Dew, Rosie, Norton, Michael, Aitken-Fell, Paul, Blance, Phil, Miles, Steven, Potts, Sean and Wilkes, Scott (2024) Knowledge and barriers of out of hospital cardiac arrest bystander intervention and public access automated external defibrillator use in the Northeast of England: a cross-sectional survey study. Internal and emergency medicine. p. 211. ISSN 1970-9366

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Title Page

Article title: **Knowledge and Barriers of Out of Hospital Cardiac Arrest Bystander Intervention and Public Access Automated External Defibrillator Use in the Northeast of England. A Cross-sectional Survey Study.**

Authors

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***Word count*:** 4208

***Number of figures and tables*:** 6 tables

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Statements and Declarations

Ethics approval and consent to participate

Ethical approval was granted by the University of Sunderland Research Ethics Committee. Identifiable personal data were not collected from participants. Participation was voluntary and agreeing to answer the survey was considered as consent to participate in the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors state they have no conflicts of interest

Funding

This project was funded by Cardioproof CIC

Authors' contributions

MN, RD and SW designed the study. RD, MN, PA-F, PB, SM and SP collected the study data. RD analysed the data and wrote the first draft of the paper with MN. All authors reviewed and edited the paper.

Acknowledgements

The authors would like to thank all participants who took part in this study. Thank you to the North East Ambulance Service (NEAS) for their support. The authors would like to thank Liam Townend, Aoife Norton and Ciara Norton for their help during this project.

List of abbreviations

OHCA: out of hospital cardiac arrest; AED: automated external defibrillator; CARES: Cardiac Arrest Registry to Enhance Survival; PAD: public access automated external defibrillator; OR: odds ratio; CI: Confidence Interval; NRCPR: National Registry of Cardiopulmonary Resuscitation; CPR: cardiopulmonary resuscitation; CA: cardiac arrest; BLS: Basic Life Support; DH: The Department of Health; CARU: Cardiac Arrest Response Unit

Abstract

Introduction: Intervention by members of the public during an out of hospital cardiac arrest (OHAC) including resuscitation attempts and accessible automated external defibrillator (AED) has been shown to improve survival. This study aimed to investigate the OHCA and AED knowledge and confidence, and barriers to intervention, of the public of North East England, UK

Methods: This study used a face-to-face cross-sectional survey on a public high street in Newcastle, UK. Participants were asked unprompted to explain what they would do when faced with an OHCA collapse. Chi-Square analysis was used to test the association of the independent variables sex and first aid trained on the participants' responses.

Results: Of the 421 participants recruited to our study, 82.9% (n=349) reported that they would know what to do during an OHCA collapse. The most frequent OHCA action mentioned was call 999 (64.1%, n=270/421) and 58.2% (n=245/421) of participants reported that they would commence CPR. However, only 14.3% (n=60/421) of participants spontaneously mentioned that they would locate an AED, while only 4.5% (n=19/421) recounted that they would apply the AED. Just over half of participants (50.8%, n=214/421) were first aid trained, with statistically more females than males being first aiders ($p=0.01$ $\chi^2=7.41$). Most participants (80.3%, n=338/421) knew what an AED was, and 34.7% (n=326/421) reported that they knew how to use one, however, only 11.9% (n=50/421) mentioned that they would actually shock a patient. Being first aid trained increased the likelihood of freely recounting actions for OHCA and AED intervention. The most common barrier to helping during an OHCA was lack of knowledge (29.9%, n=126/421)

Conclusion: Although most participants reported they would know what to do during an OHCA and had knowledge of an AED, low numbers of participants spontaneously mentioned specific OHCA and AED actions. Improving public knowledge would help improve the public's confidence of intervening during an OHCA and may improve OHCA survival.

Keywords

Out of hospital cardiac arrest, public access defibrillator, automated external defibrillator, bystander intervention, public knowledge

Background

In the UK it is estimated that around 60,000 out of hospital cardiac arrests (OHCA) occur each year (1). For the estimated 30,000 arrests where emergency medical services (EMS) initiate resuscitation, rate of survival is still low at around 9% (2). However, there is a significant body of evidence showing that bystander cardiopulmonary resuscitation (CPR) significantly improves outcomes after OHCA (3, 4). Moreover, rapid defibrillation by bystanders using an automated external defibrillator (AED) has shown improved survival rate to hospital discharge (5-7) and discharge with favourable functional outcome (7), as well as being a cost-effective OHCA intervention (6). Moreover, studies have shown that the earlier the defibrillation following an OHCA the better the survival outcomes, most notably within the first 3 minutes after collapse (8), and each 1-minute delay of first defibrillation has been associated with a reduction in the likelihood of good neurological recovery in patients with OHCA who presented with ventricular fibrillation (9)

Although it is well documented that defibrillation by a member of the public improves outcomes following an OHCA, access to, and knowledge of AEDs is an issue and public access defibrillation is only used in 0.2–4.3% of all OHCA (10). Reported bystander defibrillation use has seen little change with time, with some studies showing only 1.1% increase in bystander defibrillation in a 9 year period (11).

Previous research investigating public knowledge of bystander intervention has been conducted in a number of countries and has shown general low understanding. In an Australian telephone survey, around half (50.5%) of participants stated they would give chest compressions during an cardiac arrest (CA) scenario (12), and a UK

based survey study recorded lower levels, with 41.4% of participants spontaneously stating they would perform CPR during an OHCA (13), while an Austrian questionnaire study found 33% of participants would be willing to perform CPR (14). In terms of AED intervention, even lower public confidence has been found with only 5.3% of participants in a Taiwanese telephone interview study stated they had the confidence to use an AED (15). In a US study, 2.2% of respondents of a convenience survey spontaneously mentioned defibrillation when questioned on their attitudes to a CA (16), and similar results were found in the UK with only 2.1% of participants stating they would apply and use a PAD (13). Additionally, common misconceptions of CPR and AED knowledge were seen in Saudi Arabia and 92.3% of participants were unsure on how to use an AED correctly (17).

Barriers to bystander AED use have also been investigated, the initial fear of using the AED incorrectly and legal liability were stated by 57% and 28% of respondents respectively in a survey in a US shopping mall (18). Furthermore, a UK study has shown more than 60% of community PADs lack signage (19), likely exacerbating low public knowledge.

Public knowledge can be increased by education, and studies have found training in AED use (18, 20) and Basic Life Support (BLS) (20, 21) increases the likelihood of intervention by bystanders. Furthermore, a meta-analysis showed community interventions, such as training the lay public in CPR, were associated with greater bystander CPR rate (OR, 1.28 and 95%CI, 1.06, 1.54) and increased survival to discharge or 30-day survival (OR 1.34 and 95% CI 1.14, 1.57) (22)

The Department of Health (DH) stated that bystander resuscitation rates is an area which seeks improving (23), and in 2013, the UK government's Cardiovascular Disease Outcomes Strategy for England set a target of increasing survival from OHCA by 50% giving 1000 additional lives saved each year (24), and improvements in patient outcomes following an OHCA is part of the National Health Service (NHS) long term plan published in 2019 (25), as well as there being international efforts to improve OHCA outcomes (26). For this to be supported, increasing the public knowledge and confidence of public access AED (PAD) is essential.

Public knowledge and confidence of PAD has been previously explored in Southampton, in the South of England (13), however, it is unknown what the beliefs are of the members of public in the North of England. This is of

interest as there are documented differences, such as areas of deprivation (27) and population demographics (28, 29) between the north and south of England, and bystander resuscitation varies by area in England (30). The overall aim of this study was to ascertain the public's level of knowledge and awareness of CA and PAD, the perceived barriers to helping during an OHCA, and the experience of AED use in the north of England. We also aimed to provide educational information on OHCA and AED use to help improve understanding and attitudes to the use of an AED to address the barriers to responding to an OHCA and improve the rate of bystander AED use.

Methods

Setting

This study used a face-to-face cross-sectional survey method to collect data. The study was performed on Gosforth High Street in Newcastle-upon-Tyne, in the North East of England. Data collection took place from January and August 2018 between 11:00 and 18:00 on both weekdays and weekends. Gosforth High Street is approximately 1.2Km long (31), with a variety of amenities including shops, restaurants, pubs, a gym, a church and businesses on either side of a road. In 2018, Gosforth High Street had two PADs within approximately 200 metres of each other. Ethical approval was granted by the University of Sunderland Research Ethics Committee.

Participants and Sampling

In 2011, the resident population of Gosforth was 20,136 (32). From a sample size calculation considering the total population size of the area (20,136), the required confidence interval (95%), the margin of error (5%) and z-score (1.96), to support an accurate reflection of the total population (33), this study aimed to recruit a minimum convenience sample of 377 members of the public. A lower age limit was not set since there are endorsements by the World Health Organisation in training school children in CPR (34, 35), and children under 16 were questioned if they volunteered to participate and there was consent from an adult guardian.

The research team stood approximately in the middle of Gosforth High Street. Interviewers either wore full paramedic outfits or wore a jacket with the North Ambulance Service (NEAS) logo on and were accompanied by a parked NEAS Cardiac Arrest Response Unit (CARU) car to distinguish the research team. Members of the public were approached by researchers and invited to take part in a questionnaire. The interviewers were non-

discriminatory in their choice of participants and the closest member of the public was invited to participate. No participant exclusion criteria were used, and all members of the public on Gosforth High Street at the time of the study session were considered potential participants.

Questionnaire

Members of public that agreed to participate were presented with a questionnaire consisting of nine questions, and was based on the semi-structured questionnaire used by Brooks et al., (13) which included questions regarding BLS, bystander CPR, AED knowledge and first aid training. In our study we separated question 2 from Brooks et al.,'s questionnaire into 2 different questions, and participants were asked separately if they knew what an AED was, and where they might find one. Additionally, our questionnaire also investigated whether a participant knew the difference between a CA and a heart attack, whether there was anything that would prevent them from helping in a situation when someone had collapsed following a presumed CA, if they knew where the closet AED was, and how often they visit Gosforth High Street. A copy of our questionnaire is available (see additional file 1).

Participants were required to spontaneously suggest answers to the survey questions and were not prompted. Paper based questionnaires were used and participant answers were marked in pen on the questionnaire by the researchers. Since this study sought to help improve knowledge, the researchers provided informative answers to participants if they do not know the answer to the survey questions with the aim to help improve the public's knowledge.

Data analysis

Questionnaire answers were collated and entered into a Microsoft Excel spreadsheet. Results were analysed using SPSS Statistics for Windows®, Version 24 (IBM, Armonk, NY: IBM Corp). Questionnaire answers are reported as count and percentage, and continuous data are presented as median and range. Chi-Square analysis was used to test the association of the independent variables sex (male/female) and first aid trained (yes/no) on the participants' responses. Answers to question 3 "*Is there anything that might prevent you from the*

above/helping?" were coded and grouped into categories and overarching themes. Content analyses were used to calculate frequencies of themes (36).

Results

Participants

A total of 421 participants were recruited to our study across 10 study sessions; the average number of participants sampled per session was 34. The median participant age was 47 years (range 10-92 years) and 52.3% (n=220/421) of the participants were female (Table 1). The majority of participants visited Gosforth High Street weekly or more often (72.9%, n=307/421). Information on the number of members of public declining participation or withdrawing the questioning was not recorded.

[Table 1 near here]

First Aid Training

Just over half of the respondents claimed to have first aid training (50.8%, n=214/421), with significantly more females than males being first aiders (57.3% n=126/220 females and 43.9% N=87/198 males, p=0.01 χ^2= 7.41, Table 2). The location or source of first aid training and the length of time since training are shown in Table 3. Of the participants who could recall the location of their first aid training, training received from a charity and through work were the most frequently mentioned by participants (14.0%, n=30/214 and 11.7%, n=25/214 respectively). Nearly half of participants reported they received first aid training more than 3 years ago (48.1% n=103/214), while 20.6% (n=44/214) had received first aid training within the past year.

[Table 2 & 3 near here]

Cardiac Arrest Knowledge

Out of all the respondents, 30.9% (n=130/421) identified the difference between a heart attack and a cardiac arrest (Table 2), and little difference between sex was seen (29.8%, n=59/198 of males and 32.4%, n=71/220 of females, p=0.56 χ^2=0.33). Significantly more first aiders were aware of the difference between a heart attack and a cardiac arrest than non-first aiders by a relative percentage difference of 70.2% and an absolute

percentage difference of 16.0% (38.8% n=83/214 *versus* 22.8% n=47/207 respectively, p<0.001 χ^2=12.53**,** Table 2).

Response to a Collapse following an Out of Hospital Cardiac Arrest

Most respondents (82.9%, n=349/421) reported that they would know what to do if someone were to collapse in front of them with a presumed CA (Table 2). Moreover, 91.6% (n=196/214) of first aiders compared to 73.9% (n=153/207) of non-first aiders stated they would know what to do (p<0.001 χ^2=23.19) and little difference was seen between sex (80.3%, n=159/198 of males *versus* 85.5%, n=188/220 of females, p=0.16 χ^2=1.96).

When asked what they would specifically do in response to a collapse following a CA, most participants spontaneously reported that they would call 999 (64.1% n=270/421) and commence CPR (58.2%, n=245/421), while 24.0% (n=101/421), 17.6% (n=74/421) and 14.3% (n=60/421) reported they would check breathing, shout for help and locate a defibrillator respectively (Table 2). Only 9.7% (n=41/421) participants reported they would check for a response, while 4.5% (n=19/421) claimed they would apply the defibrillator, and 3.3% (n=14/421) reported they would continue CPR until the ambulance arrives. Compression ratio or rate was rarely spontaneously mentioned by participants, and only 3.1% (n=13/421) and 1.4% (n=6/421) claimed they would use a compression/breath ratio of 30:2 or a compression rate of 100-120/minutes respectively.

Out of the actions for cardiac arrest mentioned by participants, little difference was seen between sex, except an absolute difference of 10% more females than males reported they would call 999 (59.1% n=117/198 of males *versus* 69.1% n=152/220 of females, p=0.03 $\chi^{2=}$4.54, Table 2).

A greater proportion of first aiders mentioned actions for cardiac arrest than non-first aiders for all actions (Table 2). Additionally, statistically significant differences were seen between first aiders and non-first aiders for shout for help (22.0%, n=47/214 *versus* 13.0% N=27/207, p=0.02 χ^2=5.78), check for response (15.4%, n=33/214 *versus* 3.9% n=8/207, p<0.001 χ^2=15.99), check breathing (31.8%, n=68/214 *versus* 15.9%, n=33/207, p<0.001 χ^2=14.47), commence CPR (68.2%, N=146/214 *versus* 47.8%, n=99/207, p<0.001 χ^2=18.00), locate defibrillator

(20.6%, n=44/214 *versus* 7.7%, n=16/207, p<0.001 χ^2=14.18), and apply defibrillator to patient and use if appropriate (7.0%, n=15/214 *versus* 1.9%, n=4/207, p=0.01 χ^2=6.29).

Factors preventing intervention during an Out of Hospital Cardiac Arrest

The barriers to helping during a CA stated by participants are shown in Table 4. Almost a third of participants (29.9%, n=126/421) remarked that there were barriers preventing them from helping, and little difference was seen between males and females (27.3%, n=54/198 of males and 32.7%, n=72/220 of females, p=0.23 χ^2=1.47 Table 2). More first aiders (40.7%, n=87/214) commented that there were barriers preventing them from helping than non-first aiders (18.8%, n=39/207) by an absolute percentage difference of 21.9% (p<0.001 χ^2=23.87) (relative percentage difference of 114.9%) (Table 2). The most common barrier stated by 42.1% (n=53/126) of our participants was lack of knowledge (Table 4)

[Table 4 near here]

AED and AED location

The majority of participants knew what a defibrillator was (80.3%, n=338/421, Table 5), with significantly more first aiders than non-first aiders accurately describing an AED (91.1%, n=195/214 *versus* 69.1%, n=143/207 p<0.001 χ^2=32.29). Similar findings were found amongst females and males for AED knowledge (Table 5).

At 74.3% (n=313/421), most respondents knew where defibrillators were generally located (Table 5), with more first aiders (81.8%, n=175/214) than non-first aiders (66.7%, n=138/207) describing AED locations (p<0.001 χ^2=12.59). Statistically more females than males were aware of AED locations by an absolute percentage difference of 10.3% (79.5%, n=175/220 of females and 69.2%, n=137/198 of males, p=0.02 χ^2=5.90). The most common locations to find an AED suggested by participants were sport centres (22.7%, n=71/313) and hospitals (21.4%, n=67/313) (Table 6).

Of all respondents, only 20.9% (n=88/421) recounted that they knew where the closest defibrillator was, with small differences observed between sex (17.7%, n=35/421 of males and 24.1%, n=53/421 of females). Significant

difference, however, was seen amongst first aiders and non-first aiders with more first aiders recounting the location of the nearest AED (28.5%, n=61/421 of first aiders *versus* 13.0%, n=27/421 non-first aiders, relative percentage difference of 119.2%).

A higher proportion of respondents who reported they visited Gosforth High Street weekly or more often knew where the closest AED was compared to those who visited less than weekly (25.7%, n=79/421 for ≥weekly and 10.2% n=9/421 for <weekly, $p<0.001$ $\chi^2=16.00$, Table 6).

[Table 5 near here]

[Table 6 near here]

Knowledge of AED Operation

Out of all the respondents, 34.7% (n=146/421) stated they knew how to operate an AED, and no statistical difference was observed between sex for any AED action (Table 5).

Of all participants, 16.2% (n=68/421) freely recounted they would open the AED and 25.2% (n=106/421) of participants claimed they would listen and follow instructions. 19.7% (n=83/421) of respondents recounted they would apply adhesive pads in the correct area on chest, and 5.7% (n=24/421) stated they would await analysis of rhythm (Table 5). Additionally, 9.5% (n=40/421) and 11.9% (n=50/421) of respondents spontaneously claimed they were aware to be clear of the patient before shocking, and to shock the patient if advised. Only 3.8% (n=16/421), 1.7% (n=7/421) and 1.9% (n=8/421) of participants stated they would continue CPR should shock not be advised/successful, call 999 and follow instructions from 999, respectively (Table 5).

All AED actions were statistically different between first aiders and non-first aiders, with a larger proportion of first aiders having a greater knowledge of AED use than non-first aiders (Table 5). This was most apparent for self-reported defibrillator knowledge (51.9%, n=111/214 *versus* 16.9%, n=35/207 of first aiders and non-first aider respectively, $p<0.001$ $\chi^2=56.77$), listen and follow instructions by 26.5% (38.3%, n=82/214 *versus* 11.8%, n=24/207 of first aider and non-first aider respectively, $p<0.001$ $\chi^2=40.83$) and apply adhesive pads in the correct

area on chest by 20.6% (29.9%, n=64/214 *versus* 9.3%, n=19/207 of first aider and non-first aider respectively, $p<0.001$ $\chi^2=29.19$).

More first aiders recounted that they would open the AED than non-first aiders (23.8%, n=51/214 *versus* 8.3% n=17/207 respectively, $p<0.001$ $\chi^2=19.38$, Table 5), were aware people should be clear of patient before shocking (17.2%, n=36 *versus* 2.0% n=4 respectively, $p<0.001$ $\chi^2=27.50$), and freely mentioned they would shock a patient (21.1%, n=44/214 *versus* 2.9%, n=6/207 respectively, $p<0.001$ $\chi^2=31.82$). Moreover, the AED actions which were lesser mentioned, including await analysis of rhythm, continue CPR should shock not be advised/successful, and follow instructions from 999, were infrequently mentioned by non-first aiders (≤0.5%), with no non-first aiders mentioning that they would call 999. Although more first aiders claimed they would perform these AED actions, low counts were still observed for spontaneous mention of call 999 and follow instructions from 999 (both 3.3%, n=7/214). However, a much higher relative difference was seen between first aiders and non-first aiders for await analysis of rhythm (11.0%, n=23/214 of first aiders *versus* 0.5%, n=11/207 of non-first aiders, $p<0.001$ $\chi^2=20.85$).

Discussion

Summary of main findings

This study investigated the knowledge and confidence of the public in intervening during an OHCA. Although most participants stated they would know what to do during an OHCA and knew what an AED was, when questioned further, low knowledge was recorded, and generally low numbers of participants spontaneously mentioned specific bystander OHCA responses and AED actions. Moreover, over half of our participants stated that lack of knowledge was a barrier to helping during an OHCA and first aid training was found to statistically increase knowledge of OHCA responses and AED actions.

Comparison with other literature

In comparison to a similar survey study by Brooks et al., conducted in South West England, similarities in the percentage of participants reporting that they would know what to do if someone were to collapse in front of them with a presumed CA, the CA actions call 999 and 30:2 compression ratio were found (13). Similar numbers

have also been reported for those who stated they would commence CPR in an Australian survey study (12), however, this study reported that women were less likely than men to state that they would give chest compressions (12), moreover, females reported a lower willingness to initiate basic life support (BLS) attempts and to use an AED device in a Austrian survey study (14). In our study, out of most questions asked, little difference was seen between sex, except for statistically more females than males reported they would call 999, and more females than males were aware of AED locations. This may reflect the statistically higher levels of first aid training in females in our study cohort, whilst the above studies did not compare first aid training between sexes. Although there was mostly little difference between our male and female responses, the higher proportion of first aid training within the female cohort suggests that initiatives to increase recruitment of males to first aid training may be needed in the North East of England.

Lower numbers of first aiders who spontaneously mentioned check for response and check breathing were recorded in our study compared to the study by Brooks et al. (13) (15.4% *versus* 50% and 31.8% *versus* 58% respectively). Moreover, only 5.2% of Brooks et al.'s participants spontaneously recounted that they would locate a defibrillator while 20.6% of our participants did. Overall, although both conducted in England, the discrepancies noted above between studies may have occurred due to differences in locations, populations and data collection year used in the studies. Moreover, variation in bystander responses has been reported in the literature, for example, a systematic review of surveys and qualitative interviews concluded that overall awareness of the purpose of an AED ranged between 15-89% (10), which accounts for the variation seen between our participants (80.3%) and those from Brooks et al.'s study (69%) who stated they knew what a defibrillator was.

Another discrepancy between our results and those published included an Austrian telephone survey study which reported more than two-fold more participants would check for breathing compared to our study (52% *versus* 24% respectively) (14), however, significantly higher levels of our participants self-reported that they would commence CPR (58% *versus* 33%). Again, these differences could be attributable to the variances between survey study stated above, and specifically the questionnaire used with different phrases and 4 different answer options provided to the participant by the researchers.

Similar to our findings, research has also found more first aiders self-reported actions for cardiac arrest (12, 13) and AED actions (13) than non-first aiders. Significantly more females than males were first aiders in our study, with similar findings in other studies from the UK (20) and Australia (37, 38), but not in Singapore (39), additionally, more females than males were aware of AED locations.

Of all our respondents, 74.3% could name potential AED locations, however, only 20.9% recounted that they knew where the closest defibrillator was, which is at the top end of the range of 5–22% of people who collectively reported they were able to locate their nearest PAD in a systematic review (10). This is considerably higher than the 5.1% of people who knew where or how to find their nearest PAD in the study by Brooks et al. (13).

More CA actions and all AED actions were reported statistically more by first aiders than non-first aiders in our study, and more first aiders recounted the location of the nearest AED than first aiders. This aligns with the literature where previous training in CPR and/or AED use is associated with improved CPR psychomotor skills (40), increased likelihood of performing CA actions (41), increased AED and PAD location knowledge (12) and confidence in AED use (12, 16).

A recent systematic review and meta-analysis of patients with OHCA found rates of bystander CPR and survival to discharge were lower for patients from more deprived communities than those from higher socioeconomic status (SES) communities (42). Since Gosforth is an affluent area of Newcastle, a relatively high proportion of bystander intervention could be assumed. Moreover, in 2011 it was found that patients in the least deprived areas were more likely to receive bystander CPR than those from the most deprived areas (23.3% *versus* 14.5%) in the North East of England (43). These proportions are lower than the findings from our study (58.2% freely stated they would commence CPR) and may be due to the discrepancies between participant responses to a survey compared to actual bystander intervention, but may also indicate an increase in knowledge and awareness over time within the region.

Almost a third of our participants remarked that there were barriers preventing them from helping during a collapse following a CA with the most common barrier stated by these participants being lack of knowledge. Fear of not having the skills and/or causing harm are also the most common barriers previously mentioned for

CA actions (12, 15, 39) and PAD use (10, 15, 39) in the literature, which supports the need of training to enhance knowledge and increase bystander confidence.

Limitations and Future Implications

A main limitation of this study is self-selection of participants, reducing the representativeness of our findings. Furthermore, answers to the survey questionnaire may not represent what an individual would do under pressure at a time of a OHCA collapse, and we did not record the participant response rate. Gosforth is an affluent area, and similar research in deprived areas of Newcastle and the UK would provide deeper insights. However, 10.0% (N=42) of participants stated they only visit Gosforth once a year, and our findings still show low knowledge within a potentially affluent participant sample.

Since disparities in intervention, healthcare and outcomes have been seen in deprived communities and ethnic minorities (44), further exploration of the demographic factors such as ethnicity, education level and employment (10) in the UK and their role on AED coverage, knowledge, training and confidence in their use would provide deeper insights. Moreover, data were collected in 2018 and so may be somewhat dated, and investigation into the affect the COVID-19 pandemic (45) and the novel developments in OHCA intervention such as smartphone-based use (46), or drone delivery of AEDs (47-49) on bystander response, warrants further research. Notwithstanding the above limitations, this survey study used a suitable sample size and provides further understanding into public knowledge and confidence in the use of AEDs, the barriers to helping during a CA and acquiring an AED on a public high street in the North East of England.

Conclusion

Although most participants reported they would know what to do during an OHCA and what an AED was, low numbers of participants spontaneously mentioned OHCA responses and AED actions, suggesting low knowledge. The most frequent OHCA actions mentioned were call 999 and commence CPR. Just over half of participants were first aid trained, with more females being first aiders. Only around a fifth of participants knew where the closest AED was.

Knowledge of CA and AED actions, and location of the nearest AED are barriers to public OHCA intervention. Our results show that first aid training improves knowledge in helping during an OHCA collapse. Increasing knowledge and confidence through campaigns such as the annual Restart a Heart initiative (50) will help address the low public involvement and under use of PAD during OHCAs, and improve OHCA outcomes.

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Tables

Table 1 Participant Characteristics

Participant Characteristic	Participants (N=421)
Age years (median, range)	47.0 (10-92)
Sex N (%)	
Female	220 (52.3)
Male	198 (47.0)
Not recorded	3 (0.7)
Frequency of visit to Gosforth High Street N (%)	
<weekly	114 (27.1)
≥weekly	307 (72.9)

Table 2 Cardiac Arrest Knowledge, N (%)

First Aid Training, Cardiac Arrest Knowledge and Barriers to Helping during an OHCA	All Respondents (N=421), N (%)	Sex N (%)			First Aid Training N (%)		
		Male (N=198)	Female (N=220)	Probability	Non-First Aider (N=207)	First Aider (N=214)	Probability
First aid trained	214 (50.8)	**87 (43.9)**	**126 (57.3)**	**p=0.01 χ^2=7.41**	*n/a*	*n/a*	*n/a*
knowledge of the difference between a heart attack and a cardiac arrest	130 (30.9)	59 (29.8)	71 (32.4)	p=0.56 χ^2=0.33	**47 (22.7)**	**83 (38.8)**	**p<0.001 χ^2=12.53**
Self- reported knowledge of what to do if someone were to collapse following a CA	349 (82.9)	159 (80.3)	188 (85.5)	p=0.16 χ^2=1.96	**153 (73.9)**	**196 (91.6)**	**p<0.001 χ^2=23.19**
Shout for help	74 (17.6)	30 (15.2)	43 (19.5)	p=0.24 χ^2=1.40	**27 (13.0)**	**47 (22.0)**	**p=0.02 χ^2=5.78**
Call 999	270 (64.1)	**117 (59.1)**	**152 (69.1)**	**p=0.03 $\chi^{2=}$4.54**	123 (59.4)	147 (68.7)	p=0.05 $\chi^{2=}$3.93
Check for response	41 (9.7)	15 (7.6)	26 (11.8)	p=0.15 χ^2=2.12	**8 (3.9)**	**33 (15.4)**	**p<0.001 χ^2=15.99**
Check breathing	101 (24.0)	53 (26.8)	47 (21.4)	p=0.20 χ^2=1.67	**33 (15.9)**	**68 (31.8)**	**p<0.001 χ^2=14.47**
Commence CPR	245 (58.2)	112 (56.6)	132 (60.0)	p=0.48 χ^2=0.51	**99 (47.8)**	**146 (68.2)**	**p<0.001 χ^2=18.00**
Locate defibrillator	60 (14.3)	27 (13.6)	33 (15.0)	p=0.69 χ^2=0.16	**16 (7.7)**	**44 (20.6)**	**p<0.001 χ^2=14.18**
Apply defibrillator to patient and use if appropriate	19 (4.5)	7 (3.5)	12 (5.5)	p=0.35 χ^2=0.89	**4 (1.9)**	**15 (7.0)**	**p=0.01 χ^2=6.29**
Continue CPR until ambulance arrives	14 (3.3)	6 (3.0)	8 (3.6)	p=0.73 χ^2=1.2	4 (1.9)	10 (4.7)	p=0.12 χ^2=2.46
Compression rate 100-120/minute	6 (1.4)	4 (2.0)	2 (0.9)	p=0.34 χ^2=0.91	1 (0.5)	5 (2.3)	p=0.11 χ^2=2.57
Compression/breath ratio 30:2	13 (3.1)	7 (3.5)	6 (2.7)	p=0.64 χ^2=0.23	3 (1.4)	10 (4.7)	p=0.06 χ^2=3.65
Barrier/s to helping during an OHCA mentioned	126 (29.9)	54 (27.3)	72 (32.7)	P=0.23 χ^2=1.47	**39 (18.8)**	**87 (40.7)**	**p<0.001 χ^2=23.87**

Values displayed in bold represent statistically significant difference at p<0.05

Table 3 Location or Source of First Aid Training and Length of Time since First Aid Training

Location or Source of First Aid Training	Participants N=214 N (%)
Charity	30 (14.0)
Work	25 (11.7)
Medical Doctor	18 (8.4)
Military/police	14 (6.5)
School	13 (6.1)
Health Care Worker	12 (5.6)
Hobby	3 (1.4)
Unknown	99 (46.3)
Length of time since first aid training	
>3 years ago	103 (48.1)
≤ 1 year ago	44 (20.6)
Between 1 and 3 years	9 (4.2)
Unknown	58 (27.1)

Table 4 Perceived Barriers to Helping during an OHCA

Perceived Barriers to Helping	Participants, N=126 N (%)
Lack of knowledge	53 (42.1)
Danger (electric shock, fire, weapons)	44 (34.9)
Fear of catching infectious disease	16 (12.7)
Symptoms associated with trauma (blood, fractures)	12 (9.5)
Other ((Do not attempt resuscitation (DNAR), presence of vomit, intoxicated patient))	7 (5.6)
Physically unable (unable to bend/kneel, speech impediment)	6 (4.8)
Family members/pets	5 (4.0)

Table 5 Self-reported AED Knowledge

Self-reported Knowledge, N (%)	All respondents N=421	Sex			First Aid training		
		Male N=198	Female N=220	Probability	Non-First Aider N=207	First Aider N=214	Probability
Knowledge of a defibrillator/AED	338 (80.3)	158 (79.8)	178 (80.9)	p=0.78 χ^2=0.08	**143 (69.1)**	**195 (91.1)**	**p<0.001 χ^2=32.29**
Knowledge of defibrillator location/s	313 (74.3)	**137 (69.2)**	**175 (79.5)**	**p=0.02 χ^2=5.90**	**138 (66.7)**	**175 (81.8)**	**p<0.001 χ^2=12.59**
Knowledge of closet defibrillator	88 (20.9)	35 (17.7)	53 (24.1)	P=0.11 χ^2=2.58	**27 (13.0)**	**61 (28.5)**	**p<0.001 χ^2=15.21**
Self-reported knowledge of defibrillator/AED use	146 (34.7)	67 (33.8)	77 (35.0)	p=0.80 χ^2=0.6	**35 (16.9)**	**111 (51.9)**	**p<0.001 χ^2=56.77**
Open AED	68 (16.2)	30 (15.3)	37 (17.2)	p=0.60 χ^2=0.27	**17 (8.3)**	**51 (23.8)**	**p<0.001 χ^2=19.38**
Listen to and follow instructions	106 (25.2)	48 (24.5)	58 (27.0)	p=0.57 χ^2=0.33	**24 (11.8)**	**82 (38.3)**	**p<0.001 χ^2=40.83**
Apply adhesive pads in the correct area on chest	83 (19.7)	38 (19.4)	44 (20.5)	p=0.79 χ^2=0.08	**19 (9.3)**	**64 (29.9)**	**p<0.001 χ^2=29.19**
Await analysis of rhythm	24 (5.7)	7 (3.6)	17 (7.9)	p=0.06 χ^2=3.51	**1 (0.5)**	**23 (10.7)**	**p<0.001 χ^2=20.85**
If shock advised, respondent aware that people should be clear of patient before shocking	40 (9.5)	19 (9.7)	21 (9.8)	p=0.98 χ^2=0.00	**4 (2.0)**	**36 (16.8)**	**p<0.001 χ^2=27.50**
Shock patient	50 (11.9)	22 (11.2)	28 (13.0)	p=0.58 χ^2=0.31	**6 (2.9)**	**44 (20.6)**	**p<0.001 χ^2=31.82**
Continues CPR should shock not be advised/successful	16 (3.8)	8 (4.1)	8 (3.7)	p=0.85 χ^2=0.04	**1 (0.5)**	**15 (7.0)**	**p<0.001 χ^2=12.40**
Call 999	7 (1.7)	2 (1.0)	5 (2.3)	p=0.31 χ^2=1.04	**0 (0.0)**	**7 (3.3)**	**p=0.01 χ^2=6.95**
Follow instructions from 999	8 (1.9)	3 (1.5)	5 (2.3)	p=0.56 χ^2=0.34	**1 (0.5)**	**7 (3.3)**	**p=0.035 χ^2=4.44**

Values displayed in bold represent statistically significant difference at p<0.05

Table 6 Suggested AED locations and Knowledge of AED location based on Frequency of Gosforth High Street visit

Suggested AED location	Participants N=313, N (%)
Sport Centres (Gyms, rugby, golf and bowling clubs)	71 (22.7)
Hospital	67 (21.4)
Supermarket	53 (16.9)
Public building	53 (16.9)
GP surgery	41 13.1)
On the street	30 (9.6)
Shopping centre, shops, bank	28 (8.9)
Dental Surgery	19 (6.1)
Train/metro station	18 (5.8)
School/college/University	18 (5.8)
At work	18 (5.8)
Airport	17 (5.4)
Ambulance	11 (3.5)
Other (church, phone box, police, pharmacy, library, restaurants, pubs, cafes, coast guard, football stadium, care home, hotel, taxi)	24 (7.7)

Knowledge of Closest AED, N (%)	**Frequency of visit to high street**		
	<weekly	**≥weekly**	**Probability**
	9 (10.2)	**79 (25.7)**	**p<0.001 χ^2=16.00**

Values displayed in bold represent statistically significant difference at p<0.05

Additional file 1

AED Study Questionnaire

Interviewer: ……
Respondent ID number: …….
Consent obtained: ☐Yes ☐No
Age of respondent:…… Sex of respondent: ☐Female ☐Male

Q1. Do you know the difference between a heart attack and a cardiac arrest?

☐Yes - Satisfactory description provided.

Heart attack: *pain in chest/blood vessel blocked but heart beating/plumbing problem/ heart not stopped/alive/ conscious/ not enough blood supply/ plaque rupture.*

Cardiac arrest: *heart stopped/ pump problem/ electrical problem/ unconscious/ not breathing/ abnormal breathing/ no pulse/ dropped dead.*

☐No - inform participant of the difference.
Heart attack occurs when an artery in the heart becomes blocked, usually leads to chest pain (sweating, nausea, pain in arm). Cardiac arrest occurs when the heart stops beating, the person will usually collapse to the ground unconscious with no breathing/abnormal breathing.

Q2. Would you know what to do if someone were to collapse and have a cardiac arrest?
☐Yes ☐No - offer invitation to emergency life support introduction.

If yes, ask what they would do, and tick appropriate boxes:
☐Shout for help
☐Call 999
☐Check for response
☐Check breathing +/- pulse
☐Commence CPR +/- give breaths
☐Locate defibrillator
☐Apply defibrillator to patient and use if appropriate
☐Continue CPR until ambulance arrives

Additional:
☐Compression rate 100-120/minute
☐Compression/breath ratio 30:2

Q3. Is there anything that might prevent you from the above/helping?

……

Q4. Do you know what a defibrillator/AED is?
☐ Yes - Satisfactory description provided

☐ No - Inform participant of what an AED is
Machine that provides electric shock to restart the heart

Q5. Do you know where you might find an AED?
☐ Yes - Able to suggest suitable location/s

☐ No - Inform where AEDs are commonly located
Hospital/ GP surgery/ dentist/ gym/ sport centre/ supermarket/ public building/ airport/ train station/ on the street

Q6. Do you know where the closet defibrillator/AED is?
☐ Yes - Able to locate defibrillator
☐ No - Inform where to find local AED
Opposite The County pub outside Café 95. In cabinet box on the wall. Code from 999 or staff within the building. Another AED also located at St Charles church

Q7. Do you know how to use a defibrillator/AED?
☐ Yes - Satisfactory description provided
☐ No - Offer invitation to emergency life support introduction

If yes, ask how they would use it, and tick appropriate boxes as below:
☐Open AED

☐Listen to and follow instructions

☐Apply adhesive pads in the correct area on chest

☐Await analysis of rhythm

☐If shock advised, respondent aware that people should be clear of patient before shocking

☐Shocks patient

☐Continues CPR should shock not be advised/successful
☐Call 999

☐Follow instructions from 999

Q8. Do you have any first aid training?
☐Yes ☐No

If yes, please state location/source of training and date/year of trainig……

Q9. How often do you visit Gosforth High Street?

……