

Bystander Cardio-Pulmonary Resuscitation Practice among Out- of- Hospital Cardiac Arrest: Rajavithi Hospital's Narenthorn Emergency Medical Service Center, Thailand

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ABSTRACT

This study aimed to examine outcomes of bystander Cardio-Pulmonary Resuscitation (CPR) among Out-of-hospital cardiac arrest (OHCA) patients at Rajavithi Hospital's Narenthorn Emergency Medical Service (EMS) Center, Thailand. A retrospective study using secondary data of 510 OHCA patients from 2014 to 2016 was conducted. Descriptive statistics, inferential statistics, univariate (Chi-square), and multivariate analyses (Logistic regression) were employed for data analysis. The majority of bystander CPR performers were volunteers (87.3%) and 43.7% generate return of spontaneous circulation (ROSC).

Calling time duration and initial electrocardiogram (EKG) had significant relationship with OHCA patients' survival to those receiving bystander CPR. Therefore, calling time and initial EKG were major factors of OHCA patients' survival. Encouraging CPR training and providing automated external defibrillator devices (AED) in many public areas is important for effective bystander CPR.

Keywords: bystander cardiopulmonary resuscitation, out-of-hospital cardiac arrest, Rajavithi Hospital's Narenthorn Emergency Medical Service Center



Out-of-Hospital Cardiac Arrest (OHCA) is a worldwide public health problem and leading cause of death in the developed countries. The estimated incidence in the US is about 300,000 annually (92% of all deaths)¹. According to a report by the UK National Health Service, British emergency ambulances help about 30,000 OHCA patients annually with 73 to 87% mortality rate². In Singapore, the number of OHCA patients is two to three daily with a 82% mortality rate³. In Europe, the incidence of OHCA patients was 86.4 per 100,000 person-years and survival to discharge ranged from 3% to 43%⁴. The Australian Heart Association reported about 15,000 OHCA patients annually and these patients are likely to survive if they received Cardio-Pulmonary Resuscitation (CPR) quickly and shockable rhythm treatment from bystanders without waiting for resuscitation teams. However, during the waiting time for arrival of the resuscitation team, only 30% of bystanders performed CPR⁵.

Rajavithi Hospital's Narenthorn Emergency Medical Service (EMS) Center is the first EMS model in Thailand. From 2014 to 2016, 205, 251, and 279 OHCA cases occurred, respectively⁶. Presently, Thailand is in the process of developing a database of OHCA incidents. The success of life saving requires a systemic coordination between people and rescuers, especially providing bystander CPR

before the resuscitation team to arrive^{7, 8}. In 2007, the Rajavithi Hospital's Narenthorn EMS Center report revealed that only 27.4% OHCA patients received bystander CPR before the resuscitation team arrived⁷. Providing bystander CPR before the resuscitation team arrives is a factor related to OHCA patients' survival. With bystander CPR, the survival rate is increased 5.6 times⁷. Without bystander CPR, the rate is reduced by 10% every minute that passes by⁹.

Since 1995, the first EMS center at Rajavithi Hospital, Bangkok, named "Narenthorn EMS Center", has been one of the government policies to manage any emergency health crises. The EMS Act 2551 B.E. was endorsed 7 March 2008 with emergency call number 1669. In 2009, the Rajavithi Hospital's Narenthorn EMS Center, started to provide a bystander CPR training program, based on the American Heart Association (AHA) guidelines, for people living near Rajavithi Hospital. Trainees were volunteers, relatives of patients at risk of cardiac arrest, and general public, 100 trainees per course. They were instructed to call for help at the Narenthorn EMS Center and perform CPR accurately and promptly while waiting for the resuscitation team to reduce OHCA patient deaths and complications. However, the situation of OHCA bystander CPR in responsible areas of Rajavithi Hospital's Narenthorn EMS Center

remains unknown. Therefore, the objective of this study was to examine incidences and outcomes of bystander CPR practice for OHCA patients at Rajavithi Hospital's Narenthorn EMS Center, Thailand. The results could be valuable for developing an OHCA support system in Rajavithi Hospital's Narenthorn EMS Center and other emergency medical service providers.

In 2018, 5.68 million people are registered¹⁰ in the Bangkok Metropolitan area with nine areas providing out-of-hospital emergency medical services. The Rajavithi Hospital's EMS Center's responsible area is Zone 8, serving as the head quarter working together with six other hospitals for the advanced life support (ALS) teams. Over 2000 patients request for ALS in Zone 8 annually. Almost 50% of these records were patients receiving EMS from the Rajavithi Hospital's Narenthorn EMS Center. Most patients (52.2%) were delivered by their families or witnesses.⁶

The Zone 8 area covers 75 square kilometers of 8 districts of Bangkok Metropolitan, including Phyathai, Huaykwang, Rajthevi, Dindang, Bang Sue, Wangthonglang, Chatuchak, and Ladprao⁶. Many people in zone 8 voluntarily support life support team by taking their own vehicles and their private time. These volunteer are mostly reaching the emergency site and taking on scene care while waiting for the EMS team arrives. One study

conducted by Rajavithi Hospital's Narenthorn EMS Center in 2007⁷ established the policy of promoting bystander CPR training program for laypeople, including life support volunteers, patients' relatives, and other individuals. The 6-hour program consists of 1-hour lecture, 3-hour simulation practice, and 2-hour return demonstration examination, training skill of emergency calling, life signs assessment and performs CPR for an OHCA person. Pre-test and post-test questionnaires are required to assess their performance. Therefore, as being the effectiveness of this CPR training program, this study aims to examine outcomes of bystander CPR among OHCA patients.

Method

This is a retrospective study from secondary data at Rajavithi Hospital's Narenthorn EMS Center. The data are the records of bystander CPR for OHCA from 2014 to 2016 which was given a permission to deploy in this study by the director, Rajavithi hospital. Inclusion criteria comprised data of OHCA patients aged 18 years and older and exclusion criteria comprised records with no resuscitation. Sample size estimation was computed using a proportional formula¹¹, revealing a bystander CPR rate of 27.4% from one study in 2007⁷, equal to 477 recordings. The recordings of OHCA from 2014 to 2016 totaled 735, and the complete records totaled 570 (77.7%).



Demographic characteristics, time of incidences, initial electrocardiogram and survival rate were collected and re-arranged. Of the 570 records, 510 records (89.4%) documented bystander CPR. Therefore, all record of OHCA based on the purpose of this study, data analyses were employed to examine resuscitation rates among OHCA patients involving bystander CPR before the resuscitation team arrived, to categorized bystander who performed CPR among OHCA patients, to study survival rate defined as return of spontaneous circulation (ROSC), and to determine factors affecting ROSC.

Research ethic approval

The study proposal was approved by the Ethical Committee on Human Rights, Rajavithi Hospital, document number 035/2560. The secondary data was derived from the Rajavithi Hospital's Narenthorn EMS Center records and name of the victims was not included, without any human harm detected.

Data analyses

Data were analyzed to compare qualitative and quantitative data with ROSC records. Therefore, descriptive statistics, Chi-square test and logistic regression analysis (ref: call time 12.00 am-07.59 am) were employed with

statistical significance set at 0.05.

Results

In 2014 to 2016, 152, 181, and 177 OHCA patient receiving bystander CPR were recorded, respectively. The incidence was most recorded from 4.00 pm–11.59 pm (212 records; 41.6%), at patients' residences (410 records; 80.4%), and without any witness (431 records; 84.5%). Most OHCA patient (365 records; 71.6%) were male, aged 40 to 59 years (178 records; 35.0%) with unknown underlying illness (257 records; 50.4%). Their initial electrocardiogram (EKG) involved asystole (448 records; 87.8%). The results after performing CPR were recorded as "dead at the scene" (287 records; 56.3%), 32.0% (163 records) "survived at emergency department (ED)", 10.6% (54 records) "survived and admission", and 1.1% (6 records) "survived and discharged". Notably, in 2015 and 2016, bystander CPR practice was found greater than those in 2014. The location of the OHCA was mostly at patients' residence (80.4%). The records revealed that most of the bystander CPR performers was volunteers (445 records; 87.3%) following by relatives (39 records; 7.6%), health personnel (18 records; 3.5%), and others (not specified). Of the bystanders CPR, 88.6% (452 records) experienced CPR training (Table 1).

Table 1 Numbers and Percentages of General Characteristics and Illness Situation of OHCA Patients Having Bystander CPR. (n=510)

| Characteristics and illness situation | Number | % |
|---------------------------------------|--------|------|
| Year | | |
| 2014 | 152 | 29.8 |
| 2015 | 181 | 35.5 |
| 2016 | 177 | 34.7 |
| Emergency Call Time | | |
| 08.00 am-03.59 pm | 163 | 31.9 |
| 04.00 pm-11.59 pm | 212 | 41.6 |
| 12.00 am-07.59 am | 135 | 26.5 |
| Sex | | |
| Male | 365 | 71.6 |
| Female | 145 | 28.4 |
| Age (years) | | |
| < 40 | 98 | 19.2 |
| 40-59 | 178 | 35.0 |
| 60-79 | 134 | 26.2 |
| ≥ 80 | 81 | 15.9 |
| Unknown | 19 | 3.7 |
| Underlying illness | | |
| Heart disease | 26 | 5.1 |
| Other diseases | 150 | 29.4 |
| Trauma | 77 | 15.1 |
| Unknown | 257 | 50.4 |
| Witness(es) | | |
| yes | 79 | 15.5 |
| no | 431 | 84.5 |
| Location of arrest | | |
| Patient's residence | 410 | 80.4 |
| Other places | 100 | 19.6 |



Table 1 Numbers and Percentages of General Characteristics and Illness Situation of OHCA Patients Having Bystander CPR. (n=510) (cont.)

| Characteristics and illness situation | Number | % |
|--|--------|------|
| Initial electrocardiogram (EKG) | | |
| Ventricular tachycardia (VT) | 2 | 0.4 |
| Ventricular fibrillation (VF) | 36 | 7.1 |
| Pulseless electrical activity (PEA) | 24 | 4.7 |
| Asystole | 448 | 87.8 |
| Survival status | | |
| Dead at scene | 287 | 56.3 |
| Survival to ER | 163 | 32.0 |
| Survival to ward | 54 | 10.6 |
| Survival to discharge | 6 | 1.1 |
| Types of bystander CPR | | |
| Volunteer | 445 | 87.3 |
| Relative(s) | 39 | 7.6 |
| Medical personnel | 18 | 3.5 |
| Others | 8 | 1.6 |
| Life support training | | |
| yes | 452 | 88.6 |
| no | 58 | 11.4 |

Univariate analysis and multivariate analysis revealed that the emergency call time record from 08.00 am-03.59 pm (OR 2.07; 95%CI: 1.26-3.39), 04.00pm-11.59 pm (OR 1.62;

95%CI: 1.01-2.56) and initial EKG of shockable rhythm treatment (OR 5.23; 95%CI: 2.21-12.41) significantly correlated with survival of OHCA patients (Table 2 and 3).

Table 2 Univariate Analysis of Factors Affecting Survival of OHCA Patients by Bystander CPR. (n=510)

| Factor | Total (n=510) | Death (n=287) | | Survive (n=223) | | p |
|----------------------------------|------------------|---------------|---------|-----------------|---------|--------|
| | | number | percent | number | percent | |
| Call time | | | | | | 0.010 |
| 08.00 am-15.59 pm | 163 | 79 | 48.5 | 84 | 51.5 | |
| 16.00-23.59 pm | 212 | 119 | 56.1 | 93 | 43.9 | |
| 24.00-07.59 am | 135 | 89 | 65.9 | 46 | 34.1 | |
| Age (years) | | | | | | 0.459 |
| < 40 | 98 | 55 | 56.1 | 43 | 43.9 | |
| 40-59 | 178 | 101 | 56.7 | 77 | 43.3 | |
| 60-79 | 134 | 69 | 51.5 | 65 | 48.5 | |
| ≥ 80 | 81 | 49 | 60.5 | 32 | 39.5 | |
| Unknown | 19 | 13 | 68.4 | 6 | 31.6 | |
| Gender | | | | | | 0.363 |
| Male | 365 | 210 | 57.5 | 155 | 42.5 | |
| Female | 145 | 77 | 53.1 | 68 | 46.9 | |
| Underlying Illness | | | | | | 0.833 |
| Heart disease | 26 | 14 | 53.8 | 12 | 46.2 | |
| Others | 150 | 83 | 55.3 | 67 | 44.7 | |
| Trauma | 77 | 47 | 61.0 | 30 | 39.0 | |
| Unknown | 257 | 143 | 55.6 | 114 | 44.4 | |
| Witnessed arrest | | | | | | <0.001 |
| Witnessed arrest | 79 | 30 | 38.0 | 49 | 62.0 | |
| Un -witnessed arrest | 431 | 257 | 59.6 | 174 | 40.4 | |
| Location of arrest | | | | | | 0.337 |
| In-residence | 410 | 235 | 57.3 | 175 | 42.7 | |
| Non-residential | 100 | 52 | 52.0 | 48 | 48.0 | |
| Initial electrocardiogram | | | | | | <0.001 |
| Shockable rhythm | 38 | 7 | 18.4 | 31 | 81.6 | |
| Non -shockable rhythm | 472 | 280 | 59.3 | 192 | 40.7 | |



Table 2 Univariate Analysis of Factors Affecting Survival of OHCA Patients by Bystander CPR. (n=510) (cont.)

| Factor | total (n=510) | Death (n=287) | | Survive (n=223) | | p |
|----------------------------------|------------------|---------------|---------|-----------------|---------|-------|
| | | number | percent | number | percent | |
| Category of bystander CPR | | | | | | 0.010 |
| Volunteer | 445 | 261 | 58.7 | 184 | 41.3 | |
| Relative | 39 | 18 | 46.2 | 21 | 53.8 | |
| Medical personnel | 18 | 4 | 22.2 | 14 | 77.8 | |
| Others | 8 | 4 | 50.0 | 4 | 50.0 | |
| CPR training experience | | | | | | 0.007 |
| Training | 452 | 264 | 58.4 | 188 | 41.6 | |
| No-Training | 58 | 23 | 39.7 | 35 | 60.3 | |

Table 3 Multivariate Analysis of Factors Affecting Survival of OHCA Patients by Bystander CPR Using Logistic Regression Analysis. (n=510)

| Factor | Crude Odds ratios (95% CI) | p | Adjusted Odd Ratios (95% CI) | 95% CI | | p |
|-------------------------|----------------------------------|--------|------------------------------------|--------|-------|--------|
| | | | | Lower | Upper | |
| Call time | | | | | | |
| 12.00am-07.59am | Ref | | Ref | | | |
| 08.00am-03.59pm | 2.06(1.29-3.29) | 0.003 | 2.07 | 1.26 | 3.39 | 0.004 |
| 04.00pm-11.59pm | 1.51(0.97-2.37) | 0.070 | 1.62 | 1.01 | 2.59 | 0.045 |
| Witnessed arrest | 2.41(1.47-3.95) | <0.001 | 1.61 | 0.91 | 2.84 | 0.100 |
| Shockable rhythm | 6.46(2.79-14.97) | <0.001 | 5.23 | 2.21 | 12.41 | <0.001 |
| Training | 2.14(1.22-3.74) | 0.008 | 1.31 | 0.26 | 6.53 | 0.745 |
| Volunteer | 0.45(0.26-0.77) | 0.004 | 0.67 | 0.14 | 3.26 | 0.616 |

Discussion

The increase of the bystander CPR from 2014 to 2016 reflected the success of the annual bystander CPR program training since 2009. It will increase the chance of survival of OHCA patients when the results are extended to other areas. These findings differed from the study in 2007 reporting that OHCA patients receiving Bystander CPR totaled only 27.4%⁷. This was similar to findings from many related reports in Thailand^{8, 12-13}. Studies in other countries^{9, 14-18} revealed that the bystander CPR was increasing, especially in the Netherlands with 76% bystander CPR cases¹⁷. However, the Pan Asian Resuscitation Outcomes Study (PAROS) found that the number of people receiving bystander CPR before the resuscitation team arrived in Japan, Singapore, South Korea, Malaysia, Taiwan, Thailand, and Dubai were different¹⁹. Therefore, bystander CPR training program should be encouraged and provided to the public continuously. In Japan, this kind of the program was provided to community members²⁰⁻²². The majority of bystanders CPR in this study were volunteers (87.3%) because they had more opportunity to find OHCA patients. In addition, volunteers trained and always joined the annual CPR training program provided by the Rajavithi Hospital's Narenthorn EMS Center. This training program improved their skills and increased rate of bystander CPR.

Only 7.6% of bystander CPR involved OHCA patients' relatives (Table 2). This finding could be explained that patient's relative might be in a panic situation and they might not know how to help. The finding is consistent with one related study in that only 13% of bystanders were willing to perform CPR to help their family members and friends²³. On the other hand, this finding differed from two studies in China²⁴ and Arizona, USA²⁵ revealing that over 80% of respondents expressed their willingness to perform CPR for their family members.

The emergency call time record from 08.00 am to 03.59 pm and 04.00 pm to 11.59 pm revealed more OHCA survival cases than those of between 12.00 am to 07.59 am. This finding was consistent with many previous studies. Kim and colleagues found that the emergency call time from 06.01am to 12.00 pm, 12.01 pm to 06.00 pm, and 06.01 pm to 12.00 am revealed higher OHCA survival rates than those calls between 12.01 am to 06.00 am²⁶. In addition, the initial EKG expressing a shockable rhythm held a significant relationship with OHCA patients' survival rates. This finding revealed an importance of the Automated External Defibrillator (AED) device to increase the survival rate of OHCA patients, consistent with the study conducted by Nakahara and colleagues²⁷. However, in Thailand, no report



of OHCA bystander CPR exists. It found only one study of nurses' perception regarding quality of care for patients having severe trauma²⁸. The calling time and initial EKG were major factors of OHCA patients' survival. Encouraging CPR training and providing AED devices in many public areas are important for effective bystander CPR. In addition, the AED maintenance system should be scheduled to help lifesaving and increase survival rates among OHCA patients.

The limitations of this study included records of OHCA with severely injured, where the emergency call time which was not the exact time of cardiac arrest, and time lapse between time the call center was notified and time the resuscitation team arrived (response time). The reason was many written records were uncompleted. Another limitation was the record of OHCA patients from 2010 to 2013 during the civil unrest in Bangkok Metropolitan area. The records were excluded due to unusual circumstances. Lastly, this study did not investigate "response time" because of the transition to the recording system, so some data were incomplete affecting the research results.

Further study should examine records of OHCA incidences at high building residences which is a lifestyle trend in Bangkok Metropolitan area. With the ongoing trend to

distribute AED devices in public places; therefore, the epidemiology of OHCA patients should be studied to install AED devices in necessary areas. In addition, a study should compare bystanders CPR performers in urban and rural areas, using different contexts and limitations, should be examined.

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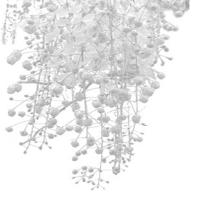
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การนวดหัวใจผายปอดกู้ชีพผู้ป่วยที่มีภาวะหัวใจหยุดเต้น โดยผู้ประสบเหตุนอกโรงพยาบาล: ศูนย์กู้ชีพ “นเรนทร” โรงพยาบาลราชวิถี

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์ เพื่อศึกษาผลลัพธ์ของการนวดหัวใจผายปอดกู้ชีพผู้ป่วยที่มีภาวะหัวใจหยุดเต้นโดยผู้ประสบเหตุนอกโรงพยาบาลของศูนย์กู้ชีพ “นเรนทร” โรงพยาบาลราชวิถี โดยใช้ข้อมูลทุติยภูมิจากบันทึกผู้ที่มีภาวะหัวใจหยุดเต้นนอกโรงพยาบาลของศูนย์กู้ชีพ “นเรนทร” โรงพยาบาลราชวิถี ระหว่างปี พ.ศ. 2557-2559 วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา และสถิติเชิงวิเคราะห์ แบบการวิเคราะห์ตัวแปรตัวเดียว (Chi-square) และ การวิเคราะห์พหุตัวแปร (Multiple Logistic regression) ผลการศึกษาพบว่า กลุ่มผู้ประสบเหตุที่ทำการช่วยนวดหัวใจผายปอดกู้ชีพเป็นกลุ่มอาสาสมัครมากที่สุด (ร้อยละ 87.3) และพบว่า มีการรอดชีวิต (คำพบชีพจร) ร้อยละ 43.7 ซึ่งปัจจัยที่มีความสัมพันธ์กับ

การรอดชีวิตอย่างมีนัยสำคัญทางสถิติ คือ ช่วงเวลาที่แจ้งเหตุ และคลื่นไฟฟ้าหัวใจที่บันทึกได้ครั้งที่แรกที่พบผู้ป่วย ดังนั้น ช่วงเวลาที่แจ้งเหตุ และคลื่นไฟฟ้าหัวใจที่บันทึกได้ครั้งที่แรกที่พบผู้ป่วย เป็นปัจจัยสำคัญต่อการรอดชีวิต การฝึกอบรมการนวดหัวใจผายปอดกู้ชีพ การใช้เครื่องกระตุ้นหัวใจอัตโนมัติและติดตั้งให้ครอบคลุมพื้นที่สาธารณะ รวมถึงการสร้างระบบการบำรุงรักษาเครื่องมือดังกล่าวให้มีประสิทธิภาพและพร้อมใช้งาน จะช่วยให้การนวดหัวใจผายปอดกู้ชีพโดยผู้ประสบเหตุมีประสิทธิภาพดียิ่งขึ้น

คำสำคัญ: การนวดหัวใจผายปอดกู้ชีพโดยผู้ประสบเหตุ, ภาวะหัวใจหยุดเต้นนอกโรงพยาบาล, ศูนย์กู้ชีพ “นเรนทร” โรงพยาบาลราชวิถี

* ศูนย์กู้ชีพ “นเรนทร” โรงพยาบาลราชวิถี

** ภาควิชาการพยาบาลสาธารณสุข คณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหิดล