

# **Dispatcher-Activated Neighborhood Access Defibrillation and Cardiopulmonary Resuscitation**

**NCT02010151**

2018.5.23

## Study setting

In Korea, the national fire department exclusively operates the EMS system, and EMS CPR protocol follows the 2010 and 2015 American Heart Association (AHA) guidelines. Ambulance crews can provide CPR at the scene and during transport, but they cannot stop CPR in the field unless the return of spontaneous circulation (ROSC) occurs and cannot declare death in the field because only a physician can declare death. Seoul is a large metropolitan city with a single-tiered intermediate level EMS. The population of Seoul is approximately 10 million in an area of 605 km<sup>2</sup>. One dispatch center is responsible for the entire city, and a DA-CPR protocol was adopted in late 2010. Seoul is composed of 25 administrative and health districts. Each district consists of a number of neighborhoods ('town level'). There are an average of 17 neighborhoods in each district (total 429 neighborhoods). Average population of districts is approximately 400,000 in an average area of 24 km<sup>2</sup> and the average population of the neighborhoods is 20,000 in an average area of 1.5 km<sup>2</sup>.

## Intervention program

In May 2015, Seoul launched the TM alert system, called the dispatch-activated neighborhood access defibrillation and cardiopulmonary resuscitation program ("NAD-CPR" program) in 5 districts serving a population of 2.2 million (Gangdong-gu, Gangbuk-gu, Nowon-gu, Seocho-gu, and Jungnang-gu). The intervention consisted of three major components: registration of volunteers after CPR training, active installation and registration of a PAD, and dispatcher activation of registered volunteers for bystander CPR and defibrillation.

First, the CPR volunteer network was organized for those who agreed to register for the TM alert system after completing the CPR training courses provided in participating district health center. The CPR network was explained to the all trainee when CPR training was conducted and the trainees voluntarily registered themselves to the network after training. They were trained with a 1-hour CPR training course and received a certification card from the city mayor. The volunteers' telephone number, workplace address, and home address were collected and transferred to the dispatch center to integrate with the EMS call system. For quality control of the CPR trainee, the volunteer registration remained valid for 2 years, and after that it was automatically removed. If someone want to remain in the network after two years, they should be attend CPR renewal course and register again. The program started in

2013 as a pilot program and was implemented in 2014.

Second, the Seoul health authority expanded the installation of PADs. All PADs were registered in the National Emergency Medical Center by the EMS Act, and the PAD registry was developed and recorded for use. The active installation and registration of the PADs were guided by each district's health authorities at predesignated places by the EMS Act, such as public and commercial buildings, traffic stations, sports and cultural areas, and large-sized apartments. The city government provided half of the financial support for PADs, and the remainder were deployed by the private sector.

Third, according to the DA-CPR protocol, the dispatcher asked two key questions regarding altered mental status and abnormal breathing. When a suspected arrest occurred, to issue an alert about an OHCA event, the dispatchers pushed a button to send a short text message containing the location of the cardiac arrest and the location of nearest available PAD to registered all volunteers within one geographic town according to a time window. This time window address-matched volunteers to their workplace or home address during the intervals from 6 AM to 22PM. The protocol for the TM alert service was not applied to all OHCA, especially in cases which occurred during the time interval from 00:00-05:59 and 22:00-23:59, because the night was regarded as an ineffective time to alert volunteers due to being too late.

The dispatchers, EMS crew, registered CPR volunteers, and medical record reviewers who were employed to review the hospital outcomes by the Korea CDC were blinded to the study intervention.

### Study design

This was a non-randomized, pre- and post-intervention trial. Since the intervention program started in May 2015, the period from January 2013 to December 2014 was defined as the pre-intervention period, and the period from January 2015 to December 2016 was defined as the post-intervention period. The TM cases were defined as the cases for which an TM alert was sent. Other cases were defined as standard care cases (non-TM cases).

### Study population

We enrolled all OHCA patients with a presumed cardiac etiology who were more than 15 years old and

who were treated by an EMS provider between January 2013 and December 2016 within the study area in Seoul. Those cases without an attempted resuscitation effort, cases that were witnessed by EMS providers or those that occurred at a nursing home or medical facility were excluded.

#### Data collection and variables

We collected data from the Korean OHCA Registry including the ambulance run sheet, dispatch record, cardiac arrest in-depth registry, and medical records for outcomes from the Korea Centers for Disease Control and Prevention. We developed the TM alert system registry by linking the TM cases that had a message sent to the registered volunteers. We checked the OHCA registry to confirm whether or not the case was a real arrest. Such cases were excluded if they were not a cardiac arrest or death was confirmed at the scene and no transfer to the emergency department (ED) occurred.

The main exposure of interest was the intervention phase (before- and after-intervention periods), and the secondary exposure was TM sent from the TM alert system. Demographic factors that were collected included the following: date of arrest, time of the call (00:01-05:59, 06:00-11:59, 12:00-17:59, and 18:00-23:59), age, gender, and comorbidities (diabetes, hypertension, heart disease, and stroke). Community and EMS factors that were collected included the following: witness information, location of the arrest, bystander CPR, laypersons' use of a PAD, primary electrocardiogram (ECG) at the scene, EMS response time interval (RTI, from the time of the call to the time of EMS arrival at the scene), scene time interval (STI, from the time of arrival at the scene to the time of departure from the scene), transport time interval (TTI, from the time of departure from the scene to the time of EMS arrival at the hospital), prehospital airway management by an EMS provider (endotracheal intubation, supraglottic airway device, or bag valve mask). Hospital factors included the emergency department (ED) level (regional level 1 ED, local level 2 ED, local level 3 ED) and post-resuscitation care, such as percutaneous coronary intervention (PCI), targeted temperature management (TTM), and extracorporeal membrane oxygenation (ECMO).

#### Main outcomes

The primary endpoint was good neurological outcomes of OHCA patients, which were classified as

cerebral performance category I or II at discharge. The secondary endpoints were the survival to discharge and prehospital ROSC. The tertiary outcomes were the provision of bystander CPR, regardless of dispatcher-provided CPR instructions, and bystander defibrillation.

### Statistical analysis

The demographics of the registered volunteers, registered PADs, and the number of TM alerts sent during the study period were compared for the study setting. A descriptive analysis was performed to determine the distribution of the categorical variables (counts and proportions) and continuous variables (medians and inter-quartile ranges). The chi-square test was performed for categorical variables, and the Wilcoxon rank-sum test was performed to compare continuous variables across the intervention periods.

Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for bystander CPR and defibrillation by TM versus non-TM were calculated using multivariable logistic regression analysis with adjustment for potential confounders. Adjustment for age, gender, and comorbidities were included as confounders in Model 1, and time factors (season, weekend, and time of the arrest) and characteristics of the arrest (witnessed, location of arrest) in addition to the confounders in Model 1 were added in Model 2.

Multivariable logistic regression analyses for outcomes (good CPC, survival to discharge, and PROSC) were used. Model 1 was adjusted for demographic factors (age, gender, and comorbidities); Model 2 was adjusted for the demographic factors from Model 1 as well as time factors related to the event (season, weekday, and daytime), Utstein factors (initial ECG, witness, and place), and EMS factors (RTI, STI, TTI, and prehospital airway); Model 3 was adjusted for the same confounders as Models 1 and 2 as well as factors related to advanced hospital care (PCI, TTM, and ECMO).

For the sensitivity analysis, a final multivariable logistic regression analysis was conducted for the subgroup population when the call occurred during the study time (TM sent time), from 6 AM to 10 PM. The confounders were same as the main analyses for each outcome. The main exposure was TM (cases who received TM alerts) versus non-TM (cases who did not receive TM alerts) for bystander CPR and defibrillation during the before- and after-intervention periods for outcomes (PROSC, survival to discharge, and good CPC).

All the statistical analyses were conducted using SAS software, version 9.4 (SAS Institute Inc., Cary, NC, USA). P values were based on a two-sided significance level of 0.05.