

System-based interventions to improve outcome in out-of-hospital cardiac arrest patients: a Dutch experience

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Introduction

Sudden cardiac arrest is the third leading cause of death in Europe. The annual incidence of Out of Hospital Cardiac Arrest (OHCA) is not exactly known and varies largely between countries from 28 to 160 per 100 000 inhabitants [1].

Quality of early cardiopulmonary resuscitation (CPR) by bystanders and ambulance staff can lead to a significant improvement in Return of Spontaneous Circulation (ROSC) and good neurological outcomes [2,3].

In the mid-west ambulance region of the Netherlands (the RAVHM) [4] a combined series of interventions were implemented as a system-level approach with the intent to provide the best possible care to patients with OHCA and improve their survival [5–7]. The region covers 875 km² of the urbanized countryside. RAVHM provides ambulance services from 9 locations and 31 vehicles, serving approximately 775 000 inhabitants. RAVHM receives about 65 000 ambulance calls annually, of which 42% have high priority. In this viewpoint, we will glimpse into the different interventions that are aimed at improving the prognosis after OHCA.

Improved availability and quality of early bystander basic life support and early defibrillation

The dispatch center developed standardized instructions for the recognition of cardiac arrest and for the assistance of callers and/or bystanders to provide optimal basic life support (BLS). Police and fire department staff were equipped with automated external defibrillators (AEDs) and were specifically trained to perform optimal BLS including automatized defibrillation.

In 2018, the interventions of early CPR were completed by the introduction of a national text message alert system (Hartslagnu.nl) in the RAVHM region, detecting and notifying trained volunteers who are within a range of 750 m to a suspected OHCA. Text message-responders receive a text message on their cell phone directing them to the patient or to the location of the nearest AED first when an

AED was available within a range of 500 m. All text message responders are trained yearly by professional trainers in providing CPR. There were 12.5 text message-responders per km² and 0.6 AEDs/km² in 2019 [8].

Improving fast availability and quality of advanced life support

When the dispatch center is called for a (suspected) OHCA an ambulance is sent to the scene within 20 s before starting the complete dispatch process. After finishing the dispatch process or as soon as a cardiac arrest is confirmed, a second ambulance is sent to the scene as well as police and fire department staff in the range of the OHCA.

Ambulance staff in the Netherlands is using a uniform national advanced life support (ALS) protocol conform European Resuscitation Council (ERC) guidelines [9,10]. In the RAVHM region, the ambulance staff is regularly and frequently trained and tested in all ALS interventions with the goal of the correct and time-sensitive application of the ALS interventions. CPR by the ambulance staff includes the use of the combination of a mechanical thorax compression device, the Lund University Cardiopulmonary Assist System (Jolife AB, Lund, Sweden), and the Boussignac tube (Vygon, Paris, France) as preferred assistive devices to minimize no-flow time while realizing constant adequate ventilation/oxygenation and early transport to the hospital [11–13].

Standardized in-hospital and postresuscitation care

The Leiden University Medical Centre (LUMC) is the only hospital in the region of RAVHM with 24/7 intervention capacity (including acute primary coronary angioplasty) and therefore most OHCA patients are presented here. Preannouncement and handover to the hospital team were standardized to guarantee proper preparation and fast and complete information transfer. The emergency department (ED) team is working to conform a standardized pathway to defined members, tasks, and process flow to support continued circulation

and early recognition and treatment of possible reversible causes. All patients with ROSC at presentation on the ED or after assessment in the ED went to the Cardiac Care Unit or ICU. Postresuscitation care is standardized conform ERC guidelines.

Centralization of rehabilitation

The cardiology department of the LUMC refers eligible OHCA patients for cardiac rehabilitation to one specialized rehabilitation center (Basalt, Leiden). Cardiac rehabilitation is aimed at improving physical fitness and healthy behavior. It has been shown that cardiac rehabilitation can reduce mortality [14]. At the start of cardiac rehabilitation, screening for cognitive impairments is performed in each OHCA patient and there is an option to follow an additional cognitive rehabilitation program for OHCA patients with postanoxic encephalopathy [15].

Outcome

All interventions, with exception of the national text message alert system, were implemented between 2006 and 2010. The system-level approach with interventions on all levels of the chain of survival has led to improvement of the number of patients with ROSC at arrival at the ED as well as improvement of the 1-year-survival rate in this RAVHM region.

After the interventions, the percentage of patients presented with ROSC at the ED of LUMC increased to about 50% without a national text message system and even 60% after its introduction. The 3-month survival rate is about 42% and the 1-year survival rate is more than 38%. The majority of ROSC patients had good (neurological) outcomes.

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Conflicts of interest

There are no conflicts of interest.

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