Resuscitation 96 (2015) 317–322

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

# Challenges in out-of-hospital cardiac arrest – A study combining closed-circuit television (CCTV) and medical emergency calls☆

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ARTICLE INFO

*Article history:*
Received 25 November 2014
Received in revised form 7 May 2015
Accepted 2 June 2015

*Keywords:*
Out-of-hospital cardiac arrest
Basic life support
Bystander
Emergency medical dispatch
Cardiopulmonary resuscitation
Human factors

ABSTRACT

The aim of this study was to explore challenges in recognition and initial treatment of out-of-hospital cardiac arrest (OHCA) by using closed-circuit television (CCTV) recordings combined with audio recordings from emergency medical calls.

*Method:* All OHCA captured by CCTV in the Capital Region of Denmark, 15 June 2013–14 June 2014, were included. Using a qualitative approach based on thematic analysis, we focused on the interval from the victim's collapse to the arrival of the ambulance.

*Results:* Based on the 21 CCTV recordings collected, the main challenges in OHCA seemed to be situation awareness, communication and attitude/approach. Situation awareness among bystanders and the emergency medical dispatchers (dispatcher) differed. CCTV showed that bystanders other than the caller, were often physically closer to the victim and initiated cardiopulmonary resuscitation (CPR). Hence, information from the dispatcher had to pass through the caller to the other bystanders. Many bystanders passed by or left, leaving the resuscitation to only a few. In addition, we observed that the callers did not delegate tasks that could have been performed more effectively by other bystanders, for example, receiving the ambulance or retrieving an Automated External Defibrillator (AED).

*Conclusion:* CCTV combined with audio recordings from emergency calls can provide unique insights into the challenges of recognition and initial treatment of OHCA and can improve understanding of the situation. The main barriers to effective intervention were situation awareness, communication and attitude/approach. Potentially, some of these challenges could be minimized if the dispatcher was able to see the victim and the bystanders at the scene.

A team approach, with the dispatcher responsible for the role as team leader of a remote resuscitation team of a caller and bystanders, may potentially improve treatment of OHCA.



## 1. Introduction

Only 5 to 10 per cent of patients survive out-of-hospital cardiac arrest (OHCA).[1,2] However, survival rates can reach 20 to 40 per cent in witnessed OHCA with ventricular fibrillation in communities where the chain of survival is strong.[3,4] Substantial interventions have been made to increase bystanders' ability to intervene with cardiopulmonary resuscitation (CPR). These efforts have focused on how best to educate laypersons and to use dispatcher-assisted telephone-guided cardiopulmonary resuscitation (T-CPR) to assist them perform CPR during the emergency call.[5–10] Bystanders' interactions with Emergency Medical Dispatchers (dispatcher) during the emergency calls can improve the rate of recognition of cardiac arrest and of bystanders' CPR.[5,11–13] In addition, the dispatcher can refer the caller to the nearest Automated External Defibrillator (AED).[14] However, we have little knowledge of bystander behaviour and challenges at the scene before the arrival of an ambulance.

The aim of this study was to explore challenges of recognition and initial treatment of out-of-hospital cardiac arrest (OHCA) by

☆ A Spanish translated version of the Abstract of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2015.06.003.

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http://dx.doi.org/10.1016/j.resuscitation.2015.06.003

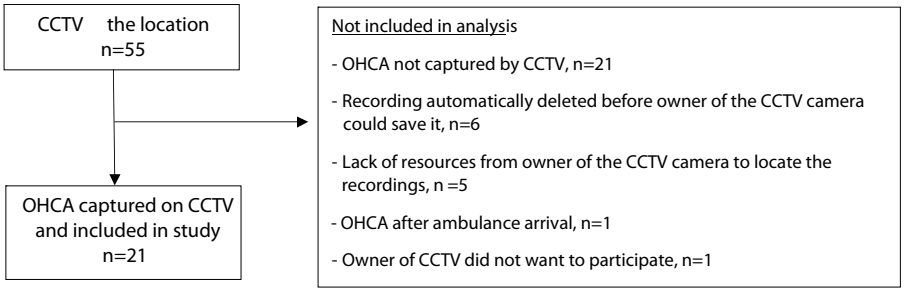


**Fig. 1.** Flow-diagram: out-of-hospital cardiac arrests (OHCA) captured by closed-circuit television (CCTV) in the Capital Region of Denmark, 15 June 2013–14 June 2014.

using closed-circuit television (CCTV) recordings combined with audio recordings from the emergency medical call.

## 2. Methods

We used a triangulated design for this study that combined video and audio recordings from OHCA incidents, focusing on the interval from the victim's collapse to the arrival of the ambulance.

### 2.1. Setting

The Emergency Medical Dispatch Center (EMDC), Copenhagen, Denmark serves 1.7 million inhabitants. All 1-1-2 emergency calls are initially handled by a call centre. The call centre identifies the location and forwards all medical calls to EMDC. The response in EMDC is two-tiered: an emergency medical dispatcher (dispatcher) answers the call and decides the appropriate response while another EMDC staff member handles the logistics of dispatching ambulances. Dispatchers are specially trained nurses and paramedics whose decision-making is supported by a criteria-based, nationwide emergency medical dispatch system called the Danish Index for Emergency Care.[15] The main priority of the Danish Index for Emergency Care is to discover whether the individual is unconscious and breathing abnormally. If OHCA is suspected, dispatchers guide bystanders to perform CPR. If bystanders have no previous CPR training, dispatchers are instructed to give guidance on administering chest compressions only.

### 2.2. Data collection

All OHCA captured by CCTV in the Capital Region of Denmark, 15 June 2013–14 June 2014, were included. OHCAs in public places were identified, either by the dispatcher or by the physician at the mobile emergency care unit dispatched to the scene. The study group contacted all owners of CCTV in the surroundings of the OHCA incident to ascertain whether the episode was captured on surveillance cameras. Under Danish law, CCTV recordings must be deleted within 30 days if no specific permission is given. However, some recordings are saved for only 24 h.

The corresponding audio recordings from the emergency calls were obtained from the emergency medical service database.

### 2.3. Ethical approval

The Danish Data Protection Agency approved this study (PHV-2013-001). We applied for ethical approval from The Danish National Committee on Health Research Ethics (DNVK 1211665), but approval was not necessary for this study. All CCTV recordings were formatted to allow access only to investigators. Faces of individuals on the recordings were blurred to prevent identification. Any identifying data for victims and callers were deleted.

### 2.4. Data analysis

We applied a qualitative research methodology using thematic analysis with an explorative and inductive approach. The first author followed Braun and Clark's six-step analytical approach[16]: familiarizing with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. A single episode of great importance was sufficient to form a theme. Codes and themes were organized using a programme designed to handle qualitative data such as video- and audio recordings (Nvivo10 software, QSR International Pty Ltd, Australia). The first author did the initial analysis. The last author reviewed all the data, coding and themes. All researchers participated in the final analysis in order to enhance confidence in the ensuing findings. Consensus on themes was required.

## 3. Results

In the study period, we identified CCTV recordings in 55 cases of OHCA in a public place. In 21 of these cases, the CCTV recording captured the OHCA incident and was available for analysis (Fig. 1). In 3 of the 21 cases, the patient was not visible in the recording and only bystanders could be observed. Table 1 shows the demographic characteristics of OCHA victims and callers. All data were estimated from the CCTV or audio recordings. In all cases in which the dispatcher identified OCHA, CPR was performed before the ambulance arrived ($n = 17$). In 10 cases the bystanders started CPR on their own initiative. The dispatchers tried to guide bystanders in CPR after realizing that they were already performing CPR. In 7 cases CPR was initiated in interactions with the dispatcher. Table 2 lists the observed examples of poor quality CPR and AED usage. Bystanders trained in CPR were present in all cases where an AED was retrieved.

We identified three main themes in our qualitative analysis: (1) situation awareness, (2) communication, and (3) attitude/approach. Situation awareness refers to how the bystanders and dispatchers understand the situation; communication includes the type of information and how it is passed on; attitude/approach includes opinions or feelings that affect behaviour. Each theme contains subthemes highly interrelated between bystander and dispatcher. Table 3 contains a summary of the themes and subthemes and provides examples from audio and CCTV recordings that support the themes related to the bystander and dispatcher.

### 3.1. Situation awareness

Identification of OHCA depended on the bystandersí situation awareness, which was influenced by what they could observe. If the bystanders were not present when the victim collapsed or if the victim's need for help was less obvious, they hesitated to intervene (Table 3). In addition, bystanders' reactions were dependent on their prior skills and knowledge of OHCA. In 10 cases OHCA was identified and CPR started by the bystanders themselves. However,