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Public Access Defibrillation: Great benefit and potential but infrequently used☆

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ABSTRACT

Background: In Copenhagen, a volunteer-based Automated External Defibrillator (AED) network provides a unique opportunity to assess AED use.

We aimed to determine the proportion of Out-of-Hospital Cardiac Arrest (OHCA) where an AED was applied before arrival of the ambulance, and the proportion of OHCA-cases where an accessible AED was located within 100 m. In addition, we assessed 30-day survival.

Methods: Using data from the Mobile Emergency Care Unit and the Danish Cardiac Arrest Registry, we identified 521 patients with OHCA between October 1, 2011 and September 31, 2013 in Copenhagen, Denmark.

Results: An AED was applied in 20 cases (3.8%, 95% CI [2.4 to 5.9]). Irrespective of AED accessibility, an AED was located within 100 m of a cardiac arrest in 23.4% (n = 102, 95% CI [19.5 to 27.7]) of all OHCAs. However, at the time of OHCA, an AED was located within 100 m and accessible in only 15.1% (n = 66, 95% CI [11.9 to 18.9]) of all cases.

The 30-day survival for OHCA with an initial shockable rhythm was 64% for patients where an AED was applied prior to ambulance arrival and 47% for patients where an AED was not applied.

Conclusions: We found that 3.8% of all OHCAs had an AED applied prior to ambulance arrival, but 15.1% of all OHCAs occurred within 100 m of an accessible AED. This indicates the potential of utilising AED networks by improving strategies for AED accessibility and referring bystanders of OHCA to existing AEDs.

1. Introduction

Out-of-hospital cardiac arrest (OHCA) is a significant health problem associated with cardiovascular disease, which is the leading cause of sudden death.[1,2] Early defibrillation is essential to increase survival and the use of publicly accessible Automated External Defibrillators (AED) has been shown to increase the chances of survival up to 74%.[3–9] Despite initiatives to disseminate AEDs in public settings, the proportion of OHCA-victims defibrillated prior to arrival of the Emergency Medical Services (EMS) is reported to be less than 3% and a real opportunity to save lives is missed.[9–11]

The European Resuscitation Council and the American Heart Association recommend Public Access Defibrillation (PAD) programmes, but the deployment and registration of AEDs is often random and poorly organized, with no available information on location and accessibility, impeding use of AEDs by bystanders and linkage to the Emergency Medical Dispatch Centre (EMD). In Copenhagen, the capital of Denmark, a volunteer-based AED network has been established with validated information about AED location and accessibility. The network is linked to the EMD to enable guidance to nearest accessible AED in case of cardiac arrest. This provides a unique opportunity to assess the use, effects, and coverage of PAD as the network also allows systematic collection of data from applied AEDs.

In this study, we aimed to determine the proportion of OHCA-cases where an AED was applied prior to arrival of the ambulance

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and the proportion of OHCA-cases where the EMD referred bystanders to an AED. In addition, we sought to determine the proportion of OHCA-cases where an accessible AED was located within 100 m at the time of the cardiac arrest. Finally, we sought to evaluate characteristics and survival of OHCA-victims according to use of an AED.

2. Methods

2.1. Study setting

Copenhagen is the capital of Denmark, and the city centre comprises 94.9 km^2 with a population of 661,461 people.

The EMS in Copenhagen is a 2-tiered system comprising ambulances providing life support including use of defibrillators, and physician-staffed mobile emergency care units providing additional advanced life support. In the event of a cardiac arrest, both tiers of response are activated simultaneously. Data from each cardiac arrest are systematically and prospectively recorded by the physician at the scene and entered into a database maintained by the EMS in Copenhagen. Additionally, ambulance personnel are required to complete documentation for the National Danish Cardiac Arrest Registry for every resuscitation-attempted OHCA.

2.2. AED network

In 2007, the private foundation TrygFonden established an online network (http://www.hjertestarter.dk/Service-Pages/InEnglish) in which registration of both private and public AEDs is voluntary but recommended by the Danish Health and Medicines Authority and AED-vendors. The network provides detailed information about AED location (exact address) and accessibility, including hours when the AED is available, as described in detail elsewhere.[12] The EMDs across the country have implemented an IT-solution based on the AED network, enabling them to refer a bystander to the nearest accessible AED in the event of suspected OHCA. When an emergency call is received and the location is determined, the medical dispatcher is provided with a map showing the accessible AEDs within 100 m, thus enabling the dispatcher to refer a bystander to the nearest AED. If only one bystander is present, the dispatcher can choose to contact the AED location and have the AED brought to the scene of the cardiac arrest. When an AED is referred to by the dispatcher, an e-mail is automatically generated and sent to the network enabling them to unsubscribe the AED until in place again. Every case is followed up by an e-mail or a telephone call to the person listed as responsible for the AED in the network, thereby validating the use of the AED related to an OHCA. On January 2014, 850 AEDs in the city centre of Copenhagen were registered on the webpage.

Systematic follow-up of AEDs applied by bystanders in Copenhagen began in 2011 as part of a project on systematic downloading of AED data.[13] Each time an AED is applied by a bystander prior to arrival of the ambulance, the AED is brought to the EMD in Copenhagen in order to retrieve the stored data. The data are transmitted to the admitting hospital and the AED is returned to the owner.

2.3. Study population and data collection

This observational study evaluated the use and effects of PAD in the city centre of Copenhagen from October 1, 2011 through September 31, 2013. A cardiac arrest was defined according to the Utstein criteria for laypersons and ambulance personnel.[14] All cases of OHCA were included in the final analysis when a clinical condition of cardiac arrest resulted in resuscitation efforts by either bystanders or ambulance personnel. We excluded cardiac arrests witnessed by ambulance personnel as this study focused on PAD. Reporting was done in accordance with the Utstein template for reporting OHCA.[14]

For this study we included information on date, time, location of arrest (home vs. public location, the latter defined as all areas accessible to the general public), exact address of cardiac arrest, witnessed or not, whether the bystander performed cardio pulmonary resuscitation (CPR), defibrillated the victim or both, first recorded cardiac rhythm, ambulance response time (interval between call to the EMD and ambulance arrival), survival to hospital, and 30-day survival. Information regarding referral of bystanders to the nearest accessible AED by the EMD was collected from the online AED network. Data regarding use of AEDs (defined as AED applied to a patient prior to ambulance arrival) were obtained from the EMD and validated through prehospital medical records. Information on 30-day survival was obtained from the Danish Civil Registration System, which assigns all Danish citizens a civil registration number, a unique personal identification number.

Exact geographical location of OHCAs and AEDs was determined using a geographic information system (QGIS, http://www.qgis.org/en/site). Each location was geocoded to the street level based on the address of the incident and it was verified that each cardiac arrest occurred in the city centre of Copenhagen. The geocoding process assigns a latitude and longitude coordinate to each address. An AED was considered to cover an area within 100 m, based on the estimate that an AED within that range could be transported by bystanders to the victim within 1.5 min, in accordance with the American Heart Association recommendations.[15]

2.4. Ethics

The study, and the processing of personal data, was approved by the Danish Health and Medicines Authority (J. nr. 3-3015-560/1) and the Danish Data Protection Agency (J. nr. 30-1223). Ethical approval is not required for registry-based studies in Denmark.

2.5. Statistics

Continuous variables are presented as median with their associated inter quartile range [IQR]. A Mann–Whitney test was used for comparisons between the groups. Categorical data are reported as absolute number with proportion and comparisons were done using Fisher's exact test. All analyses were performed using the SAS Enterprise Guide statistical software package, version 6.1 (SAS Institute Inc., Cary, NC, USA). For all analysis, a 2-sided value of $p < 0.05$ was considered statistically significant.

3. Results

A total of 2075 cases of OHCA were recorded by the mobile emergency care unit in the city centre of Copenhagen during the study period. Of these, 1476 cases were excluded because resuscitation was not attempted. Five OHCA-cases, which were not registered with the EMD, were found in the Danish Cardiac Arrest Registry. We identified 604 OHCA-victims, in whom resuscitation was attempted, corresponding to an all-cause OHCA incidence of 46 OHCA per 100,000 person years.

For further analysis, we included 521 resuscitation-attempted OHCAs as 83 cases (mainly EMS-witnessed OHCAs) were excluded (Fig. 1).

An AED was applied prior to ambulance arrival in 20/521 (3.8%, 95% CI [2.4 to 5.9]) cases and 13/521 (2.5%, 95% CI [1.3 to 4.2]) OHCA-victims were defibrillated by an AED.