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Systematic Review

Influence Factors of Emergency Medical Services (EMS) Prehospital Time Interval Variety: A Systematic Review

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ABSTRACT

Introduction: Prehospital time interval was one of important indicators of EMS performance. It consisting of total prehospital time (TPT), response time (RT), on-scene time (OST) and transport time (TT) in the world is very diverse. Many factors were able to affect the duration of prehospital time. The purpose of this systematic review was to identify internal and external EMS factors that affect prehospital time which was useful as a predictor of the prehospital time interval variety.

Methods: This study was conducted with a systematic method by reviewing the literature obtained from four electronic databases namely ProQuest, PubMed, ScienceDirect, and Google Schoolar. Seven keywords were used to get some of relevance literatures. Using PRISMA flow diagram, the literatures were screened by three inclusion criteria: original research article, published in the 2007-2018 timeframe, discusses EMS prehospital time interval and the factors that influence it.

Results: Seventy-five literature were obtained, of which 14 articles met the requirements for analysis. Factors influencing prehospital time variations can be classified as two. First, internal factors which include: facilities and infrastructure, human resources, and service protocols. Second, external factors which include: natural and non-natural environment, and the patient's clinical condition.

Conclusion: Investigation at prehospital time intervals and influential factors is useful in developing evidence-informed in assessing EMS performance and correcting the obstacles found. This review also identifies the gaps in the existing literature to inform future research efforts.

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INTRODUCTION

Prehospital emergency services are fast becoming the needs of all countries in the world. The speed of prehospital time (PT) and Emergency Medical Services (EMS) are important to be assessed and discussed (Brown et al., 2016; Golden & Odoi, 2015). There are three compelling reasons to investigate the achievement of prehospital time in the world. First, the achievement of PT or EMS total prehospital time (TPT), which includes response time (RT), on-scene time (OST), and transport time (TT), varies greatly in each country, so different studies on the various causes are needed. Second, the speed at which officers provide assistance determines patient safety. The speed of staff time is correlated with "time is life" in out-of-hospital-cardiac-arrest (OHCA) patients, "time is brain" in stroke patients, and "life-saving and limb-saving" for trauma patients (Paravar, Hosseinpour, Mohammadzadeh, & Mirzadeh, 2014; Puolakka, Vayrynen, Erkkila, & Kuisma, 2016b). Third, achieving prehospital time can be an important indicator in evaluating EMS performance (Rahman et al., 2015). In the past, response time was the only reliable indicator of performance because it was objective, easily measured and easily understood by

many groups (Al-Shaqsi 2010; Gonzalez, Cummings, Phelan, Mulekar, & Rodning, 2009). Now, researchers are starting to see on-scene time as an important indicator of EMS performance (Puolakkaet al., 2016a; Vincent-Lambert & Mottershaw, 2018)

Previous research states that the prehospital time interval (PTI) is influenced by three factors namely, environmental factors, system factors and clinical factors of patients (Nehme, Andrew, & Smith, 2016; Vincent-Lambert & Mottershaw, 2018). Environmental factors include regional geographical differences, weather, and traffic congestion (Gonzalez et al., 2009; Kitamura et al., 2014; Lam et al., 2015; Vincent-Lambert & Mottershaw, 2018). System factors include the number and type of ambulances, the set of ambulances, the level of EMS staff training, hours and days of service, the use of lights and sirens, the number of officer interventions in the field and the activation of important codes during dispatch (Nehme et al., 2016; Puolakka et al., 2016a; Puolakkaet al., 2016b; Vincent-Lambert & Mottershaw, 2018). The large number of EMS staff calls to doctors or hospitals and the time to wait for other response teams such as firefighters, and the police also affect the PTI. The last factor is the clinical factor of the patient, which consists of age, gender, main complaint and the severity of the patient.

Investigation of factors affecting PT has been carried out. Some of these studies focus on total response time, while others focus on response time, on-scene time or transport time. Unfortunately, there are still few systematic reviews that provide complete information about prehospital time intervals in developed and developing countries. This review aims to collect and identify EMS PTI achievements in several countries in the world, and the factors that influence it are seen from the internal and external factors of EMS.

MATERIALS AND METHODS

This systematic review was organized through five stages (Davies & Crombie, 2001), which were defining an appropriate question, searching for literature, searching for research (assessing the studies), combining the results of research (combining the results), and synthesizing research results into systematic review (placing the findings in content).

Determine Research Questions

The first step in preparing this study is to determine the research questions. Based on the background of the problem, the researcher determines one research question, that is, "What factors influence the EMS prehospital time (PT) in various countries of the world?"

Perform Literature Search

The second step in preparing this study was to search for literature. Researchers conducted a literature search in January 2019 using four electronic databases including ProQuest, ScienceDirect, PubMed and Google Schooler. A manual search through the Google search engine was also used to obtain articles that may not be identified by an electronic database. The keywords used in the search were “prehospital time interval”, “factors influencing prehospital time”, “ambulance time interval”, “total prehospital time”, “EMS Response time”, “EMS On-scene time”, and “EMS transport time”. PRISMA flow diagrams (Figure 1) were used to guide the flow of literature selection. From 75 literatures obtained, then 14 articles were selected that met the criteria for analysis. Literature was chosen based on inclusion criteria, namely, original research articles, in English, available in full-text, published in the 2007-2019 timeframe in international journals, and discussing the EMS prehospital time (PT) and the influencing factors. Literature that was not related to the purpose of our systematic review was released for the following reasons. This study only focuses on factors that influence the variation in prehospital time. Analytical studies and interventions related to the prehospital time variation process were not included because, in this review, we did not consider the results and effects of exposure and intervention. Instead, we explore the factors that influence prehospital time variations in the EMS system. Some articles that were deemed not to meet the criteria of the PRISMA model were not used by researchers.

Reviewing Research Results

The researchers conducted the study results as a third step. The assessment was done by reviewing the title, abstract and full text. The instrument in the form of a critical appraisal check from The Joanna Briggs Institute (JBI) was used to assess the quality and eligibility of articles. There are three checklists used in the systematic review, namely, a checklist for cross-sectional studies, cohorts and qualitative research (The Joanna Briggs Institute, 2017a, 2017b, 2017c). Fourteen selected articles were declared eligible, because they were able to fulfil all the assessment components in the JBI checklist clearly.

Integrate Research Results

The fourth step is to integrate research results. After obtaining eligible articles, the researchers analyzed and summarized the results of each article. Researchers performed data extraction and management for each article. Data about the author, publication year, method, target group, research design, research settings, study focus, and assessment tools used in each article were extracted by researchers. All article evaluations used the PRISMA guidelines. Next, the researchers grouped the results of the study based on four groups of TPT, RT, OST and TT (see Table 1). System, environmental and clinical factors that affect each group were then grouped into internal and external EMS factors (see table 2). Internal factors are factors that originate from inside

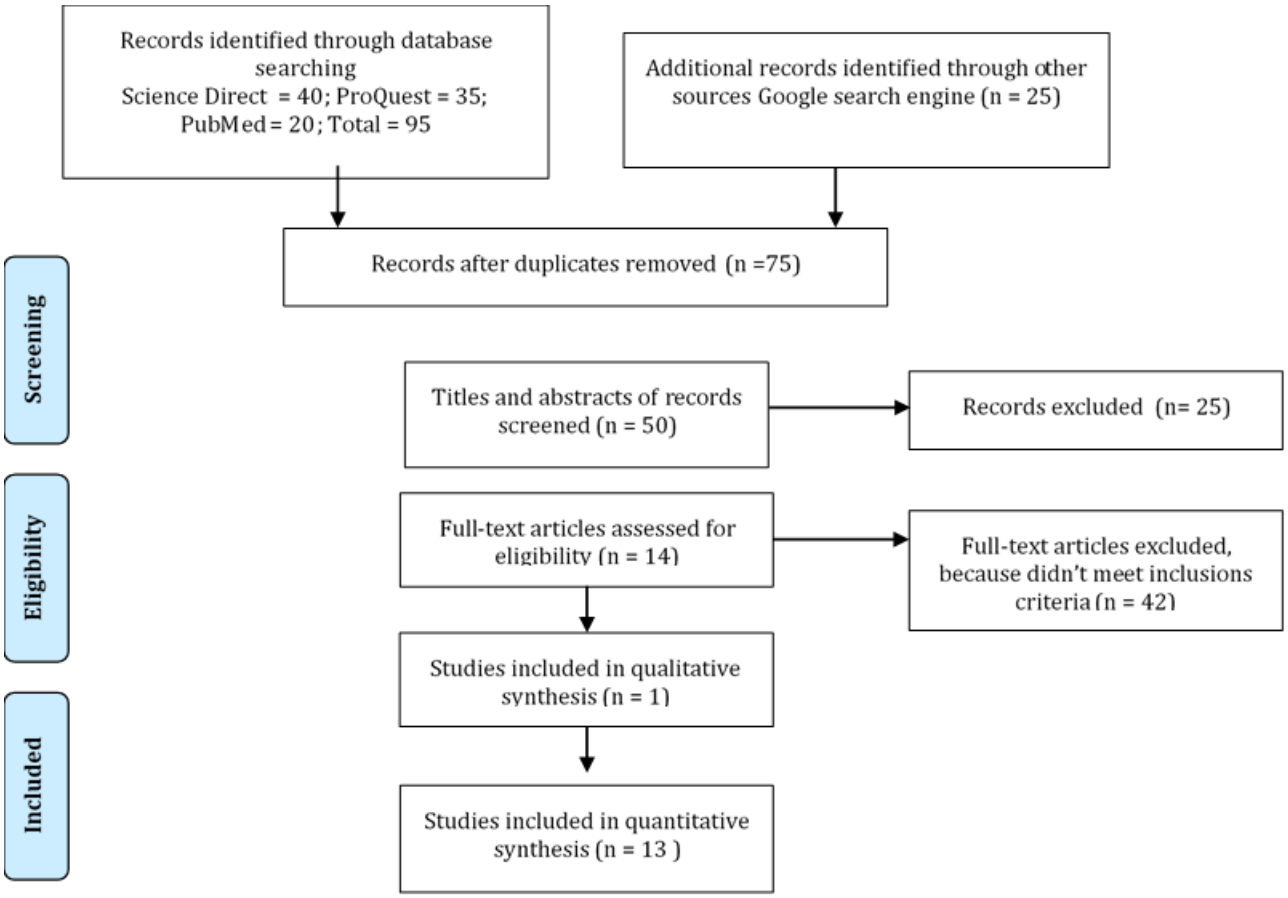

Figure 1. PRISMA Flow Diagram

the EMS, while external factors are factors that originate from outside the EMS.

Synthesize Research Results into a Systematic Review (Placing the Findings in Context)

The final step in the systematic review is to synthesize the results of the review in the discussion. Researchers formulated factors that influence PT in a different way from previous studies. This study discusses these factors based on the origin of the sources, namely internal and external EMS factors. The reason for grouping these factors into two domains is to make it easier to think systematically in understanding the factors that influence prehospital time in the EMS system

RESULTS

After eliminating duplicate article titles, 75 titles and abstracts were obtained, then 14 articles that met the criteria were reviewed and interpreted in the discussion. Four journals explained specifically about the factors that influence the total prehospital time, while 10 journals explained about the factors that affect three prehospital time intervals of 3 RT, 6 OST, and 1 TT (see Table 2). Fourteen articles were quantitative research and one article was qualitative. The results of the review show that the factors that influence prehospital time can be divided into two main groups.

First, internal factors, namely factors originating from the EMS system, include facilities and infrastructure, human resources, and the service protocol. The facilities and infrastructure include the number and location of EMS, type and number of ambulances, and GPS technology. Human Resources consist of the level of EMS staff training, the frequency of EMS officer consultations with doctors, and officer intervention skills. The service protocol consists of an action protocol, a dispatch protocol, an ambulance lamp and siren protocol, a collaboration protocol with doctors / hospitals and other response teams,

Second, external factors, namely factors originating from outside the EMS system, include: natural and non-natural environment, and clinical patients' condition. Environment includes natural, namely weather, geographical areas (urban vs. rural) and non-natural, such as traffic jams, access, awareness and community cooperation. Clinical patient is the clinical condition of the patient such as: gender, age, fear of the patient, patient extraction and multicausal cases

This study also found the variation in total prehospital time that can be achieved by EMS in each country from 23.2 minutes in Japan to 42.1 minutes in the state of Alabama (USA). Prehospital time can be subdivided into three time intervals, namely response time (RT), on-scene time (OST) and transport time

Table 1 EMS Prehospital Time in Various Countries and Factors Affecting it

Group	No	Author	Country	Methods	Sample	Findings	
						Prehospital Time (PT)	Influence Factors
A.TPT	1.	Katayama et al. (2019)	Jepang	Retrospective observational study	66,243 traffic accident patient data from 2004-2015. 3390 patients experienced CPA when they arrived at the hospital. 62853 patients lived on arrival at the hospital	Prehospital urban time vs rural, 35 minutes (IQR 27-45 minutes) vs 37 minutes (IQR 28-49) p (0.001)	Rural areas are related to the extension of the prehospital time interval from the start of the ambulance call to the arrival of the ambulance at the hospital
	2.	Gonzalez et al. (2009)	Alabama	Retrospective study	- - 34,341 data on motor vehicle crush (MVC) patients in rural areas. - - 11,422 MVC patient data in urban areas	Total rural vs urban prehospital time: 42.1 minutes vs 25.4 minutes (p <0.0001) 1. average rural vs urban response time is 10.67 minutes vs 6.5 minutes 2. average scene time is 18.87 minutes vs 10.83 minutes 3. The average transport time is 12, 45 minutes vs. 7.43 minutes.	Rural and urban locations have a significant influence on total prehospital time, response time, on-scene time and transport time.
	3.	Kitamura et al. (2014)	Jepang	Retrospective study	8,596 AMI patient data (1998-2007) and 9,283 OHCA patients (2000-2007)	Prehospital time intervals from calling to arriving at the hospital: 1. AMI patients: 23.2 minutes for 1 call to the hospital to 39.7 minutes with a call to the hospital ≥5 2. OHCA patients: 24.4 minutes with 1 call to the hospital up to 36.6 minutes with ≥5 calls	The time interval to arrive at the hospital extends along with the increasing number of calls from the ambulance to the hospital
	4.	Khorazani-Zavareh et al. (2018)	Iran	Qualitative Study	18 participants		Barriers related to prehospital intervals are: 1. Cooperation between the community and the EMS team when a traffic accident occurs. 2. Prehospital system factors include: number and location of EMS facilities, type and number of ambulances and staff.

Group	No	Author	Country	Methods	Sample	Findings	
						Prehospital Time (PT)	Influence Factors
B. RT	1	Lam et al. (2015)	Singapore	Retrospective study	70,286 data of patients who had an accident	Response time category: 1. short (<4 minutes) 50% 2. moderate (4-8 minutes) 38% 3. the duration (> 8 minutes) is 11.1%	Weather factors, traffic density and the scene affect the response time. Dense traffic and rain caused a long ambulance response time (ART) of> 8 minutes. More patients who were at home or in the shops also had longer ART.
	2.	Do et al. (2013)	Singapore	Retrospective study	30,687 patient electronic data	the average ART was 8.2 minutes and the median was 7.5 minutes	The quantitative regression results show that system factors, such as the high number of calls for ambulance services, significantly lengthen ART. Patient factors generally do not affect ART.
	3.	Nehme et al. (2016)	Melbourne, Australia	Retrospective study	1,000,458 patient electronic data that gets priority code 1. Data taken from patient records since July 1, 2009 until June 30, 2014	1. Response time: 10.6 minutes (IQR 8.1-14.0). 2. Time at scene: 13, 8 (IQR 20.8-33.0) 3. Transport time: 19.0 (12.9-27.5)	EMS response time is influenced by: 1. System factors, namely, distance to location, activation time, turnout time, cases, hour of day, day of week, workload in the previous hour, set, ambulance, priority cases (such as suspected cardiac arrest or respiratory arrest), and average hospital delay time in the previous hour. 2. Patient factors: age, gender, major complaints, severity
C. OST	1.	Vincent-Lambert and Mottershaw (2018)	Africa Selatan	Prospective descriptive study	36 respondents	Being at the scene> 20 minutes can be considered excessive for trauma and medical emergencies	The elongated scene time can be influenced by three factors namely environmental, clinical and system factors. Factors that have the potential to exert an effect on OST are: 1. Environmental factors: congestion, weather and patient access and removal. 2. System factors: waiting for firefighters, police and rescue officers, 3. Clinical factors: the patient's acute condition, patient extraction and multi-casual events 4. Use of air ambulances
	2.	Brown et al. (2016)	Pennsylvania	Retrospective study	164,471 data from trauma patients from 2000-2013	1. Total prehospital time = 42 (33-54) 2. Response time = 11 (7-15) minutes 3. On-scene time = 15 (11-20) minutes 4. Transport time = 15 (13-22)	Extension of time at the site occurs due to the extraction process ± 4 minutes 2 seconds, and due to the intubation procedure ± 6 minutes 22 seconds.

Group	No	Author	Country	Methods	Sample	Findings	
						Prehospital Time (PT)	Influence Factors
	3.	van Der Velden et al. (2008)	Netherlands	Prospective study	147 Blunt trauma patients	1. EMS can reach "golden hour" 83% 2. On-scene time = 28 minutes (20-37) minutes 3. Transport time 14 minutes (9-24)	1. 81% of interventions can be done before admission to the hospital. 2. The number of prehospital interventions in each patient was related to the duration of on-scene time (p <0.001): a. 0 interventions -> 22 minutes OST (16-29) b. 1 intervention -> 25 minutes (20-31) c. 2 interventions -> 31 minutes (24-41) d. 3 interventions -> 34 minutes (27-43) e. 4 interventions -> 55 minutes
	4.	Puolakka, et al. (2016b)	Finland	Prospective observation study	77 patients with acute stroke were candidates for thrombolysis	1. Alarm to door time = 40 minutes (IQR = 33-49) 2. Ambulance response time = 7 minutes (IQR 5-10) 3. On-scene time ambulance = 21 minutes (18-24) 4. Ambulance transport time 9 minutes (6-13)	The short on-scene time can be influenced by the activation of the stroke code during dispatch
	5.	Nagata et al. (2016)	Jepang	Retrospective study	11,585 patients were transported by ambulance from April 2010-March 2013	1. Response time = 7 minutes (6-9) 2. On-scene time = 17 (13-23) 3. Transport time 7 (5-11)	a. Factors related to lengthening the on-scene time interval are: the large number of telephone calls from EMS officers to hospital staff, intoxication, minor disease and geographical area. b. Age, gender, hours and days are not related to on-scene time that is more than 30 minutes.
	6.	Puolakka et al. (2016a)	Helsinki	Prospective Intervention Study	141 thrombolysis candidate patients before EMS staff training to optimize on-scene time, 148 patients after the implementation of the training.	1. In the On-scene Time (OST) group ≤ 24 minutes vs> 24 minutes found: 2. Dispatch-to-hospital arrival 41.0 (35.0-45.5) vs. 50.5 (43.5-56) 3. Dispatch-to-scene time 7.5 (5.5-9.0) vs 7.0 (5.5-9.0) 4. Ambulance transport time 13.5 (10.0-17.5) vs 11.0 (7.0-15.0)	a. Telephone consultation with a prehospital emergency doctor or neurologist prolongs the time of OST b. The level of training of EMS officers. The higher level of training the officer can shorten the duration of the OST.

Group	No	Author	Country	Methods	Sample	Findings	
						Prehospital Time (PT)	Influence Factors
D. TT	1.	Fleischman et al. (2013)	Oregon	Retrospective study	48,308 patient data	The use of lights and sirens can shorten the transport time to 3.1 minutes for transport <8.8 minutes, and 5.3 minutes for longer transport.	Transport time is longer during the daytime and during peak hours Transport time is shorter by turning on lights and sirens when transporting patients.

Table 2. Internal And External Factors that Influence Prehospital Time

Prehospital Time	Variations of Prehospital Time Factors	The Conclusion of Internal and External Factors that Influence Prehospital Time
TPT	1. Internal Factors a. the number of calls from the ambulance to the hospital b. the number and location of EMS facilities c. type and number of ambulances d. the officer 2. External factors a. Environment: Geographical area b. Clinical patients:-	1. Internal factors, namely factors originating from the EMS system, include: a. Facilities and infrastructure: number and location of EMS, type and number of ambulances b. HR: level of EMS officer training, frequency of EMS officer consultation with doctors and officer intervention ability. c. Service Protocol: action protocol, dispatch protocol, ambulance lamp and siren use, protocol of collaboration with doctors / hospitals and other response teams, 2. External factors, namely factors originating from outside the EMS system, include: a. The environment includes: 1. Natural: weather, geographical area (urban vs. rural, patient's home vs. shopping area vs. highway) 2. Non-natural: traffic jams, patient access, awareness and community cooperation. b. Clinical patient clinical condition of the patient such as: gender, age, fear of the patient, patient extraction and multicausal cases
RT	1. Internal factors a. The number of ambulance service calls, b. Distance of the EMS facility to the scene, c. Activation time, d. Turnout time, e. Hour of day, f. Day of week, g. Workload in the previous hour, set, ambulance, h. Case priority i. Average hospital delay time in the previous hour. 2. External factors a. Environment : Weather, traffic density, location of events, b. Clinical patients: - age,	

Prehospital Time	Variations of Prehospital Time Factors	The Conclusion of Internal and External Factors that Influence Prehospital Time
	- gender, - main complaint, - severity	
OST	1. Internal factors a. Cooperation and integration with other response teams b. The number of interventions carried out c. Officer intervention ability d. The priority case code activation protocol (such as a stroke case) at dispatch e. Consultation with an Emergency doctor f. The number of EMS staff calls to hospital staff g. Level (level) of officer training 2. External factors a. Environment: Weather, patient access and patient removal, geographical location, b. Clinical patients: The patient's acute condition, patient extraction and the number of patients in multicausal events.	
TT	1. Internal factors a. Protocol for using lights and sirens 2. External factors a. Environment b. Clinical patient	

(TT). RT variations in some countries range from <4 minutes -10.6 minutes, OST 15 - 28 minutes, and TT varies from 7 minutes - 19 minutes. An extension of one of the three response time intervals, on-scene time and transport time, impacts the lengthening of total prehospital time.

DISCUSSION

This systematic review focuses on the factors that influence EMS prehospital time in the world. Based on the articles collected, it is known that the prehospital time is the total time required by the EMS team from the call to help patients to the time of arrival at the hospital. This total time is often known as total prehospital time (TPT). TPT can be subdivided into three more specific time intervals, including response time (the time from activation of the EMS system until the ambulance arrives at the scene), on-scene time (the time used by the ambulance while at the scene), and transport time (time from the patient leaving the scene until arriving at the hospital) (Brown et al., 2016; Katayama et al., 2019). Each time has a different interval, according to the challenges and factors faced at each time interval (Brown et al., 2016).

The analysis of this study shows that the factors that influence TPT, RT, OST and TT are not much different. Factors that can prolong response time, on-scene time and transport time can affect the total prehospital time. Previous studies divided these factors into system, environmental and clinical factors of patients (Vincent-Lambert & Mottershaw, 2018). Another study only divided these factors into system factors and patient factors (Do, Foo, Ng , & Ong 2013; Nehme et al., 2016). The present study analyzes the factors that influence prehospital time based on the source of origin, namely internal and external EMS factors. Internal factors, namely factors originating from the EMS system, include: facilities or infrastructure and facilities of the EMS, human resources, and EMS service protocols.

Adequate facilities and infrastructure, such as ambulance sets, GPS technology, type and number of ambulances and have an important role in accelerating PT as stated by Khorazani-Zavareh, Mommadi, and Bohm (2018) in their qualitative study in Iran. This opinion is supported by Nehme et al. (2016) who conducted a retrospective study of 1,000,458 patient electronic data in Australia. The results showed the EMS team in Melbourne could reach RT within 10.6 minutes, one of which was influenced by equipment (set) and the ambulance affected fast and slow response time (Nehme et al., 2016). GPS technology is also an important tool for EMS. Poor mapping systems can hinder staff time to speed up response time (Khorazani-Zavareh et al., 2018). On the other hand, the presence of GPS facilities can help the EMS team to choose the fastest route to get to the scene. Another thing related to the facility is the choice of ambulance type in the form of an ambulance motorbike, car or air ambulance such as Helicopter EMS (HEMS). An ambulance motorbike is quite effective as a means to speed up response time during rush hour compared to an ambulance (Lin et al., 1998). Some studies show the use of air ambulances can prolong OST time (van Der Velden et al., 2008; Vincent-Lambert & Mottershaw, 2018). This is because ambulance personnel often intervene more and more in advance at the scene (van Der Velden et al., 2008). On the positive side, helicopter ambulances can increase a patient's survival rate because the patient can be immediately intubated, paired with a chest-tube and a second intravenous line. The last aspect of the facility is the number of ambulances available. The availability of sufficient numbers will affect the speed of the EMS team responding to patient calls. At certain times the number of ambulance calls increases (Do et al., 2013; Nehme et al., 2016), so the ratio of the number of ambulances that meet the needs is needed to cope with high workload (Nehme et al., 2016).

The second internal factor is human resources (HR). Quality human resources are very much needed in carrying out EMS services that are full of time targets. This study shows that the duration of PT can be influenced by the quality of human resources, such as the ability to intervene and the frequency of telephone consultations and the level of training of EMS personnel, to doctors / hospitals. Interventions needed at prehospital include Basic Life Support (BLS) and Advance Life Support (ALS) interventions (Paravar et al., 2014). Studies show that the majority of interventions carried out are IV-line installations (van Der Velden et al., 2008). Advance interventions such as intubation can prolong OST time to ± 6 minutes 22 seconds (Brown et al., 2016). Ideally the composition of personnel in a team is based on the ability of the BLS and ALS. Other research related to EMS HR was conducted by Puolakkaet al. (2016a) in thrombolysis candidate patients and EMS officers who were trained in ACLS. The results study showed that consultation with an emergency physician or neurologist via telephone and the level of training can affect OST. EMS officers often need to consult a doctor to ensure interventions that must be carried out. Officers who have a higher level of training (ACLS) can take action quickly and precisely on patients, for example patients in thrombolysis. Reliable officers are expected to be able to carry out relief with confidence so as to reduce the frequency of telephone calls to emergency physicians will and shorten the time of OST (Khorazani-Zavareh et al., 2018; Puolakka et al., 2016a).

A clear and good service protocol can affect the fast or slow PT. Required protocols include action protocols, activation of priority case codes, use of ambulance lights and sirens, collaboration protocols with hospitals and other response teams. The results show actions such as patient extraction from building debris or vehicle clamps, and intubation actions often prolong PT, especially at OST intervals (Brown et al., 2016; van Der Velden et al., 2008). The number of interventions made by officers also requires a longer

OST (van Der Velden et al., 2008). Clarity in the field of action protocols is useful as a guide for officers to conduct prehospital interventions. This protocol will help officials to immediately determine the principle of relief, whether "load and go" with less intervention, or "stay and play" by carrying out more interventions (Al-Shaqsi 2010). Another protocol needed is the use of ambulance sirens in heavy traffic. Lights and sirens that are turned on when carrying patients can shorten the transport time (Fleischman, Lundquist, Jui, Newgard, & Warden, 2013). On the other hand, people sometimes do not appreciate ambulance sirens and assume that the sirens that are sounded are only intended to speed up the course of the ambulance even though there are no patients (Khorazani-Zavareh et al., 2018). The existence of the siren protocol is expected to provide the right time guidance for turning on lights and sirens, and reducing the misuse of its use by ambulance officers.

The next protocol is the dispatch protocol. Previous studies showed that activation of priority case codes, such as stroke codes, during dispatch can shorten OST (Puolakka, et al., 2016b). When patched to activate this code, it can increase the EMS staff's sense of urgency. High priority case codes will guide officers not to linger at the scene, but, instead, take the patient to a health facility center. Finally, is the protocol mechanism of cooperation with hospitals and other response units. Kitamura et al. (2014) showed that the length of time to arrive at the hospital was proportional to the increasing number of EMS staff calls to the hospital. This is confirmed by study of Nagata, Abe, Nakata, and Nanako (2016), which shows that healthcare centers are often not ready to accept patients with certain cases, such as patients with cardiovascular problems. This causes EMS officers to make phone calls many times to find hospitals that have the right facilities so that impacts on the duration of PT.

External factors that affect PT, namely factors originating from outside the EMS system, include environmental factors and clinical factors of the patient. The environmental factors themselves consist of natural factors consisting of weather, and geographical areas (urban vs. rural), as well as non-natural factors, such as access, traffic congestion, and public awareness. Lam et al. (2015) found EMS in Singapore to be long (> 8 minutes) when the weather was rainy. Other research from Vincent-Lambert and Mottershaw (2018) states that the weather has the potential to have an effect on the lengthening of the OST. Another natural factor is the geographical location of the incident. Gonzalez et al. (2009) showed that differences in rural and urban areas affect TPT, RT, OST and TT. In Japan urban vs. rural prehospital time were 35 minutes vs 37 minutes, while in the state of Alabama (US) 25.4 minutes vs. 42.1 minutes (Gonzalez et al., 2009; Katayama et al., 2019). Non-natural environmental factors that are often encountered by EMS officers are traffic jams (Lam et al., 2015; Vincent-Lambert & Mottershaw, 2018). The next non-natural factor is patient access (Vincent-Lambert & Mottershaw, 2018). Patients who have to be picked up at home or in shopping areas are relatively more difficult to access compared to patients on the highway (Lam et al., 2015). This sometimes causes the RT to get longer. The last is community awareness and collaboration with the EMS team. The participants in the study conducted by Khorazani-Zavareh et al. (2018)) stated that, in an accident incident, ordinary people want to be involved in helping patients without regard to patient safety and correct procedures. As a result, the officer cannot perform the ALS procedure except in the ambulance, thus affecting the traditional OST. People sometimes also do not appreciate ambulance sirens, which hinders RT and TT. Community outreach and education to become laypersons are needed to improve synergy between EMS and the community.

The second external factor is the clinical factor of the patient, such as: gender, age, patient fear, patient extraction and multicausal cases. Nehme et al. (2016) state that RT EMS in Melbourne is influenced by patient complaints, severity, age and gender. Officers respond faster in patients who are reported to be critical or severe. In contrast to this, Nagata et al. (2016) found no clinical factors and that age and gender did not affect the length of OST in Japan.

Many factors can affect PT. The author believes that determining the internal and external factors of an EMS can be beneficial in determining improvement efforts. Internal factors are easier to identify and improve in quality. Conversely, external factors tend to be difficult to predict and modify. Improving the quality of EMS through an approach to internal factors is a more effective and efficient way.

CONCLUSION

Based on the explanation above, it can be concluded that each EMS in various countries has a variation in total prehospital time. Internal and external factors that affect response time, on-scene-time, and transport time have implications for the total prehospital time. Internal factors, namely factors originating from the EMS system, include facilities and infrastructure, human resources, service protocols. External factors, namely factors originating from outside the EMS system, include: environmental (natural, non-natural) and clinical patient clinical condition of the patient. An extension of one of the three response time intervals, on-scene time and transport time, has an impact on the length of the prehospital time. Internal and external factor investigations are useful in improving the quality of EMS services to achieve PT on target. Improving the quality of internal factors is easier to do, such as increasing the level of staff training and ability to intervene, optimizing the preparation of service protocols, such as action protocols, activation of priority case codes and protocols for the use of lights and sirens in critical cases useful in shortening PT.

CONFLICT OF INTEREST

There is no conflict of interest in this research.

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REFERENCES

Al-Shaqsi , S. Z. K. (2010). Respon time as a sole performance indicator in EMS : Pitfalls and solutions. *Open Access Emergency Medicine, 2*, 1-6.

Brown, J. B., Rosengart, M. R., Forsythe, R. M., Reynold, B. R., Gestring, M. L., Hallinan, W. M., . . . Sperry, J. L. (2016). Not All Prehospital Time is Equal: Influence of Scene Time On Mortality. *J Trauma Acute Care Surgery, 81*(1), 93-100. doi: 10.1097/TA.0000000000000099

Davies, H. T. O., & Crombie, I. K. (2001). What is a Systematic Review (Vol. 1). UK: Hayward Medical Communications.

Do, Y. K., Foo, K., Ng , Y. Y., & Ong , M. E. H. (2013). A QUANTILE REGRESSION ANALYSIS OF AMBULANCE RESPONSE TIME. *Prehospital Emergency Care, 17*, 170-176. doi: 10.3109/10903127.2012.729127

Fleischman, R. J., Lundquist, M., Jui, J., Newgard, C. D., & Warden, C. (2013). Predicting Ambulance Time of Arrival to the Emergency Department Using Global Positioning System and Google Maps. *Prehospital Emergency Care, 17*(4), 458-465. doi: 10.3109/10903127.2013.811562.

Golden, A. P., & Odoi, A. (2015). Emergency medical services transport delays for suspected stroke and myocardial infarction patients. *BMC Emergency Medicine, 15*(34). doi: 10.1186/s12873-015-0060-3

Gonzalez, R. P., Cummings, G. R., Phelan, H. A., Mulekar, M. S., & Rodning, C. B. (2009). Does Increas emergency medical services prehospital time affect mortality in rural motor vehicle crashes? A statewide Analysis. *The American Journal of Surgery, 197*, 30-34. doi: 10.1016/j.amjsurg.2007.11.018

Katayama, Y., Kitamura, T., Kiyohara, K., Sado, J., Hirose, T., Matsuyama, T., . . . Shimazu, T. (2019). Prehospital factor associated with death on hospital arrival after traffic crash in Japan: a national observational study. *BMJ Open, 9*(e025350). doi: 10.1136/bmjopen-2018-025350

Khorazani-Zavareh, D., Mommadi, R., & Bohm, K. (2018). Factors influencing pre-hospital care time intervals in Iran: a qualitative study. *J inj Vieolence Res, 10*(2), 83-90. doi: 10.5249/jivr.v10i2.953

Kitamura, T., Iwami, T., Kawamura, T., Nishiyama, C., Sakai, T., Tanigawa-Sugihara, K., . . . Hiraide, A. (2014). Ambulance calls and prehospital transportation time of emergency patients with cardiovascular events in Osaka City. *Acute Medicine & Surgery, 1*, 134-144. doi: 10.1002/ams2.25

Lam, S. S. W., Nguyen, F. N. H. L., Ng, Y. Y., Lee, V. P.-X., Wong, T. H., Fook-Chonge, S. M. C., & Ong, M. E. H. (2015). Factors affecting the ambulance response times of trauma incidents in Singapore. *Accident analysis and prevention, 82*, 27-35. doi: http://dx.doi.org/10.1016/j.aap.2015.05.007

Lin, C.-S., Chang, H., Shyu, K.-G., Liu, C.-Y., Lin, C.-C., Hung, C.-R., & Chen, P.-H. (1998). A Method to Reduce Response Times in Prehospital Care: The Motorcycle Experience. *American Journal of Emergency Medicine, 16*(7), 711-713.

Nagata, I., Abe, t., Nakata, Y., & Nanako, T. (2016). Factors related to prolonged on-scene time during ambulance transportation for critical emergency patients in a big city in Japan: a population-based observational study. *BMJ Open, 6*(e009599). doi: 10.1136/bmjopen-2015-009599

Nehme, Z., Andrew, E., & Smith, K. (2016). Factors Influencing the Timeliness of Emergency Medical Service Response to Time Critical Emergencies. *Prehospital Emergency Care, Early Online*, 1-9. doi: http://dx.doi.org/10.3109/10903127.2016.1164776

Paravar, M., Hosseinpour, M., Mohammadzadeh, M., & Mirzadeh, A. S. (2014). Prehospital Care and In-hospital Mortality of Trauma Patients in Iran. *Prehosp Disaster Medicine, 29*(5), 1-5. doi: 10.1017/S1049023X14000879

Puolakka, T., Kuisma, M., Lankimaki, S., Puolakka, J., Hallikinen, J., Rantanen, K., & Lindsberg, P. J. (2016a). Cutting the Prehospital On-Scene Time of Stroke Thrombolysis in Helsinki. *Stroke, 47*, 3038-3040. doi: 10.1161/STROKEAHA.116.014531

Puolakka, T., Vayrynen, T., Erkkila, E.-P., & Kuisma, M. (2016b). Fire engine support and On-scene time in prehospital stroke care - A prospective observational study. *Prehospital and Disaster Medicine, 31*(3). doi: 10.1017/S1049023X16000303

Rahman, N. H., Tanaka, H., Shin, S. D., Yih, Y. N., Piyasuwankul, T., Lin, C.-H., & Ong, M. E. H. (2015). Emergency medical services key performance measurement in Asian cities. *International Journal of Emergency Medicine, 8*(12). doi: 10.1186/s12245-015-0062-7

The Joanna Briggs Institute (Producer). (2017a, 1 Februari 2019). The Joanna Briggs Institute Critical Appraisal Tools for use in JBI Systematic Review. Checklist for Analytical Cohort Studies. Retrieved from

http://joannabriggs.org/research/critical-appraisal-tools.html

The Joanna Briggs Institute (Producer). (2017b, 1 Februari 2019). The Joanna Briggs Institute Critical Appraisal Tools for use in JBI Systematic Review. Checklist for Analytical Cross Sectional Studies. Retrieved from http://joannabriggs.org/research/critical-appraisal-tools.html

The Joanna Briggs Institute (Producer). (2017c, 1 Februari 2019). The Joanna Briggs Institute Critical Appraisal Tools for use in JBI Systematic Review. Checklist for Analytical Qualitative Research. Retrieved from http://joannabriggs.org/research/critical-appraisal-tools.html

van Der Velden, M. W. A., Ringburg, A. N., Berg, E. A., Steyerberg, E. W., Patka, P., & Schipper, I. B. (2008). Prehospital interventions: Time wasted or time saved? An observational cohort study of management in initial trauma care. *Emergency Medical Journal, 25*, 444-449. doi: 10.1136/emj.2007.052662

Vincent-Lambert, C., & Mottershaw, T. (2018). Views of emergency care providers about factors that extend on-scene time intervals. *African Journal of Emergency Medcine, 8*, 1-5. doi: 10.1016/j.afjem.2017.08.003