PAD. It is difficult, therefore, to advocate directly for any change in practice or policy to improve PAD.

Future Research

What is striking from the articles presented in this review is that the majority report on barriers to PAD rather than facilitators. There is also a lack of information about how to overcome these barriers, or find and test solutions in order to improve PAD.

A robust approach to develop theoretically-informed interventions to overcome barriers to PAD is appropriate. Validated frameworks exist to categorise data related to individuals' behaviour, such as the Theoretical Domains Framework [100], and this could be used to identify behavioural themes related to decisions about AED use. This framework can be linked to validated models for identifying behavioural changes [101] and ways in which these can be implemented [102]. This is an integrated and robust method to synthesise new evidence and develop potential interventions [103].

Conclusion

PAD represents an efficacious means of improving OHCA survival, but its effect at a population level is greatly hampered by low usage rates. The available evidence regarding the barriers and facilitators to the deployment of PAD in OHCA is mostly of low quality and cannot directly inform changes in policy in practice. An increase in PAD will require robust methods to identify barriers to public-access AED use and theoretically-informed interventions developed using validated frameworks.

(4,523 words)

Conflict of Interest Statement

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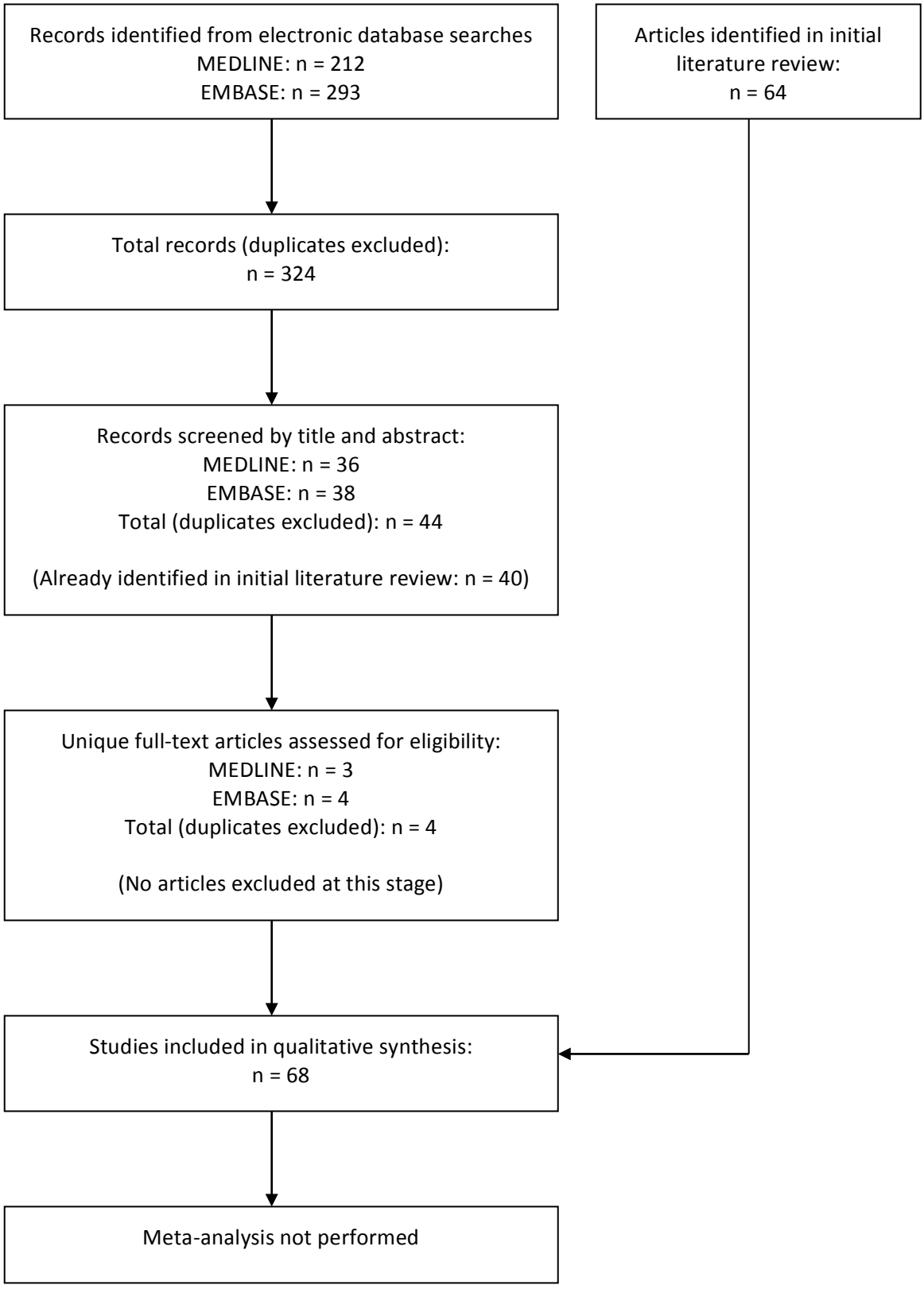
Figure Legends

Figure 1: Study Selection Process

Figure 2: Barriers and Facilitators to Public Access Defibrillation: Key Themes

Figure 1


Records identified from electronic database searches
MEDLINE: n = 212
EMBASE: n = 293
Articles identified in initial literature review:
n = 64
Total records (duplicates excluded):
n = 324
Records screened by title and abstract:
MEDLINE: n = 36
EMBASE: n = 38
Total (duplicates excluded): n = 44
(Already identified in initial literature review: n = 40)
Unique full-text articles assessed for eligibility:
MEDLINE: n = 3
EMBASE: n = 4
Total (duplicates excluded): n = 4
(No articles excluded at this stage)
Studies included in qualitative synthesis:
n = 68
Meta-analysis not performed

KNOWLEDGE AND AWARENESS [20, 33-44, 93-94, 96]

- Limited knowledge of how/when to use AED (B)
- Few know location of nearby AED (B)
- Limited recognition of AED location signs (B)
- Belief that AED for use by trained personnel (B)
- Varying knowledge of what an AED is (B,F)

WILLINGNESS TO USE [20, 33-34, 36-43, 45-49, 93, 96]

- Fear of using AED incorrectly (B)
- Fear of doing harm (B)
- Lack of confidence in using AED (B)
- Few people prepared to locate / retrieve AED (B)
- Variation in number willing to use AED (B,F)
- Belief that people should learn CPR/AED (F)
- Few people had legal/liability concerns (F)

ACQUISITION AND MAINTENANCE [50-58]

- Cost, AED not being thought necessary, lack of responsible individuals, liability concerns were reasons for not obtaining AED (B)
- Maintenance plans for AED often inadequate (B)
- AED often obtained by donation/fundraising (F)
- Previous OHCA / strong lobbyist key reasons for obtaining AED (F)

AVAILABILITY AND ACCESSIBILITY [25, 50, 53, 54, 59-77]

- Minority of OHCA occur close to an AED (B)
- Many AED not accessible 24/7 (B)
- Many AED in poorly accessible/visible areas (B)
- AED often only available to on-site trained personnel (B)
- Public-access AED used in few occasions when one was nearby and available (B)
- AED-related adverse events are rare (F)

TRAINING ISSUES [20, 36, 39-40, 42, 47-49, 78-79, 90, 95]

- Training increases knowledge and comfort about AED use (F)
- Training increases willingness to locate and use AED (F)

REGISTRATION AND REGULATION [8, 80-81]

- AED often not known to EMS or those running PAD schemes (B)
- Regulation of AED may not affect survival chances if AED used (N)

MEDICOLEGAL ISSUES [82]

Single study (US):
- No state mandates all AHA recommendations about PAD programmes in law (B)
- Quality improvement rarely mentioned (B)
- Civil immunity for rescuers often mentioned (F)

DISPATCH-ASSISTED AED USE [24, 37, 52, 62, 65, 80, 83-87]

- EMS refer minority of callers to nearby AED (B)
- Volunteer responders alerted via text message by EMS connect AED first in some cases (F)
- Simulation: dispatcher involvement allows quicker AED retrieval and correct use (F)

AED LOCATOR SYSTEMS [88]

Single Study (Japan):
- Web-based AED location software did not reduce time to AED retrieval (N)

DEMOGRAPHIC FACTORS [40-41, 48, 63, 78-79, 90, 93, 95]

- Disagreements about the effect of age, gender, employment status, ethnicity and income on the ability or willingness to use AED (N)

HUMAN FACTORS [74, 89-92]

- Few who believe in AED training have training themselves (B)
- Rescuer-related adverse events, including stress, are low after AED use (F)
- People trust the AED to perform as designed (F)

(B)	Barrier
(F)	Facilitator
(N)	Neutral
AED	Automated External Defibrillator
AHA	American Heart Association
CPR	Cardiopulmonary Resuscitation
EMS	Emergency Medical Services
OHCA	Out-of-hospital cardiac arrest
PAD	Public Access Defibrillation

Figure 2

Supplementary Files (available at journal website)

1. Electronic Database Search Strategies
2. Table S1: Barriers and Facilitators to Public Access Defibrillation – Data Collection Table
3. PRISMA Checklist
4. Complete Reference List