RESEARCH ARTICLE

Availability and use of Automated External Defibrillators in Karachi, Pakistan: A cross-sectional study

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Abstract

Objective: To assess the availability and use of automated external defibrillators in various public and private establishments, and to assess knowledge, attitude and practices related to its use.

Methods: The telephone-based survey was conducted from March to August 2019 in Karachi after approval from the ethics review committee of the Aga Khan University, Karachi, and comprised public and private establishments identified through purposive sampling based on the standard requirements for automated external defibrillators installation. Data was collected using a predesigned questionnaire which was pilot-tested for reliability and validity. Data was analysed using SPSS 23.

Results: Of the 53 establishments, 32(60.4%) were private and 21(39.6%) were public. Overall, 9(17%) establishments were aware of automated external defibrillators and 1(1.9%) had an automated external defibrillator on the premises. Also, 25(47.2%) establishments believed that having an automated external defibrillator on the premises would be useful, while 25(47.2%) were undecided. Besides, 22(41.5%) establishments said they would consider installing an automated external defibrillator on the premises, while 24(45.3%) were undecided. Finally, 37(69.8%) establishments expressed a positive desire to get trained in giving basic life support.

Conclusion: There was a need for a city-wide automated external defibrillator placement project for a reduction in mortality due to out-of-hospital cardiac arrest.

Keywords: Defibrillator, Resuscitation, Training, Bystanders. (JPMA 72: 1581; 2022)

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Introduction

Out-of-hospital cardiac arrest (OHCA) is potentially reversible with prompt use of basic life support (BLS), which includes cardiopulmonary resuscitation (CPR), and advanced life support (ALS), which includes defibrillation, cardioversion, and other treatment.[1] Approximately 347,000 people in the United States undergo treatment for OHCA annually by Emergency Medical Services (EMSs)[2] Amongst these, approximately 21.3% have ventricular fibrillation or ventricular tachycardia as in initial rhythm that is shockable and can be reversed by automated external defibrillator (AED), which is a portable, compact, effective and low-maintenance device.[2] Similarly, even though data from Pakistan is limited with regards to population size and OHCA, a study in 2020 used capture-recapture analysis and calculated the annual incidence of traumatic OHCA as 45.7/100,000 (95% confidence interval [CI]: 44.2-47.3) in Karachi, the third largest city of the world.[3]

Additionally, the Coronavirus disease-2019 (COVID-19) pandemic put significant burden on healthcare systems around the world. A systemic review and meta-analyses in December 2020 reported that the incidence and mortality associated with OHCA increased considerably when compared to pre-pandemic times due to reasons linked with increased time in the arrival of EMS and increased number of witnessed cardiac arrests, but decreased use of bystander CPR and AED.[4] It is also important to note that when AED was accessible, the likelihood of having a bystander perform defibrillation tripled, and 30-day survival nearly doubled compared to when it was inaccessible, highlighting the importance and need of optimising placements and accessibility of AEDs.[5]

Many countries around the world have guidelines, legislations and federal grants that dictate the number and placement of AEDs in public places. In the US, the Public Law 107-188, signed in 2002, authorized $30 million in federal grants in year one of the five-year measure for the purchase and placement of AED and training of the first-responders.[6] Prior to that, a federal act signed in 2000 stated that if the building owners purchased or used an AED in good faith to save a life, the law would provide them protection from unfair lawsuits.[5] Thus, to further build on this, multiple recent studies have focussed on developing the optimal method of AED placement, depending on various geographical, ecological and population-based factors.[7,8] Due to a

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positive response and rising success of AED, it is being placed in diverse resource-limited community locations with mathematical optimisation models compared to population-based models, and there has not only been a significant increase in coverage, but also a relative decrease in the financial burden.[9]

However, the spectrum of OHCA and its management is starkly different in a developing country, like Pakistan. The burden of OHCA in Karachi, the country's financial hub and the most populous city, is around 94 cases daily, or 34,257 cases annually, with an incidence of up to 166.2/100,000 persons.[10] This may yet be an underestimation, since OHCA deaths and cases that do not get managed by EMS or hospital services remain undocumented. The most recent study showed that in Karachi, the overall survival of OHCA cases to hospital discharge was 1.6%, and to 2-month post-OHCA was 0%.[11] This is largely due to delayed BLS, as there is a lack of first-responder CPR, minimal bystander CPR[11] and weak EMS.[12] Out of the city's three major ambulance services, all of which are privately run by philanthropic organisations, only one is capable of providing on-site CPR, AED services and dispatch-assisted services.[12] This understandably leads to poor survival and increased morbidity and mortality.[11]

The major reasons for high OHCA mortality could be the non-availability of ambulances with ALS, including AEDs, in public and private establishments in Karachi, or the lack of awareness and skills regarding pre-hospital care.[12] Since rapid defibrillation using AEDs can reduce OHCA mortality, its placement and increased awareness must be a priority. Minimum amount of work has been done in Pakistan regarding the frequency, use and effectiveness of AEDs.

The current study was planned to estimate the extent of AED placement in various public and private establishments in Karachi, and to assess knowledge, attitude and practices (KAPs) related to AED use in the organisations running the establishments.

Material and Methods

The telephone-based survey was conducted from March to August 2019 in Karachi after approval from the ethics review committee of the Aga Khan University (AKU), Karachi. In the absence of any formal public-access AED programme in Karachi, an expected AED frequency of 5% was used to calculate the sample size to achieve minimum power 90% with confidence level 95%. The sample size calculation was estimated using PASS V.15 (NCSS, Kaysville, Utah, USA www.ncss.com).[13]

The relevant establishments were identified through purposive sampling based on the standard requirements for AED installation: the 3-minute rule, expected high incidence of OHCA regions, security, and availability of resources for AED maintenance. Only establishments with their contact details freely available on their official websites were included. These establishments were categorised into Government, Health Centre, Higher Education Institutions, Workplaces/Industries, Public Recreational Areas, Residential Colonies, Shopping Malls, Travel and Tourism, Non-Governmental Organisations (NGOs), and Religious Places.

The survey was conducted through telephone conversation between 9am and 5pm with qualified respondents, like general managers, academic deans, overseers of religious/worship places, etc. The questionnaire, designed in English, was also translated into Urdu, the national language of the country, to avoid bias. A pilot-testing (n=60) assessing the reliability and validity of the tool Produced Cronbach's alpha value of 0.815, indicating a high level of internal consistency. Verbal informed consent was taken from each respondent. Questions ranged from descriptive information about the establishment, like establishment size, number of people on premises daily, to assessing the knowledge about AEDs, the presence of AED on site, and the need of using them in cases of OHCA. If the respondent lacked basic knowledge of AED and OHCA, or reported the absence of an AED on site, a pre-determined baseline knowledge was provided by the interviewer.

To minimise bias due to high non-contact/non-response rates, at least three attempts at different times of the day and/or different days of the week were made to contact each establishment. Responses were excluded if the call line was not answered or was found to be 'not in service', if the survey was not answered by a qualified respondent, if the survey was not completed by the respondent, if there were language barriers in conducting the survey, if the size of the establishment's premises was <800ft2 (approximately 75m2) or if there were <200 persons present on the premises daily, and if informed consent was not available.

Data was analysed using SPSS 23. Descriptive statistics, Chi-square or Fischer's Exact test and likelihood ratio were used as applicable. $P<0.05$ was considered statistically significant in all cases.

Results

Of the 100 establishments identified, 53(53%) completed the survey. The high non-response rate 47(47%) was due to refusal to participate by Government Establishments,

Table-1: Characteristics of the participating establishments.

	Number (%)
Total Establishments (Type)	
Higher Education	17 (32.1)
Recreation	12 (22.6)
Malls	12 (22.6)
Others	12 (22.6)
Total Establishments (Ownership)	
Public	21 (39.6)
Private	32 (60.4)
Size of Establishment (ft2)	
Small (< 100,000)	23 (43.4)
Intermediate (100,000 – 500,000)	17 (32.1)
Large (> 500,000)	13 (24.5)
People at Premises Daily (persons)	
Low Volume (< 1500)	19 (35.8)
Intermediate Volume (1500-5500)	25 (47.2)
High Volume (> 5,500)	9 (17.0)

Health Centres, Workplaces/Industries, Travel and Tourism, Religious Places, and Residential Colonies.

Of the 53 participating establishments, 32(60.4%) were private and 21(39.6%) were public. There were 17(32.1%) related to Higher Education, while 12(22.6) each were Recreation, Malls and Other establishments (Table-1).

Overall, 9(17%) establishments were aware of AEDs, and 1(1.9%) had an AED on the premises, which was a Hotel and Resorts establishment. There was no significant association between the type of organisation and having AED on premises or AED knowledge (p>0.05).

Also, 25(47.2%) establishments believed that having an AED on the premises would be useful, 3(5.7%) said it would not be useful, while 25(47.2%) were undecided. There was a significant association between the type of establishment and perceiving an AED as useful on the premises (p<0.05), with 10(40%) of those answering "Yes" being from the Others group.

Besides, 22(41.5%) establishments said they would consider installing an AED on the premises; 24(45.3%) were undecided; and 22(41.5%) said they would be willing to let AKU pay for and install an AED on their premises, provided the establishments would manage the upkeep and maintenance themselves. Additionally,

Table-2: Knowledge, attitude, and practices of different types of establishments.

Question	Overall n (%) 53 (100)	Educational n (%) 17 (100)	Recreation n (%) 12 (100)	Malls n (%) 12 (100)	Others n (%) 12 (100)	P-Value
Q1) Do you know what an AED is?						
Yes	9 (17)	3 (17.6)	1 (8.3)	1 (8.3)	4 (33.3)	0.333
No	44 (83)	14 (82.4)	11 (91.7)	11 (91.7)	8 (66.7)	
Q2) Any AED at your Premises?						
Yes	1 (1.9)	0 (0)	0 (0)	0 (0)	1 (8.3)	0.386
No	52 (98.1)	17 (100)	12 (100)	12 (100)	11 (91.7)	
Q3) Would an AED be useful at your Premises?						
Yes	25 (47.2)	6 (35.3)	7 (58.3)	2 (16.6)	10 (73.3)	
No	3 (5.7)	1 (5.9)	1 (8.3)	1 (8.3)	0 (0)	0.028
Undecided	25 (47.2)	10 (58.8)	4 (33.3)	9 (75)	2 (16.6)	
Q4) Would you consider installing an AED on Premises?						
Yes	22 (41.5)	5 (29.4)	7 (58.3)	1 (8.3)	9 (75)	
No	7 (13.2)	3 (17.6)	1 (8.3)	2 (16.6)	1 (8.3)	0.02
Undecided	24 (45.3)	9 (52.9)	4 (33.3)	9 (75)	2 (16.6)	
Q5) Would you let AKU install an AED at your Premises?						
Yes	22 (41.5)	6 (35.3)	5 (41.7)	2 (16.6)	9 (75)	
No	5 (9.4)	1 (5.9)	2 (16.6)	1 (8.3)	1 (8.3)	0.081
Undecided	26 (49.1)	10 (58.8)	5 (41.7)	9 (75)	2 (16.6)	
Q6) Any Cardiac Emergency at your Premises?						
Yes	8 (15.1)	0 (0)	2 (16.6)	1 (8.3)	5 (41.7)	
No	13 (24.5)	5 (29.4)	5 (41.7)	0 (0)	3 (25)	0.002
No Records	32 (60.4)	12 (70.6)	5 (41.7)	11 (91.7)	4 (33.3)	
Q7) Would you like have Sessions for AED & BLS?						
Yes	37 (69.8)	11 (64.7)	9 (75)	6 (50)	11 (91.7)	0.215
No	16 (30.2)	6 (35.3)	3 (25)	6 (50)	1 (8.3)	

AED: Automated external defibrillator, AKU: Aga Khan University, BLS: Basic life support.

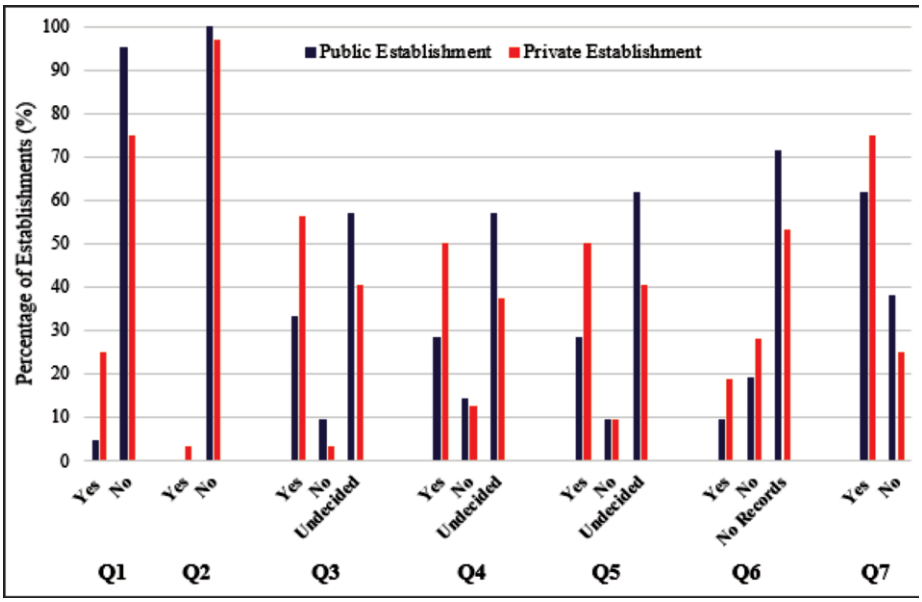

Figure: Differences in knowledge, attitude and practices of public versus private establishments.
Q1: Knowledge of automated external defibrillator (AED), Q2: AED on the premises, Q3: Usefulness of AED on premises, Q4: Willingness to install an AED on premises, Q5: Willingness for Aga Khan University (AKU) to install an AED at premises, Q6: Any cardiac emergency on premises, Q7: Need for sessions for AED and basic life support (BLS).

37(69.8%) establishments expressed a positive desire to get trained in giving BLS through training programmes conducted by AKU for the employees of their respective organisations.

Overall, 8(15.1%) establishments reported having instances of a cardiac emergency on their premises within the preceding year, while 13(24.5%) reported having none. However, the majority 32(60.4%) of places did not maintain any record in this regard (Table-2).

Private establishments generally displayed better knowledge and attitude towards AED than public establishments (Figure).

There was a significant association of establishments wanting AKU to conduct BLS training sessions with the establishments that were considering installing AEDs (p=0.015) and the establishments willing to let AKU install AEDs for them (p=0.012).

Discussion

The success of community-wide AED placement in reducing the morbidity and mortality associated with OHCA in developed countries offers a potential solution to decrease the burden of OHCA in the metropolitan megacity of Karachi.[10] The current survey was conducted to estimate the frequency of AED placement in various establishments in Karachi, as well as the knowledge, awareness, and attitudes towards AED use in these establishments.

The scarcity of AEDs in establishments is reflected by the finding of only one establishment having an on-site AED. This also correlates with the stark lack of knowledge about AEDs as well as of their usefulness in managing OHCAs. However, it is encouraging that though many places were undecided about the usefulness of AEDs and about having them installed, or letting AKU install them, on their premises, there were extremely few places that outrightly declined the installation. The responses to survey questions thus are probably due to the lack of knowledge about AEDs in general. However, it is once again encouraging that more than two thirds of the places were interested in having AKU conduct teaching and training sessions for AED use and BLS for their employees.

The results showed a severe acute need for more AEDs on the premises of organisations in Karachi. However, the data is not very helpful in narrowing down places where the installation of AEDs would be most useful, as most organisations simply maintained no records of cardiac emergencies on their premises. Nevertheless, it is generally known that most OHCAs occur in private residential areas, the workplace, nursing homes and public places in cities.[14-16] In addition, survival for OHCAs in nursing homes is also low.[17] We can thus expect a similar pattern of OHCAs in Karachi as well, which can guide plans for further work. It is very important that future city-wide AED projects should be targeted towards areas that have the highest incidence of OHCAs.[18] The American Heart Association (AHA) guidelines suggest a 20% chance of AED use annually, and the city-wide projects need to be financially feasible.[19]

Teaching and training about employing BLS and AED need to go hand in hand alongside community-wide availability of AEDs to make a significant impact in reducing OHCA burden. A study in the United Kingdom[20] demonstrated that despite the availability of public-access AEDs, only a few people reported knowing how to use one and even fewer knew where to find one. Moreover, only a small minority would attempt to find an AED in a cardiac emergency situation, and even fewer

would actually retrieve and use one.[18]

The current study also recommends that increasing public knowledge about AEDs as well as their skill and confidence in using one should be a crucial consideration when planning for future city-wide AED installation project in Karachi. The current study also indicated that private-owned places were more likely to be compatible with the implementation of a city-wide AED project, as they demonstrated increased interest towards AED installation and AED and BLS training. In addition, due to poor structural organisation in government-owned public places, it will be difficult to maintain a high-quality and self-sufficient system for AED use, maintenance and training. However, innovative ideas, such as placement of AEDs in vending machines, marking locations of AEDs on Google Maps and protection from unfair lawsuits may provide increased incentive to access and use AEDs.

The current study serves as a baseline for plans for a future city-wide AED installation project. However, there are several recommendations presented by this study that are additional pre-requisites before the beginning of a city-wide AED installation project. Research needs to be done exploring the areas with the highest OHCA incidence, while baseline knowledge and attitude of the general population towards AED use in OHCA also needs to be assessed.

In terms of limitations, the current study had a small sample size due to poor response from the establishments. The use of purposive sampling technique, and the absence of face-to-face interactions due to the preference of the establishment overseers were also part of the limitations. The findings, as such, cannot be generalised. Moreover, the lack of any proper record to track the annual incidence of OHCA in these establishments also posed a problem.

Conclusion

There is a need and the general willingness of the community for a city-wide AED placement project. However, there is scarcity of AEDs in establishments in Karachi. Placement of AEDs and increasing awareness and training of the general population through public awareness drives and workshops can offer a potential solution to increase the use of AEDs in order to decrease the OHCA burden.

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