Assessment of Prehospital Management of Patients Transported to a Thai University Hospital

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ABSTRACT

Objective: To assess the quality of prehospital care given to patients transported to a Thai university hospital.

Methods: This prospective observational study collected data from EMS providers who transported patients to Siriraj Hospital during August 2017 to November 2017. Collected data was evaluated by at least 2 EMS medical directors for appropriateness of EMS dispatch and prehospital care. The primary outcome was to determine the quality of prehospital management among patients transported by EMS. Inter-rater variability in the evaluation of patient care between EMS medical directors and medical providers in the emergency department (ED) was performed using Cohen's kappa coefficient, with a value lower than 0.7 indicating significant variability.

Results: Data was collected from 246 EMS providers that transported patients to our center. Evaluation by EMS medical directors found EMS dispatch to be appropriate in 216 cases (87.8%), and patient management to be appropriate in 198 cases (80.5%). Inappropriate prehospital management was found most often in patients who presented with out-of-hospital cardiac arrest (OHCA) (87.5%), and with chest pain (63.6%). Medical providers in the ED rated prehospital management to be appropriate in 93.1% of cases. Cohen's kappa coefficient between EMS medical directors and ED providers was 0.2, which indicates significant variability between the two groups of assessors.

Conclusion: Quality assessment of the Thai EMS system revealed opportunities for improvement in prehospital management of patients dispatched by Thai EMS. Moreover, this study found variability in the evaluation of prehospital care between medical providers at the ED and EMS medical directors. Information from this study will help to influence and guide improvement in prehospital patient care in Thailand.

Keywords: Emergency medical services; quality assessment; prehospital management; emergency department (Siriraj Med J 2020; 72: 287-295)

INTRODUCTION

Emergency Medical Service (EMS) is a system that provides emergency care for patients during transport from incident sites to hospitals. An efficient EMS system was proven to reduce mortality and morbidity in several conditions.[1] Therefore, continuous quality improvement (CQI) in an EMS system is essential to accomplish desired outcomes.

The majority of CQI systems in pre-hospital care settings use the same concepts and methods of quality measurement as those used in in-hospital settings.[2-7] Many studies in recent years were done to find pre-hospital care quality measurements; however, the majority of studies focused on a specific disease, condition, or scenario. For example, a study in out-of-hospital cardiac arrest (OHCA) reported response time, presence of

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bystander CPR, and presence of an AED as important quality indicators that were selected to be part of a CQI system.[3] Other studies that evaluated prehospital care performance in an acute coronary syndrome setting found use of a 12-lead EKG, providing initial treatment with aspirin and/or nitroglycerine, and transporting patients to appropriate hospitals to be indicators that guarantee quality in prehospital care.[9-12]

Thailand's EMS system has been developing a CQI system for 10 years. CQI-related projects have ranged from a small quality improvement project in one organization to the establishment of a national standard for EMS providers, equipment, and ambulances. To date, the national data used to evaluate EMS quality in Thailand has been data collected from Emergency Department (ED) providers. However, sometimes emergency department providers do not understand what to evaluate in a prehospital care setting, and this can make these assessments unreliable. To the best of our knowledge, no previous study from Thailand has collected data directly from arriving EMS teams, after which that data was evaluated for appropriateness by both ED providers and EMS medical directors at a national tertiary emergency department. Accordingly, the aim of this study was to evaluate the quality of pre-hospital care given to patients transported to a Thai university hospital. The secondary objective was to compare the assessments of prehospital care between ED providers and EMS medical directors.

MATERIALS AND METHODS

This prospective observational study collecting data from EMS teams who transported patients to the Department of Emergency Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Hospital during the August 2017 to November 2017 study period. Siriraj Hospital is a 2,300-bed university-based national tertiary center. We included EMS teams that transported patients to the ED or the trauma unit. This study included only EMS teams that were dispatched by the Bangkok EMS Center. EMS teams that did not agree to sign the informed consent document were excluded from the study. The protocol for this study was approved by the Siriraj Institutional Review Board (SIRB) (Si 375/2017).

Data collection

EMS teams dispatched by Bangkok EMS center came through the triage area of Siriraj Hospital. The triage nurse specified where the patient was to be sent according to ED protocol. If the patient needed emergency care, they were immediately transferred to the emergency room. The nurse waited until the EMS team communicated all appropriate information to the ED. The nurse then approached the team and asked them for their written informed consent to request, collect, and record data relating to prehospital care given to the patient that they just transported.

Outcome measurement

The record form was sent to 3 EMS medical directors for a review of the quality of prehospital care that was provided by the EMS team. The primary outcome was the appropriateness of both dispatch decisions and pre-hospital care. Appropriateness was determined based on evidence-based management data and protocols in pre-hospital care, and current resources available for use by Thai EMS teams. Appropriateness criteria were compiled in a check list form, as demonstrated in the appendix. A decision could be reached by agreement of two of three EMS medical directors, and this was the primary outcome. ED providers more broadly assessed prehospital management according to the following 4 categories: airway management, circulation management, bleeding control, and immobilization. Appropriateness among ED providers was defined as a judgment of appropriateness in all 4 categories. Inter-rater reliability between EMS medical directors and ED providers was the secondary outcome.

Sample size calculation

This research aimed to evaluate the quality of EMS prehospital patient care. Evaluation of EMS care in Thailand yielded a favorable prehospital care rate of over 90%. However, that evaluation was not performed by experts in prehospital care. The assessment for quality control was estimated using data from studies conducted in other countries that included evaluation by EMS medical directors that found only 80% adequacy of prehospital patient care by EMS teams.[13] The degree of accuracy required was 0.05 and the probability of a type 1 error was 0.05. The calculated sample size was 246 with a standard normal deviation (Z=1.96).

Statistical analysis

Statistical analysis was performed using SPSS Statistics (SPSS, Inc., Chicago, IL, USA). Demographic data were summarized using descriptive statistics. Categorical data are presented as number or number and percentage, and continuous data are presented as mean ± standard deviation. Inter-rater reliability was calculated by Cohen's kappa coefficient, and a difference in inter-rater agreement of less than 0.7 was defined as significant inter-rater variability.

RESULTS

During the study period, 286 cases were transferred by EMS to our center. Forty of those cases were excluded due to various reasons (Fig 1). The remaining 246 cases were included in our final analysis. The mean age of included patients was 67 years, and 43.1% were male. Most cases received care from advanced life support (ALS) EMS units (186 cases, 75.6%), and almost all cases that arrived were non-trauma cases (240 cases, 97.9%). Only 11 cases (4.5%) had physicians on scene, and 71 (29%) had pre-hospital notification. Table 1 describes the demographic data of patients transported by EMS to Siriraj Hospital.

In non-trauma cases, the chief complaint that led to a call for an ambulance was dyspnea (73 cases, 30.4%), followed by alteration of consciousness (57 cases, 23.7%). Other reasons included seizures (21 cases, 8.8%), weakness (13 cases, 5.4%), and chest pain (11 cases, 4.6%). Provisional diagnosis by EMS was most often dyspnea (29 cases, 12%), followed by alteration of consciousness (12 cases, 7%), hypoglycemia (19 cases, 7.9%), and seizure (18 cases, 7.5%). Regarding pre-hospital interventions, 136 patients (57%) had airway assistance, and most of those received oxygen cannula. Three cases had endotracheal tube intubation attempts, with successful intubation in all 3 cases. Intravenous access was performed in 85 cases (37%), and normal saline was the most often given initial fluid. Point-of-care testing (POCT) for glucose was performed in 150 cases (62.5%), and EKG monitoring was performed in 54 cases (22.5%) (Table 2).

Evaluation of dispatch and prehospital management by EMS medical directors demonstrated a Cohen's kappa coefficient for inter-rater agreement of 0.83 and 0.71, respectively. Final results showed appropriate dispatch in 216 cases (87.8%), and appropriate prehospital care in 198 cases (80.5%) (Table 3).

Fig 2 shows the proportion of inappropriate prehospital management classified by chief complaint. OHCA had the highest proportion of inappropriate treatment (7 out of 9 patients, 87.5%). This was due to no hospital notification in 3 patients, and no initial rhythm noted in 2 patients. The second highest inappropriately managed chief complaint was chest pain (63.3%), which was due to no EKG monitoring and no aspirin administered in ACS suspected patients. Presentation of weakness was the third most inappropriately managed chief complain (53.8%). All of those patients were suspected of having a stroke, but the EMS responders did not notify the hospital.

Only 131 cases (53%) had quality assessment performed by ED providers. Of those, 122 cases (93.1%) were judged to have received appropriate management in all 4 categories (Table 4). A total of 102 cases (78%) in this group had appropriate pre-hospital care evaluated by EMS medical directors. Cohen's kappa coefficient between EMS medical directors and ED providers was 0.2, which indicates significant variability between the two groups of assessors.

DISCUSSION

This prospective observational study collected data from EMS providers who transported patients to Siriraj Hospital. The objective was to evaluate the quality of prehospital care and dispatch. The results showed appropriate prehospital care and dispatch, as evaluated by EMS medical directors, to be 80.5% and 87.8%, respectively.

Our results showed that 80.5% of patients had appropriate care, which is lower than the recent report on EMS care in Thailand that reported appropriate care of over 90% in all categories.[14] The reason that our study found a lower result may be due to the following factors. First, the EMS directors and the ED providers did not use the same form to evaluate the patient. The research form included information that is not regularly collected from EMS providers, but it included key performance indicators in patient care. For instance, prehospital notification is essentially important in patients that are likely to require immediate urgent care upon arrival, like acute stroke patients and OHCA patients.[15] Secondly, our EMS medical directors assessed quality using a specific checklist classified by chief complaints. The checklist was created using performance indicators that were more specific and standardized. For example, POCT glucose in alteration of consciousness or hypoglycemic patients, bronchodilator in COPD/asthma exacerbation, EKG monitoring and ASA in suspected ACS, and IV fluids in sepsis patients. In contrast, medical providers in the ED evaluated cases using only primary survey assessment. So, the observed assessment variability between ED providers and EMS medical directors may be due to the different forms and using key performance indicators rather than primary survey assessments as an evaluation.

Out-of-hospital cardiac arrest had the highest proportion of inappropriate care (87.5%). Excessively long response time, no rhythm noted in the form, and no hospital pre-notification were some of the reasons for inappropriate care. Time documentation was noted in 5 patients, with a median response time of 7 minutes and a median total CPR time of 15 minutes. Response time is one of the key performance indicators in established

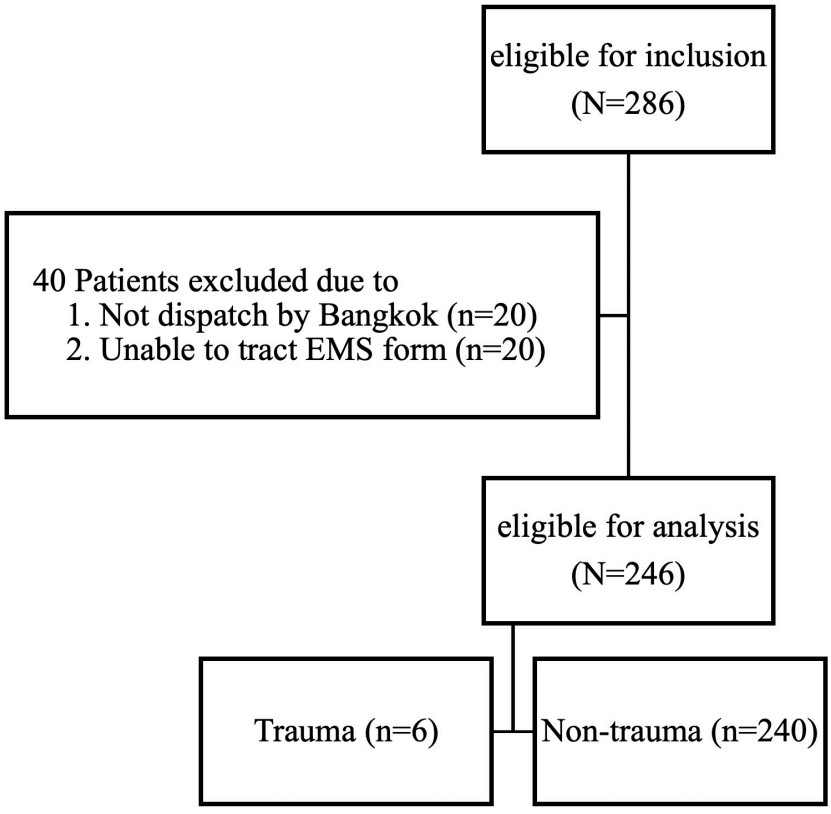

Fig 1. Flow diagram of patient enrollment
Abbreviation: EMS = Emergency medical services

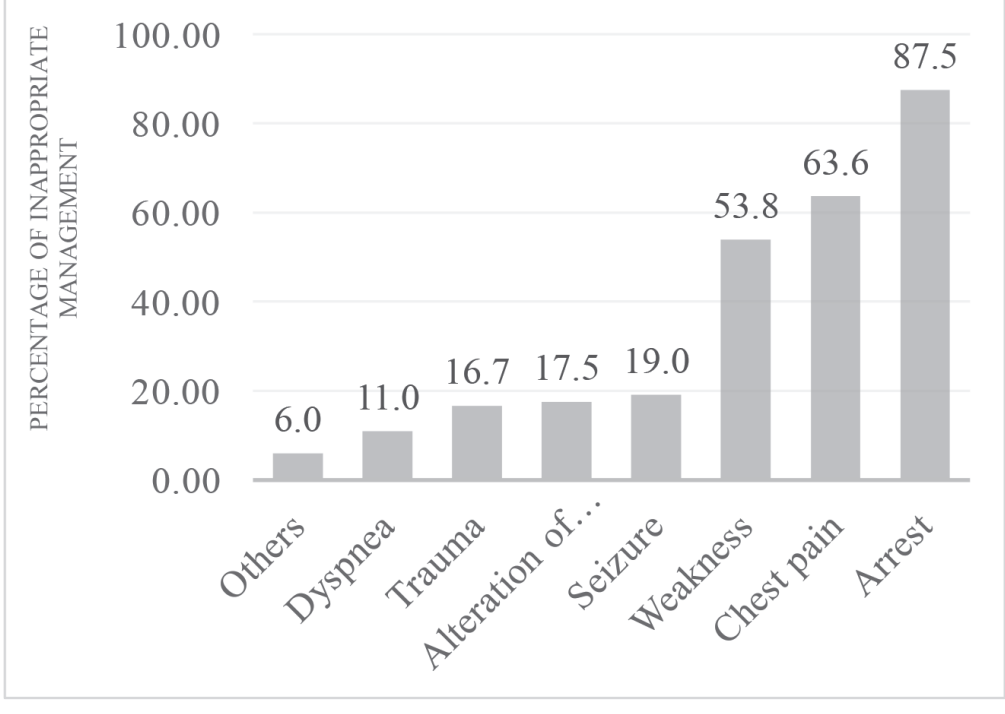

Fig 2. Proportion of inappropriate prehospital management of patients transported to Siriraj Hospital categorized by chief complaints

TABLE 1. Patient and transport characteristics.Abbreviation: SD = Standard deviation.

	Patients (N=246) Number of patients (%)
Male gender	106 (43.1)
Age (years), mean + SD	67 + 17.8
Underlying diseases	
Hypertension	123 (50)
Diabetes	94 (38.2)
Chronic obstructive pulmonary disease or asthma	19 (7.7)
Ischemic heart disease	34 (13.8)
Stroke (Ischemic/hemorrhagic)	34 (13.8)
Epilepsy	7 (2.8)
Others	80 (32.7)
Transfer by advanced life support team	186 (75.6)
Doctor on scene	11 (4.5)
Prehospital notification	71 (28.9)
Non-trauma patients	240 (97.9)

advanced EMS systems. In Thailand, the response time for OHCA should not be more than 10 minutes.[16,17] The data collected in the present study showed a median response time and call-to-arrival to the hospital time that was shorter than data from Asian populations that revealed a median response time of 11.8 minutes, and call-to-arrival to the hospital time of 41.8 minutes.[16] Only 33.3% of OHCA patients in this study had prehospital notification, which was lower than the rates reported from other Asia-Pacific countries.[16] Efforts should be made to improve EMS response or first medical contact time in cases with OHCA. Prehospital notification is also an important issue that should be emphasized to EMS teams.

Patients with chest pain that did not receive EKG monitoring or that did not receive ASA were found to have received inappropriate care. One or both of these treatment omissions was observed in 63.6% of patients that presented with chest pain. As stated in the guidelines[11], patients with suspected ACS should have an initial 12-lead EKG and EKG monitoring to detect arrhythmia or arrest. EKG monitoring was determined to be essential, and was included as a key performance indicator.[9,10] It is also recommended that patients with suspected ACS receive aspirin in prehospital settings. These are all key indicators in current international guidelines. Thai EMS systems should also apply these treatment guidelines in prehospital management to improve patient outcome. Our results showed that half of the patients that presented with weakness were prehospital diagnosed as acute stroke. All of these cases were judged to be inappropriately managed because the EMS provider did not notify the ED. Prehospital notification was shown to reduce time-to-CT and time-to-thrombolytic in patients with ischemic stroke.[18,19] Hospital prenotification, therefore, reduces morbidity and mortality in patients with suspected stroke. Hospital prenotification was reported to be a key performance indicator in an EMS CQI system.[20] Our result showed that 28.9% of EMS providers notified our center before arrival. Awareness of an incoming medical unit facilitated improved preparedness in the ED, especially in critical situations, such as trauma[21], OHCA, stroke, and myocardial infarction. Emphasis of the importance of prehospital notification by EMS units and creating a simple way to transmit patient information should be a key development objective.

Dispatch appropriateness was 87.8%, with dispatch inappropriateness defined as the patient being under-

triaged. Our number of under-triaged cases correlated with the latest 11% figure reported from the National EMS Registry.[14] The reason that patients were under-triaged was multifactorial. The type of provider that was sent depended on the decision of the dispatcher that relied on the information given by the caller. Furthermore, the availability or unavailability of ALS teams also influenced the type of ambulance sent. These findings highlight the need for improved dispatcher skills and decision making, and the need for more ALS units in our service area.

Limitations

This study has some limitations. First, this was a single-center study, which limits the number and demographics of the cases being transported to our center. Second, the number of non-trauma cases was significantly greater than the number of included trauma cases. The key reason for this difference between groups is likely that many (if not most) of the trauma cases that are transported to our center arrive by emergency medical responder, and this type of arrival was not included in our study. This highlights the questions – what are the conditions under which trauma patients are transported to our hospital, and are ALS teams being appropriately dispatched or not? Third, since the initiation of data collection was dependent on the triage nurse who was the first person in the ED to make contact with the EMS team, it is possible that some cases could have been missed. Fourth, some data were collected from patient charts due to the fact that patient data collection during real-time emergency situations is impractical. That retrospective factor means that some data could have been missing or incomplete. Fifth and last, the prospective data collected from the EMS team had to be recalled by the members of the EMS team. It is, therefore, possible that some data could be adversely affected by recall bias.

CONCLUSION

This study found that the EMS system that dispatches medical units to transport patients to the Emergency Department of Siriraj Hospital has room for improvement in several areas of prehospital patient care. Key areas of improvement that were identified include improvements in dispatcher decision making and increasing the number of ALS providers in the service area. Improved prehospital medical care provider knowledge, enhanced quality assurance data collection methods, and the implementation of a performance indicator-based system will improve prehospital care and patient outcomes.

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Conflict of interest declaration: All authors declare no personal or professional conflicts of interest relating to any aspect of this study.

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APPENDIX

Check list for EMS quality evaluation by EMS medical director
Check list for evaluator

Conditions	Inappropriate due to
OHCA	**Dispatch** ☐ Dispatch BLS team **Airway** ☐ No BVM and no supraglottic airway device and no intubation ☐ Intubation more than 2 attempts (Only for ALS team) **Circulation** ☐ No IV access if scene time more than 5 minutes (only for ALS team) **CPR** ☐ No note of initial rhythm ☐ No defibrillation if shockable rhythm **Others** ☐ Response time > 8 minutes ☐ No prehospital notification ☐ No EKG monitoring (only for ALS team)
Alteration of consciousness	**Dispatch** ☐ Dispatch BLS team if GCS < 8 **Airway** ☐ O_2sat < 94% and no airway intervention or oxygen therapy ☐ Intubation more than 2 attempts (Only for ALS team) **Circulation** ☐ No IV given if pulse > 120 or hypotension in suspected sepsis case (Only for ALS team) **Others** ☐ No POCT glucose ☐ No prehospital notification in suspected acute stroke

Dyspnea	**Dispatch** ☐ Dispatch BLS team **Airway** ☐ O_2sat < 94% and no airway intervention or oxygen therapy ☐ Intubation more than 2 attempts (Only for ALS team) ☐ No bronchodilator given in suspected exacerbation of COPD or asthmatic attack **Circulation** ☐ No IV given if pulse > 120 or hypotension in suspected sepsis case (Only for ALS team)
Chest pain	**Dispatch** ☐ Dispatch BLS team **Airway** ☐ O^2sat < 94% and no airway intervention or oxygen therapy **Others** ☐ No EKG monitoring ☐ No hospital notification in suspected ACS ☐ No aspirin if suspected ACS and no contraindication (Only for ALS team)
Weakness	**Dispatch** ☐ Dispatch BLS team if unilateral weakness **Airway** ☐ O_2sat < 94% and no airway intervention or oxygen therapy ☐ Intubation more than 2 attempts (Only for ALS team) **Circulation** ☐ No IV given if pulse > 120 or hypotension in suspected sepsis case (Only for ALS team) **Others** ☐ No POCT glucose ☐ No prehospital notification in suspected stroke
Seizure	**Dispatch** ☐ Dispatch BLS team if unilateral weakness **Airway** ☐ O_2sat < 94% and no airway intervention or oxygen therapy ☐ Intubation more than 2 attempts (Only for ALS team) **Circulation** ☐ No IV given if pulse > 120 or hypotension in suspected sepsis case (Only for ALS team) **Others** ☐ No POCT glucose
Other conditions	**Airway** ☐ O_2sat < 94% and no airway intervention or oxygen therapy ☐ Intubation more than 2 attempts (Only for ALS team) **Circulation** ☐ No IV given if pulse > 120 or hypotension in suspected sepsis case (Only for ALS team) **Others** ☐ No POCT glucose in suspected stroke ☐ No prehospital notification in suspected stroke

Trauma

Dispatch

☐ Dispatch BLS team if GCS < 8 or hypotension

Airway with C-spine

☐ No cervical collar in blunt mechanism with GCS < 15 or hypotension

Breathing

☐ O_2sat < 94% and no airway intervention or oxygen therapy

☐ No needle thoracostomy in tension pneumothorax (only for ALS team)

☐ No three side dressing in open pneumothorax (only for ALS team)

Circulation

☐ No IV fluid given in SBP < 70 mmHg (only for ALS team)

☐ Give IV and prolong scene time > 10 min

☐ No bleeding control if active bleeding

Immobilization

☐ No spinal board in blunt mechanism with GCS < 15 or hypotension

Others

☐ Scene time > 10 min