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Clinical paper

A smartphone application for dispatch of lay responders to out-of-hospital cardiac arrests

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ABSTRACT

Background: Dispatch of lay volunteers trained in cardiopulmonary resuscitation (CPR) and equipped with automated external defibrillators (AEDs) may improve survival in cases of out-of-hospital cardiac arrest (OHCA). The aim of this study was to investigate the functionality and performance of a smartphone application for locating and alerting nearby trained laymen/women in cases of OHCA.

Methods: A system using a smartphone application activated by Emergency Dispatch Centres was used to locate and alert laymen/women to nearby suspected OHCA. Lay responders were instructed either to perform CPR or collect a nearby AED. An online survey was carried out among the responders.

Results: From February to August 2016, the system was activated in 685 cases of suspected OHCA. Among these, 224 cases were Emergency Medical Services (EMSs)-treated OHCA (33%). EMS-witnessed cases (n = 11) and cases with missing survey data (n = 15) were excluded. In the remaining 198 OHCA, lay responders arrived at the scene in 116 cases (58%), and prior to EMSs in 51 cases (26%). An AED was attached in 17 cases (9%) and 4 (2%) were defibrillated. Lay responders performed CPR in 54 cases (27%). Median distance to the OHCA was 560 m (IQR 332–860 m), and 1280 m (IQR 748–1776 m) via AED pick-up. The survey-answering rate was 82%.

Conclusion: A smartphone application can be used to alert CPR-trained lay volunteers to OHCA for CPR. Further improvements are needed to shorten the time to defibrillation before EMS arrival.

Introduction

At the time of collapse, the majority of patients suffering from Out-of-Hospital Cardiac Arrest (OHCA) have an initial shockable rhythm that can be treated by means of defibrillation [1]. As Emergency Medical Service (EMS) response times are often too long, the initial shockable rhythm usually deteriorates into asystole. In cases where bystander-operated Automated External Defibrillators (AEDs) are used within the first few minutes after collapse, as many as seven out of ten may survive [2,3]. The number of publicly available AEDs is increasing [4,5] and national AED registers have been compiled with the aim of increasing awareness and providing information to dispatchers [6]. Despite this, AED use by bystanders prior to EMS arrival has been infrequent [7,8]. Current guidelines emphasize implementation of public AED programmes, effective volunteer-enhanced responses and digital applications for deployment of public AEDs [9]. In a

recent randomized study carried out in Stockholm, it was found that bystander CPR could be increased by 30% with the use of text-message (TM) to locate and direct CPR-trained volunteers to nearby OHCA [10]. Similar systems have been developed in the Netherlands [11,12] and in North America [13]. In Stockholm County, a new smartphone application has been developed and integrated with the national AED register. In addition to bystander CPR, lay volunteers were also dispatched to use AEDs. The aim of this run-in study was to evaluate the technical function and performance of this system before future randomized controlled trials.

Methods

Study design and ethics

This was a prospective observational run-in study carried out

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Table 1
Characteristics of daytime OHCA (07:00 to 23:00) during the study period.

		Not activated N = 128	Activated by the EDC N = 252
OHCAs, daytime,	n (%)	128 (33.7)	252 (66.3)
Age,	median (q25–q75)	71 (53–79.5)	73 (61–82)
Male sex,	n (%)	74 (58.3)	166 (65.9)
Witnessed by	Bystander, n (%)	61 (65.6)	132 (92.3)
	EMS, n (%)	32 (34.4)	11 (7.7)
Place	Home, n (%)	79 (63.2)	179 (71.3)
	Public, n (%)	46 (36.8)	72 (28.7)
Suspected aetiology	Presumed cardiac, n (%)	102 (79.7)	221 (91.3)
	Drug overdose, n (%)	5 (3.9)	6 (2.5)
	Trauma, n (%)	4 (3.1)	1 (0.4)
	Asphyxia, n (%)	10 (7.8)	9 (3.7)
	Suicide, n (%)	6 (4.7)	4 (1.6)
	Other non-medical, n (%)	1 (0.8)	1 (0.4)
First rhythm	VT/VF, n (%)	21 (18)	51 (22.3)
	PEA, n (%)	25 (39.3)	30 (13.1)
	Asystole, n (%)	71 (60.7)	148 (64.6)

between February 11 and August 31, 2016. We obtained ethics approval from the regional ethics board in Stockholm (DNR 2016/214-32, amendment of DNR 2009/349-31, 2009/1798-3).

Patients

The subjects were all patients suffering from suspected OHCA in Stockholm County according to dispatch protocol criteria (see [Appendix A](#)), between 07:00 and 23:00. Included in the final analysis were all EMS-treated OHCAs regardless of initial rhythm or aetiology ([Table 1](#)). Excluded from the final analysis were cases witnessed by EMSs and cases without survey data.

Setting

1.2 The study was conducted in Stockholm County, with a total area of 6519 km² and a population of 2.3 million (density 347 inhabitants/km²). The incidence rate of EMS-treated OHCAs was 50/100 000 person-years (2016).

Emergency medical system (EMS)

A single local EDC (Emergency Dispatch Centre) dispatches all ambulances in a two-tiered system. There are 55 round-the-clock ambulances and 71 are available in the daytime for dispatch. The ambulances are staffed with a nurse and a paramedic and equipped with AEDs. Furthermore, an advanced-life-support (ALS) tier staffed with a nurse-anaesthetist or a physician-anaesthetist runs around the clock. In addition, there are AED-equipped fire vehicles at each of the 16 fire stations, and about 140 AED-equipped police cars acting as professional first responders. In a medical emergency, a first surveying ambulance is dispatched. As soon as the criteria of a suspected OHCA are fulfilled, a menu is automatically presented telling the dispatcher to activate a full-scale OHCA protocol alarm, adding an ALS tier, dual dispatch of emergency responders (fire-fighters and police), and triggering of the lay responder system (see [Appendix A](#)).

The Swedish AED register

The Swedish AED register was introduced in 2009 [14]. AED owners voluntarily register their AED and grant access to the public. The AEDs are validated every half-year by the owner as regards position and accessibility for public use. By 22-11-2016 the Swedish AED register contained 2592 registered AEDs in Stockholm County, constituting 1 AED/1000 inhabitants, or 2.5 AEDs/km².

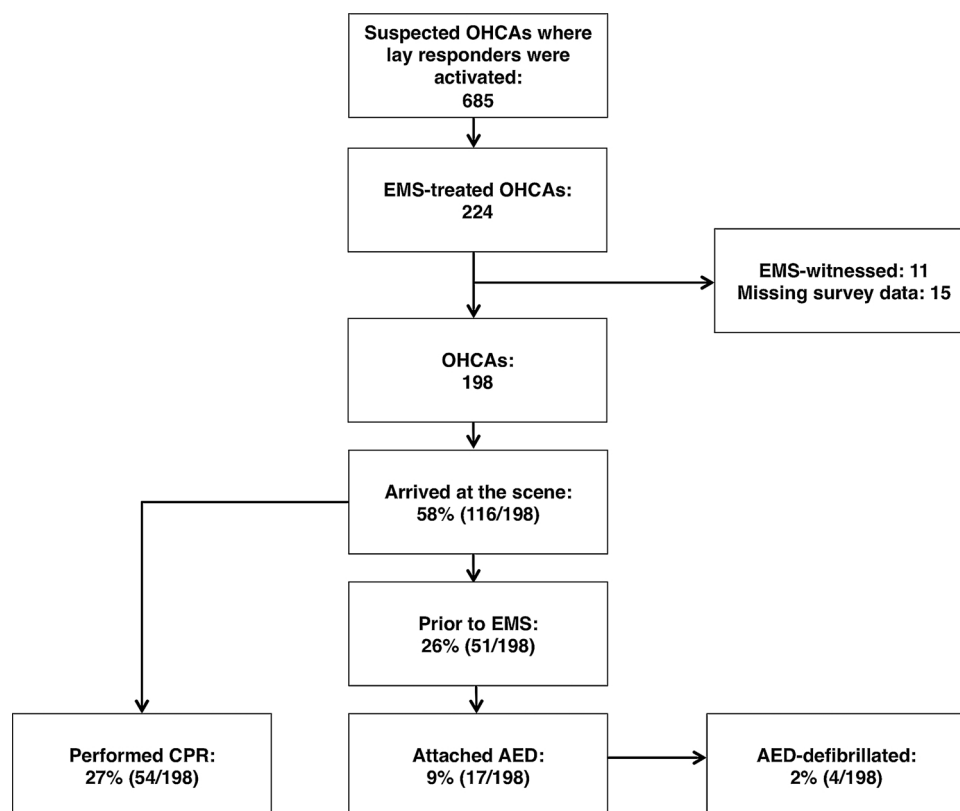


Fig. 1. Events where lay responders were directed to suspected OHCA during the run-in period (February–August 2016). Survey data from lay responders.

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