# Effect of On-Scene Time on Survival Outcome in Non-Traumatic Out-of-Hospital Cardiac Arrest

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*Objective*: To determine the optimal on-scene time (ST) to maximize survival in cases of non-traumatic out-of-hospital cardiac arrest.

*Materials and Methods*: A retrospective observational analysis reviewed non-traumatic out-of-hospital cardiac arrest patients and the effect of on-scene time on survival outcome. The 95 patients in the sample suffered out-of-hospital cardiac arrest and received cardiopulmonary resuscitation from Srinagarind EMS Unit, Khon Kaen, Thailand. Data were collected between January 1, 2014 and December 31, 2016. The present study focused on ST of 8 and above as previous studies showed a benefit from these periods of on-scene time. The outcomes were measured by survival at emergency department, survival to admission and survival to discharge.

*Results*: ST of 8 minutes and above was significantly associated with survival to admission but not survival at emergency department and survival to discharge.

*Conclusion*: The on-scene time in non-trauma out-of-hospital cardiac arrest patients should not be based on platinum 10 (less than 10 minutes) as in trauma patients. On-scene time of 8 minutes and above had a better survival to admission than on scene-time of less than 8 minutes for non-traumatic out-of-hospital cardiac arrest patients.

*Keywords*: Prehospital, cardiac arrest, On-scene time

There was over 350,000 out-of-hospital cardiac arrest in the United States, and twelve percent of these patients survived to discharge home[1]. In Thailand, the survival rate of out-of-hospital cardiac arrest was 4.2 to 11 percent[2-5]. Netherland reported a high survival rate of 43 percent[6]. The European Society of Cardiology recommends the activation of emergency medical services (EMS) in cases of out-of-hospital cardiac arrest to improve chances of survival[7]. It has been found that the time spent at the scene is associated with survival outcome[8-10]. The on-scene time is the intervals from the arrival time at the scene to the time the EMS leaves the scene. Pre-hospital trauma life support recommends the time spent at the scene for critical trauma patients should be less than 10 minutes[11]. For non-trauma patients, it has also been found that there is a specific period of on-scene time that can improve the outcome. This time is different from that for trauma patients. Studies by Shin et al[12] in Japan and Korea found that on-scene time between 8 and 16 minutes had the best survival outcome compared to on-scene time of less than 8 minutes or on-scene time over 16 minutes. Spaite et al[13] reported on-scene time of less than 12 minutes in non-trauma patients resulted in a better survival outcome than longer periods in patients in the United States. In Thailand, the country's EMS was established in 1989. Presently, there is a standard for on-scene time in trauma cardiac arrest patients. However, for non-trauma cardiac arrest, the ideal on-scene time remains unclear. In the present study, the authors aimed to test the applicability to a sample of northeast Thai patients of the suggestions of the most appropriate on-scene

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time for non-traumatic patients of more than 8 minutes for best survival outcomes.

## Materials and Methods
### Design and setting
The present study was a retrospective observational analysis. The enrolled patients were those that suffered from out-of-hospital cardiac arrest and received cardiopulmonary resuscitation (CPR) from Srinagarind EMS Unit, Khon Kaen, Thailand. All non-traumatic adult patients (older than 18 years) who received CPR from Srinagarind EMS unit were eligible for inclusion. Patients who had signed irreversible death, a Do-Not-Resuscitate order, or were transferred from other hospitals were excluded. The authors used data from the Srinagarind EMS registry. Data were collected between January 1, 2014 and December 31, 2016. The study was approved by the Khon Kaen University Ethics Committee in Human Research (HE591269). The present article focused on ST of less than 8 minutes and ST of 8 minutes or longer following the evidence from previous studies[12]. The outcomes tested were survival at emergency department, survival to admission, and survival to discharge. Survival outcomes were recorded from the CPR record sheet and patient medical record card. All patients received the same standard resuscitation protocol.

### Statistical analysis
Continuous variables were described using mean, standard deviation (SD) or median, maximum, and minimum. Categorical variables were described using frequency and percentage. Chi-square tests were used to analyze the impact of on-scene time on survival outcome. The multivariate models included on-scene time, presumed cause of arrest, initial electrocardiogram (EKG) rhythm, witnessed arrest, bystander CPR, and age group. A p-value lower than 0.05 was considered as statistically significant. All analyses were carried out using Stata version 14.

## Results
Ninety-five non-traumatic out-of-hospital cardiac arrest patients were enrolled in the present study. Baseline characteristics are presented in Table 1. Seventy percent of the sample were male. The mean age was 58.4 years, and the most common cause of arrest was cardiac. There were witnesses to the cardiac arrest for 54.7 percent of the patients, and bystanders carried out CPR for 37.9 percent. Table 2 shows that the patients who spent more than 8 minutes on-scene had

a better survival outcome at the emergency department (61.5 percent) and admission (46.1 percent). The very small groups of patients who survived to discharge showed no significant differences of on-scene time. Table 3 presents adjusted odds ratios (ORadj) with adjustments for presumed cause of arrest, witnessed arrest, bystander CPR, and age group. The on-scene time of over 8 minutes' group had a better outcome in survival, but the survival at emergency department and discharge were not statistically significant level. The on-scene time of the over 8 minutes' group (ORadj 5.54; 95% CI 1.87 to 16.4) was significantly associated with survival to admission. The Table 4 and the Figure 1 shows the ROC curve of ST over 8 minutes and the survival outcome. The AOCs of ST over 8 minutes in survival at emergency department, survival to admission, and survival to discharge were 0.59, 0.68, and 0.58, respectively.

## Discussion
The present study aimed to address the question of the optimum on-scene time for non-trauma, out-of-hospital, cardiac arrest to apply in the Srinagarind EMS protocol. Previous studies have shown different on-scene times affect the survival outcome in non-trauma out of hospital cardiac arrest. Shin et al[12] found that patients in their sample of 3,594 patients in Korea (Seoul) and Japan (Osaka) who spent on-scene time between 8 and 16 minutes showed greater survival to admission. Spaite et al[13] found the 293 patients in the United states of America that on-scene time of less than 12 minutes resulted in a better chance of survival in the field and survival to discharge. The present study results showed that on-scene time of over 8 minutes had the best survival outcome. The authors assumed that in spending resuscitation time on non-trauma cardiac arrests at the scene, patients would receive more advanced intervention such as defibrillation, intubation, medication, or intravenous fluid that might improve the survival outcome as the chain of survival key[14,15]. This was in contrast to trauma patients, where the need to reach the operating room is the principle aim of care, so a shorter on-scene time gives a better chance of survival. The present study showed that the optimal on-scene time of less than 10 minutes as in trauma patient should not be used in non-trauma out-of-hospital cardiac arrest patients. A larger sample size could improve confidence in these findings for inclusion in the Thai EMS protocol.

## Conclusion
On-scene time in non-trauma out-of-hospital

**Table 1.** Patients' baseline characteristics

| Variables | Total (n = 95) n (%) | ST <8 (n = 56) n (%) | ST ≥8 (n = 39) n (%) |
|---|---|---|---|
| Sex | | | |
|     Male | 70 (73.7) | 45 (80.4) | 25 (64.1) |
|     Female | 25 (26.3) | 11 (19.6) | 14 (35.9) |
| Age (years), Mean±SD | 58.4±18.2 | 53.1±19.5 | 66.0±13.0 |
| Distance from base station to scene, Median (min, max) | 6 (1, 20) | 5 (1, 20) | 6 (1, 20) |
| Distance from scene to hospital, Median (min, max) | 5 (1, 19) | 5 (2, 12) | 4 (1, 19) |
| Presume cause of arrest | | | |
|     Cardiac | 38 (40.0) | 24 (42.9) | 14 (35.9) |
|     Respiratory | 15 (15.8) | 7 (12.5) | 8 (20.5) |
|     Sepsis | 4 (4.2) | 3 (5.4) | 1 (2.6) |
|     Toxin | 3 (3.2) | 3 (5.4) | 0 (0.0) |
|     Upper GI bleeding | 6 (6.3) | 2 (3.6) | 4 (10.3) |
|     Unknown | 19 (20.0) | 10 (17.9) | 9(23.1) |
| Witness arrest | | | |
|     Yes | 52 (54.7) | 27 (48.2) | 25 (64.1) |
|     No | 24 (25.3) | 18 (32.1) | 6 (15.4) |
|     Unknown | 19 (20.0) | 11 (19.6) | 8 (20.5) |
| Bystander CPR | | | |
|     Yes | 36 (37.9) | 19 (33.9) | 17(43.6) |
|     No | 31 (32.6) | 17 (30.4) | 14 (35.9) |
|     Unknown | 28 (29.5) | 20 (35.7) | 8 (20.5) |
| EKG (initial rhythm) | | | |
|     Asystole | 56 (59.0) | 38 (67.9) | 18 (46.1) |
|     PEA | 12 (12.6) | 6 (10.7) | 6 (15.4) |
|     VF | 19 (20.0) | 11 (19.6) | 9 (23.1) |
|     Pulseless VT | 1 (1.0) | 0 (0.0) | 0 (0.0) |
|     Unknown | 7 (7.4) | 1 (1.8) | 6 (15.4) |

ST=on-scene time; SD=standard deviation; GI=gastrointestinal; CPR=cardiopulmonary resuscitation; EKG=electrocardiogram; PEA=pulseless electrical activity; VF=ventricular fibrillation; VT=ventricular tachycardia

**Table 2.** Survival outcomes of non-traumatic out-of-hospital cardiac arrest at emergency department, at admission and at discharge in on-scene time intervals

| Survival outcome | Total (n = 95) n (%) | ST <8 (n = 56) n (%) | ST ≥8 (n = 39) n (%) | p-value |
|---|---|---|---|---|
| Survival at ED | 48 (50.5) | 24 (42.9) | 24 (61.5) | 0.073[†] |
| Survival to admission | 27 (28.4) | 9 (16.1) | 18 (46.1) | 0.001[†] |
| Survival to discharge | 9 (9.5) | 4 (7.1) | 5 (12.8) | 0.480[‡] |

ST=on-scene time; ED=emergency department

[†] Pearson's Chi-squared test, [‡] Fisher's exact test

**Table 3.** Adjusted Odds ratios of survival outcome of non-traumatic out-of-hospital cardiac arrest and on-scene time interval

| On-scene time intervals | Survival at ED* | | | Survival to admission | | | Survival to discharge | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR$_{adj}$ | 95% CI | | OR$_{adj}$ | 95% CI | | OR$_{adj}$ | 95% CI | |
| | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| ST ≥8 | 2.11[†] | 0.77 | 5.78 | 5.54[†] | 1.87 | 16.40 | 3.15[†] | 0.51 | 19.37 |

ST=on-scene time; ED=emergency department; OR$_{adj}$=adjusted odds ratios; CI=confidence interval

* Reference group: ST <8 minutes

[†] Model were adjusted for presume cause, EKG (initial rhythm), witness arrest, and bystander CPR

**Table 4.** Comparison of the area under the receiver operating characteristic curves of on-scene time of over 8 minutes for the survival outcome

| Survival outcome | ST ≥8 minutes | |
|---|---|---|
| | AUC | 95% CI |
| Survival at ED | 0.59 | 0.49 to 0.69 |
| Survival to admission | 0.68 | 0.57 to 0.78 |
| Survival to discharge | 0.58 | 0.40 to 0.76 |

ST=on-scene time; AUC=area under the curve; CI=confidence interval; ED=emergency department



**Figure 1.** ROC curves of on-scene time of over 8 minutes for the survival outcome.

cardiac arrest patients should not be based on platinum 10 (less than 10 minutes) as in trauma patients. On-scene time of over 8 minutes has a better chance of survival to admission than on-scene time of less than 8 minutes for non-trauma out-of-hospital cardiac arrest patients

## What is already known on this topic?

The proper on-scene time for trauma patient is already known as the platinum 10. However, for non-trauma out of hospital cardiac arrest, the proper on-scene time remains uncertain. A previous study in Japan and Korea found that scene time between 8 and 16 minutes had the best survival outcome compared to on-scene time of less than 8 minutes or on-scene time over 16 minutes. However, a study in United states reported on-scene time of less than 12 minutes in non-trauma patients resulted in a better survival outcome than longer periods. For pediatric out-of-hospital cardiac arrest, survival was highest with 10 to 35 minutes of on-scene time. Attention should be paid to the optimal of on-scene time in non-trauma out of hospital cardiac arrest.

## What this study adds?

This study supports the on-scene time in non-trauma patient should not be based as in trauma
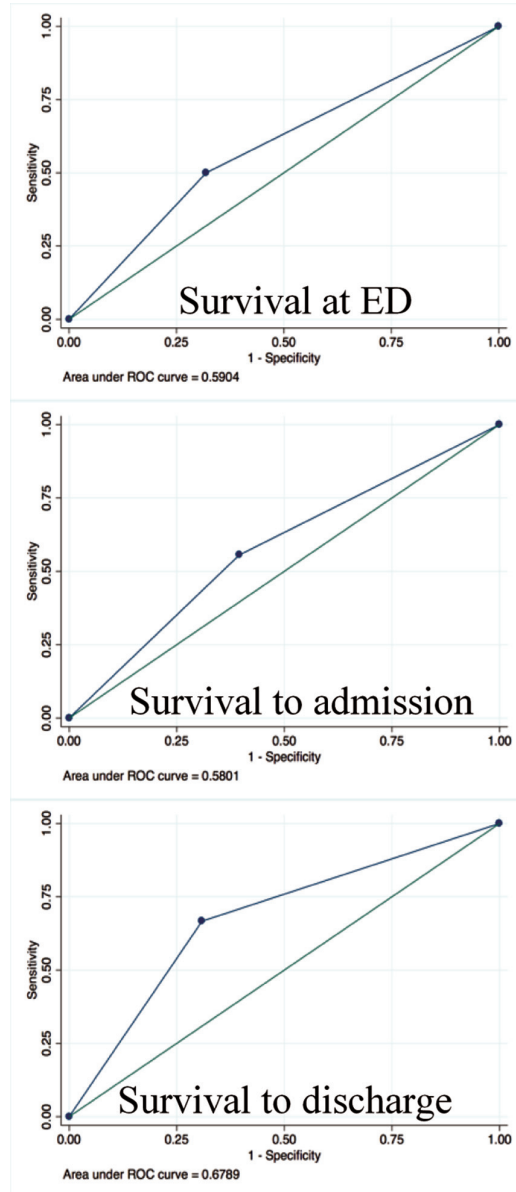
patient. The period of on-scene time of 8 minutes or more had a better survival to admission than on-scene time of less than 8 minutes for non-traumatic out-of-hospital cardiac arrest patients.

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## Conflicts of interest

The authors declare no conflict of interest.

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