Original Article

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Prehospital Time Intervals in Thailand during COVID-19

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Abstract:

Objective: To determine the effect of the coronavirus disease, 2019 (COVID-19) pandemic on the prehospital time intervals of emergency medical services (EMS) in Thailand.

Material and Methods: This retrospective cohort study analyzed the prehospital time intervals of EMS in Thailand; from January 1, 2019 to September 30, 2021 using data obtained from the national EMS database. Patients with incomplete medical records, prehospital time intervals <1 or >300 minutes, and those admitted between January 1 and March 31, 2020 were excluded. Data were compared between the following groups: Group 1, pre-COVID-19; Group 2, first- and second-wave of COVID-19; and Group 3, third-wave of COVID-19: Kruskal–Wallis, Wilcoxon rank-sum, and chi-square tests were used.

Results: A total of 3,863,153 patients were enrolled into this study. The median total prehospital time was significantly longer in Group 2 when compared to Group 1, [25 (17,34) vs. 24 (17,33) minutes, p-value<0.001]; longer on-scene time, [4 (2,7) vs. 3 (2,6) minutes, p-value<0.001]; shorter transportation time, [10 (6,17) vs. 11 (6,18) minutes, p-value<0.001]. The median total prehospital time [27 (19,37) vs. 25 (17,34) minutes, p-value<0.001], response time [8 (5,14) vs. 7 (4,11) minutes, p-value<0.001], and transportation time were significantly longer in Group 3 than in Group 2 [11 (6,18) vs. 10 (6,17) minutes, p-value<0.001].

Conclusion: The EMS prehospital time intervals in Thailand during COVID-19 were significantly longer in both the non-trauma and trauma subgroups. Appropriate pre-hospital strategies and monitoring should be developed to manage future pandemics.

Keywords: COVID-19, emergency medical services, pandemic, prehospital time intervals, Thailand

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Introduction

The emergency medical service (EMS) systems provide emergency care to individuals in need before arriving at the hospital. EMS includes: telephone dispatch; response to the scene by ambulance, treatment, and triage by EMS personnel and transport to a care facility via ambulance[1,2]. The effect of EMS on reducing the mortality and morbidity of trauma and chronic diseases has increased its importance worldwide[3,4]. One of the quality measurement tools for evaluating the EMS system are the time intervals of prehospital care. However, this standard is set differently in each country, based on geographical and multiple factors[5]. In Thailand, there is no clearly defined time standard. However, a 10-min EMS response time is used by the National Institute for Emergency Medicine (NIEM) as a quality indicator for auditing the EMS system[6]. Alternatively, in trauma patients, reaching definitive care within the first hour after a traumatic injury; referred to as the "golden hour," is thought to improve mortality rates[7].

The coronavirus disease of 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2, began to emerge in Wuhan, China, in December 2019[8,9]. Owing to its spread and severity, on March 11, 2020 the World Health Organization declared the COVID-19 outbreak a global pandemic[10-12]. On January 8, 2020 the first COVID-19 case was detected in Thailand, and the number of new COVID-19 cases kept rising[13]. On March 26, 2020 the Emergency Decree on Public Administration as an Emergency Situation, B.E. 2548 (2005), was initially declared nationwide by the Prime Minister of Thailand to combat COVID-19 situation[14,15]. The government of Thailand issued mobility restrictions on citizens (stay-at-home curfews from 10 a.m. to 4. p.m.), facility shutdowns, and social distancing policies[13]. Patients under investigation (PUI) were screened by emergency call takers or dispatchers, wearing appropriate personal protective equipment (PPE) within the time limit, and airway management procedures were conducted to avoid aerosol generation, which could extend EMS prehospital times[16,17]. Moreover, the Ministry of Public Health established operational guidelines for the Special COVID-19 Operation Team[18] as a backup when normal operations could not be performed to ensure staff safety, to help transport COVID-19 patients or PUI, and prevent the spread of COVID-19. The impact of the COVID-19 pandemic on EMS has been studied; however, the outcomes widely vary worldwide. In the United States of America, during the COVID-19 pandemic, 35.6% fewer cardiac emergency calls and 12.3% fewer stroke calls were made; however, there was an 18.2% increase in the number of cardiac arrest calls compared to 2019[19]. In Canada, the incidence of EMS calls with motor vehicle collisions significantly decreased during the COVID-19 pandemic (17.0%), while overdoses increased (70.0%) in 2020 compared to those in 2016–2019[20]. A previous study showed that EMS prehospital times for trauma patients were not significantly affected by the COVID-19 pandemic; however, the median transportation time was significantly shorter during COVID-19, resulting from public health measures and fewer people on roads[21]. Another study found that the increase in total prehospital time during the COVID-19 pandemic was caused by longer response time (9.3±3.8 vs. 8.7±3.7 minutes, p-value<0.001) and on-scene time (14.4±7.9 vs. 13.5±6.2 minutes, p-value<0.001)[16].

Therefore, the effect of the COVID-19 pandemic on EMS prehospital time intervals in Thailand needs to be elucidated. This study aimed to determine whether the COVID-19 pandemic has affected EMS prehospital time intervals in Thailand. The secondary outcome was determining the EMS prehospital time intervals for both non-trauma and trauma patients.

Material and Methods

Study design and setting

This was a retrospective cohort study of patients transported by ground EMS in Thailand; from January 1, 2019 and September 30, 2021. The 76 provinces of Thailand are divided into 12 health regions. EMS can be activated nationwide by calling the Narenthorn EMS Center throughout Thailand, and services are provided by public and private hospitals. Data were obtained from the National EMS Database (Information Technology for Emergency Medical Systems or ITEMS). This study was approved by the Research Ethics Committee of the Faculty of Medicine (REC. 65-050-20-4). Informed consent was waived because of its retrospective nature.

Study population

All patients transported by ground EMS in Thailand during the study period were enrolled. Patients with incomplete medical records, prehospital time intervals of <1 or >300 minutes, and those admitted between January 1 and March 31, 2020 were excluded. Comparisons were made based on admission date: (1) patients transported during the pre-COVID-19 period[22] (January 1, to December 31, 2019) were included in "Group 1," (2) patients transported during the period of the first and second waves of COVID-19 pandemic (April 1, 2020 to March 31, 2021) were included in "Group 2," and (3) patients transported during the third wave of the pandemic (April 1, to September 30, 2021) were included in "Group 3". The study sample size was calculated using a two-tailed test[23,24], based on a prior statistical report by ITEMS[25]. The recommended sample size was estimated to be 138,681 patients in each group. However, the researchers included all patients transported by ground EMS in Thailand fron\m; January 1, 2019 and September 30, 2021 involving a total of 4,659,843 patients.

Data collection and management

Patient dispatch information was retrospectively collected according to age, gender, EMS operation times, notification method, health region, criteria-based dispatch (CBD), etiology of illness, emergency medical units, operation at the scene; triage at the emergency department (ED), diagnosis at the ED, and type of ED disposition. The data were extracted and saved in Microsoft Excel. Statistical analyses were performed using R software (version 4.2.1; R Foundation for Statistical Computing). The missing data in this study were obtained using mean imputation.

Outcome measures

The primary outcome of this study was the EMS prehospital time interval, which consisted of: (1) total prehospital time, (2) response time, (3) on-scene time, and (4) transportation time (Figure 1). The total prehospital time was defined as the time from the emergency call until arrival at the hospital. The total pre-hospital time was divided into three segments: time from the emergency call until the arrival of EMS at the scene (response time), time from the arrival of EMS at the scene until scene departure (on-scene time), and time from scene departure until hospital arrival (transport time). The secondary outcome was EMS prehospital time interval for non-trauma and trauma patients.

Statistical analysis

Continuous variables were reported as the median and interquartile range (IQR) and were compared using the Kruskal–Wallis and Wilcoxon rank-sum tests, while categorical or discrete variables were reported as counts and percentages, and were compared using the chi-square test. R software version 4.2.1 (R Foundation for Statistical Computing, Vienna, Austria) was used for all statistical analyses. The level of statistical significance was set at a p-value≤0.05. All statistical analyses were performed by the same statistician.

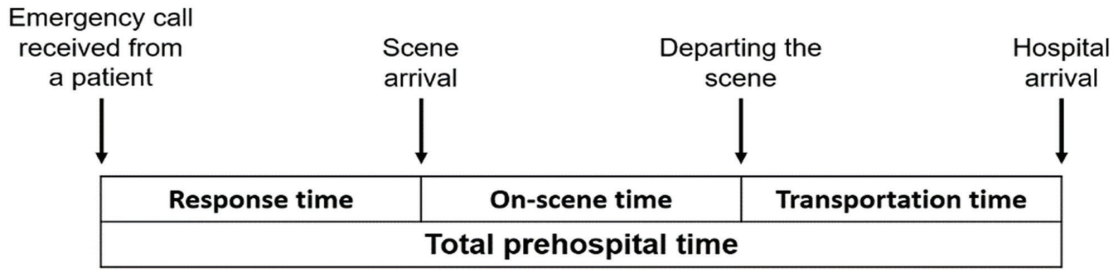
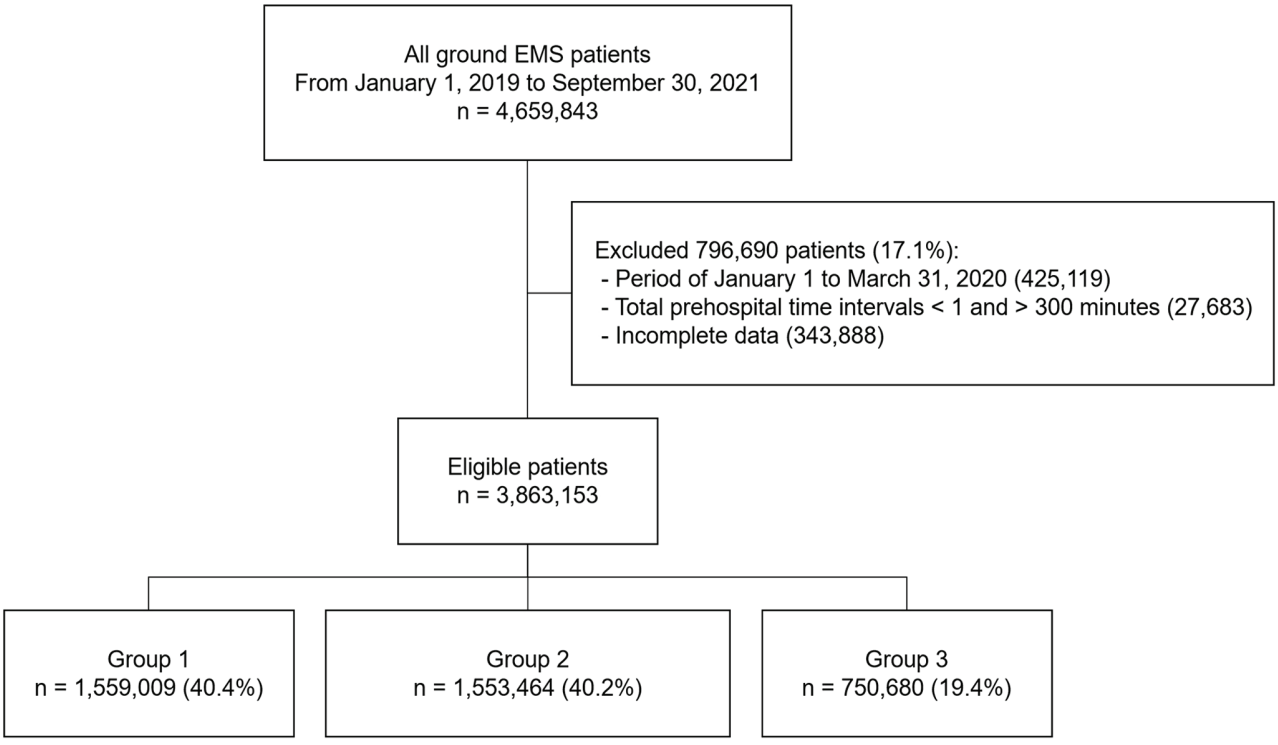


Figure 1 Time intervals for emergency medical services activity and transport



EMS=emergency medical services, Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic

Figure 2 Flowchart of patient's enrollment

Results

Characteristics of the study samples

There were 4,659,843 ground EMS transports during the study period (Figure 2). Patients whose prehospital time intervals were <1 or >300 minutes (27,683), those with incomplete data (343,888), and those who were admitted between January 1 and March 31, 2020 (245,119), were excluded from the study. Finally, 3,863,153 patients were enrolled into this study. Groups 1, 2, and 3 included: 1,559,009 (40.4%), 1,553,464 (40.2%), and 750,680 (19.4%) patients, respectively.

The median age of patients was 50 (28,67) years in Group 1, 50 (30,68) years in Group 3, and 51 (30,68) years in Group 2, which showed the highest median age of patients (Table 1). There were more males than females in all groups (56.1–57.1%). The hotline 1669 was used more frequently for notification than any other method (88.6–89.1%). The number of patients with non-trauma etiology was higher than the number of patients with trauma etiology in all groups. There were significantly more non-trauma patients in Group 3 (72.1%) than in Group 2 (64.6%) (p-value<0.001), and Group 1 (65.2%) showed significantly more non-trauma patients than in Group 2 (64.6%) (p-value <0.001). Group 3 had the highest proportion of patients transported by an advanced life support unit (ALS) and an intermediate life support unit (ILS) to the total emergency medical unit (27.6%). The number of patients transported by ALS and ILS was higher in Group 2 (21.0 %) than Group 1 (18.4%), p-value<0.001; however, the number was significantly higher in Group 3 (27.6%) than in Group 2 (p-value<0.001). However, the basic life support and first response units were the most common emergency medical units in all groups (72.4–81.6%). Most patients received treatment and were transferred to a hospital (98.9–99.1%). The number of patients who received treatment and were transferred to a hospital was higher in Group 1 (99.1%) than in Group 2 (99.0%) (p-value<0.001), but was significantly lower in Group 3 (98.9%) than in Group 2 (p-value<0.001). Group 3 had the highest number of patients who required immediate resuscitation or an emergency severity index (ESI) level of 1–2. The number of patients with ESI level 1–2 in Group 2 (23.8%) was significantly higher than that in Group 1 (20.3%) (p-value<0.001), but significantly higher in Group 3 (28.9%) than in Group 2 (p-value<0.001). In contrast, the number of patients who required urgent (ESI 3), less urgent (ESI 4), and non-urgent (ESI 5) treatments significantly decreased over time (p-value <0.001). The most common diagnosis in the ED, within all groups, was dyspepsia (2.8–3.6%), followed by dizziness (2.1–2.4%), motorcycle accidents (1.6–1.9%), and fever (1.1–2.0%). There were confirmed COVID-19 patients transported by ground EMS in Groups 3 (15.1%) and 2 (0.2%). Group 2 had the highest number of patients who were discharged due to death or were defined as do-not-resuscitate (1.8%) (Table 1).

The majority of CBD cases were motor vehicle accidents: 24.9% in Group 1 and 24.9% in Group 2 (p-value 0.112). However, there was a significant decrease in Group 3 (18.8%) compared to Group 2 (24.9%) (p-value< 0.001). The second most common CBD was abdominal/back/groin pain, which significantly decreased over time (8.6–10.5%), (p-value<0.001). The third most common CBD was breathing difficulty; however, it significantly increased over time (7.8–10.4%), p-value<0.001 (Table 2).

Health region 7 had the highest number of patients transported by ground EMS, followed by health region 9. The number of patients from health regions 1, 2, 3, 4, 5, 6, and 11 was higher in Group 2 than in Group 1 (p-value <0.001), but those from health regions 7, 8, 10, and 12 were lower in Group 2 than in Group 1 (p-value<0.001). There was an increased number of patients from health regions 4, 5, and 6 but a decreased number of patients from health regions 1, 2, 3, 7, 8, and 9 in Group 3 compared with Group 2. (p-value<0.001). The number of patients decreased over time from health region 7 which had the highest number of patients compared to other health regions in all three groups (Table 3).

Table 1 Patient characteristics

Characteristics	Group 1 n=1,559,009	Group 2 n=1,553,464	p-value	Group 3 n=750,680	p-value*
Age, median (IQR)	50 (28,67)	51 (30,68)	<0.001**	50 (31,66)	<0.001**
Sex, Male	880,355 (56.5)	887,059 (57.1)	<0.001	421,450 (56.1)	<0.001
Notification method					
Hotline 1669	1,379,833 (88.6)	1,384,389 (89.1)	<0.001	665,679 (88.6)	<0.001
Other call numbers	148,329 (9.5)	142,030 (9.1)	<0.001	63,549 (8.5)	<0.001
Radio	16,340 (1.0)	15,058 (1.0)	<0.001	11,664 (1.6)	<0.001
Unspecified	14,507 (0.9)	11,988 (0.8)	<0.001	9,787 (1.3)	<0.001
Etiology of the illness			<0.001		<0.001
Non-trauma	1,015,859 (65.2)	1,003,512 (64.6)		540,951 (72.1)	
Trauma	542,565 (34.8)	549,557 (35.4)		209,585 (27.9)	
Emergency medical unit			<0.001		<0.001
ALS + ILS	287,136 (18.4)	326,083 (21.0)		206,960 (27.6)	
BLS + FR	1,271,810 (81.6)	1,227,358 (79.0)		543,695 (72.4)	
Operation at scene					
Treatment and transfer	1,545,128 (99.1)	1,537,933 (99.0)	<0.001	742,838 (98.9)	0.001
Treatment and not transfer	2,409 (0.2)	2,812 (0.2)	<0.001	1,556 (0.2)	<0.001
Treatment/died at the scene	2,072 (0.1)	2,257 (0.1)	0.004	1,118 (0.1)	0.51
Treatment/died on transfer	503 (0.0)	428 (0.0)	0.018	202 (0.0)	0.815
Denied treatment/hospital	2,551 (0.2)	2,946 (0.2)	<0.001	1,413 (0.2)	0.83
Canceled operation	863 (0.1)	930 (0.1)	0.102	408 (0.1)	0.11
Died before the team's arrival	4,589 (0.3)	5,379 (0.3)	<0.001	2,783 (0.4)	0.004
No patient found	597 (0.0)	573 (0.1)	0.541	229 (0.1)	0.017
Triage at the ED					
Immediate resuscitation (ESI 1-2)	315,790 (20.3)	370,292 (23.8)	<0.001	216,316 (28.9)	<0.001
Urgent treatments (ESI 3)	906,639 (58.1)	893,491 (57.6)	<0.001	413,426 (55.1)	<0.001
Less urgent treatments (ESI 4)	317,619 (20.3)	269,896 (17.4)	<0.001	110,855 (14.8)	<0.001
Nonurgent treatments (ESI 5)	2,554 (0.2)	2073 (0.1)	<0.001	768 (0.1)	<0.001
Diagnosis at the ED					
Dyspepsia	46,262 (3.6)	42,592 (3.3)	<0.001	17,671 (2.8)	<0.001
Dizziness	30,718 (2.4)	30,572 (2.4)	0.24	13,195 (2.1)	<0.001
Motorcycle accident	22,436 (1.8)	24,660 (1.9)	<0.001	10,454 (1.6)	<0.001
Fever	26,072 (2.0)	17,167 (1.3)	<0.001	6,686 (1.1)	<0.001
Seizure	17,130 (1.3)	19,337 (1.5)	<0.001	8,154 (1.3)	<0.001
Muscle strain	17,698 (1.4)	17,384 (1.4)	0.034	6,698 (1.1)	<0.001
Hypoglycemia	13,157 (1.0)	15,066 (1.2)	<0.001	6,962 (1.1)	<0.001
Acute gastroenteritis	10,418 (0.8)	13,905 (1.1)	<0.001	7,314 (1.2)	<0.001
Head injury	14,381 (1.1)	12,372 (1.0)	<0.001	4,768 (0.8)	<0.001
Stroke	11,912 (0.9)	13,957 (1.1)	<0.001	5,504 (0.9)	<0.001
Confirmed COVID-19 patients	-	3,857 (0.2)	-	113,720 (15.1)	<0.001
Type of ED disposition					
Death or DNR	26,185 (1.6)	28,308 (1.8)	<0.001	13,307 (1.7)	0.008
Admit or transferred	1,311,359 (84.1)	1,300,845 (83.7)	<0.001	630,252 (84.0)	<0.001
Others***	221,465 (14.3)	224,311 (14.5)	<0.001	107,121 (14.3)	<0.001

IQR=interquartile range, ALS=advance life support unit, ILS=intermediate life support unit, BLS=basic life support unit, FR=first response unit, ED=emergency department, ESI=emergency severity index, COVID-19=coronavirus disease 2019, DNR=do-not-resuscitate, Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic Data are presented as n (%) unless otherwise indicated. *p-value between Groups 2 and 3 **Age was tested by the Wilcoxon Rank-Sum test. Other variables were tested by the Chi-square test ***Other ED dispositions include: leaving against medical advice, unspecific results, and unknown results

Table 2 The comparison of criteria-based dispatch of patients

Criteria-based dispatch	Group 1 n=1,559,009	Group 2 n=1,553,464	p-value	Group 3 n=750,680	p-value*
01:Abdominal/back/groin pain	163,387 (10.5)	157,936 (10.2)	<0.001	64,633 (8.6)	<0.001
02:Anaphylaxis/allergic reaction	9,381 (0.6)	10,710 (0.7)	<0.001	6,501 (0.9)	<0.001
03:Animal bites	11,827 (0.8)	11,095 (0.7)	<0.001	5,925 (0.8)	<0.001
04:Bleeding (non-traumatic)	19,989 (1.3)	22,513 (1.4)	<0.001	10,199 (1.4)	<0.001
05:Breathing difficulty	122,132 (7.8)	129,160 (8.3)	<0.001	78,048 (10.4)	<0.001
06:Cardiac arrest	2,781 (0.2)	4,223 (0.3)	<0.001	2,180 (0.3)	0.013
07:Chest pain/discomfort/heart problems	42,579 (2.7)	48,042 (3.1)	<0.001	23,097 (3.1)	0.519
08:Choking	2,119 (0.1)	2,586 (0.2)	<0.001	1,140 (0.2)	0.01
09:Diabetic patients	28,305 (1.8)	30,704 (2.0)	<0.001	13,351 (1.8)	<0.001
10:Environmental/toxic exposure	475 (0.0)	2,040 (0.1)	<0.001	4,572 (0.6)	<0.001
12:Head/neck	43,595 (2.8)	41,883 (2.7)	<0.001	17,696 (2.4)	<0.001
13:Mental/emotional/psychological	16,116 (1.0)	19,764 (1.3)	<0.001	9,158 (1.2)	<0.001
14:Overdose/poisoning	6,283 (0.4)	7,209 (0.5)	<0.001	3,634 (0.5)	0.038
15:Pregnancy/childbirth/gynecology	27,919 (1.8)	28,771 (1.9)	<0.001	13,231 (1.8)	<0.001
16:Seizures	50,339 (3.2)	55,812 (3.6)	<0.001	24,499 (3.3)	<0.001
17:Unspecific sickness	327,293 (21.0)	307,544 (19.8)	<0.001	212,856 (28.4)	<0.001
18:Stroke	19,004 (1.2)	23,295 (1.5)	<0.001	11,024 (1.5)	0.069
19:Unconscious/unresponsive/syncope	72,548 (4.7)	76,468 (4.9)	<0.001	33,728 (4.5)	<0.001
20:Pediatric emergencies	49,787 (3.2)	23,757 (1.5)	<0.001	5,479 (0.7)	<0.001
21:Assault/Trauma	22,917 (1.5)	22,077 (1.4)	<0.001	8,924 (1.2)	<0.001
22:Burns	3,693 (0.2)	4,059 (0.3)	<0.001	1,889 (0.3)	0.181
23:Drowning/diving/water-related Injury	1,809 (0.1)	1,606 (0.1)	<0.001	815 (0.1)	0.264
24:Falls/accidents/pain	126,452 (8.1)	134,287 (8.6)	<0.001	56,748 (7.6)	<0.001
25:Motor vehicle accident	387,694 (24.9)	387,528 (24.9)	0.112	141,209 (18.8)	<0.001

Data on several patients was tested by chi-square test *p-value between Groups 2 and 3
Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic

Primary outcome

The median total prehospital time was the longest in Group 3 at 27 (19, 37) minutes (Table 4, Figure 3). The median total prehospital time was significantly longer in Group 2 than in Group 1 [25 (17, 34) vs. 24 (17, 33) minutes, p-value<0.001], and it was significantly longer in Group 3 [27 (19, 37) minutes] than in Group 2 (p-value<0.001). The longer total prehospital time in Group 2 was caused by a longer on-scene time than that in Groups 1 and 4 (2, 7) vs. 3 (2, 6) minutes, p-value<0.001. Although, the median transportation time was significantly lower in Group 2 than in Group 1 [10 (6, 17) vs. 11 (6, 18) minutes (p-value <0.001)], there were significantly increased response times and transportation times in Group 3 [8 (5, 14) and 11 (6, 18.4) minutes, respectively] compared to those in Group 2 [7 (4,11) and 10 (6,17) minutes, respectively (p-value<0.001)].

The number of patients whose total prehospital time was >60 minutes was also the highest in Group 3, followed by Groups 2 and 1. In Group 2, [39,138 patients (2.5%)] had a total prehospital time of >60 minutes, which was a significant increase from the number of patients in Group 1 [34,881 patients (2.2%); p-value<0.001]. However, there was a significant increase in Group 3 (49,237 patients, 6.6%) compared to Group 2 (p-value<0.001).

Table 3 The health region of patients

Health region**	Group 1 n=1,559,009	Group 2 n=1,553,464	p-value	Group 3 n=750,680	p-value*
1	153,348 (9.8)	156,590 (10.1)	<0.001	72,317 (9.6)	<0.001
2	71,735 (4.6)	73,591 (4.7)	<0.001	34,643 (4.6)	<0.001
3	61,841 (4.0)	64,665 (4.2)	<0.001	30,339 (4.0)	<0.001
4	92,613 (5.9)	98,893 (6.4)	<0.001	59,205 (7.9)	<0.001
5	101,342 (6.5)	113,917 (7.3)	<0.001	65,291 (8.7)	<0.001
6	130,990 (8.4)	137,629 (8.9)	<0.001	72,241 (9.6)	<0.001
7	238,938 (15.3)	210,988 (13.6)	<0.001	91,756 (12.2)	<0.001
8	165,325 (10.6)	162,047 (10.4)	<0.001	71,743 (9.6)	<0.001
9	174,753 (11.2)	173,345 (11.2)	0.157	77,051 (10.3)	<0.001
10	139,131 (8.9)	133,669 (8.6)	<0.001	65,203 (8.7)	0.04
11	114,710 (7.4)	116,183 (7.5)	<0.001	56,476 (7.5)	0.232
12	114,283 (7.3)	111,947 (7.2)	<0.001	54,415 (7.2)	0.244

Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic
*p-value between Groups 2 and 3
**Health region:
1: Chiang Mai, Mae Hong Son, Lampang, Lamphun, Chiang Rai, Nan, Phayao, and Phrae
2: Tak, Phitsanulok, Phetchabun, Sukhothai, and Uttaradit
3: Kamphaeng Phet, Nakhon Sawan, Phichit, Uthai Thani, and Chai Nat
4: Nonthaburi, Pathum Thani, Phra Nakhon Si Ayutthaya, Saraburi, Lopburi, Sing Buri, Ang Thong, and Nakhon Nayok
5: Kanchanaburi, Nakhon Pathom, Ratchaburi, Suphan Buri, Prachuap Khiri Khan, Phetchaburi, Samut Songkhram, and Samut Sakhon
6: Prachinburi, Sa Kaeo, Chanthaburi, Trat, Rayong, Chonburi, Samut Prakan, and Chachoengsao
7: Kalasin, Khon Kaen, Maha Sarakham, and Roi Et
8: Loei, Nong Khai, Nong Bua Lamphu, Udon Thani, Bueng Kan, Nakhon Phanom, Mukdahan, and Sakon Nakhon
9: Chaiyaphum, Nakhon Ratchasima, Buriram, and Surin
10: Yasothon, Sisaket, Amnat Charoen, and Ubon Ratchathani
11: Chumphon, Surat Thani, Nakhon Si Thammarat, Ranong, Phang Nga, Phuket, and Krabi
12: Phatthalung, Trang, Songkhla, Satun, Pattani, Yala, and Narathiwat

Secondary outcomes

The subgroup analysis revealed that the median total prehospital time was the longest in Group 3. Patients with non-trauma etiology had a longer median total prehospital time than those with trauma etiology in all groups (Table 4, Figure 3). Among patients with non-trauma etiology, there was a significantly increased total prehospital time in Group 2 compared to Group 1, [26 (18, 35) vs. 25 (18, 34) minutes, p-value<0.001], and that was significantly increased in Group 3 [28 (20,40) minutes] compared to Group 2 (p-value<0.001). In Group 2, 29,079 patients (2.9%) had a total prehospital time >60 minutes, which was significantly higher than that in Group 1 [25,486 patients, 2.5%; p-value<0.001]. In Group 3, 44,685 patients (8.3%) had a total prehospital time of >60 minutes, which was also significantly higher in Group 2 (p-value<0.001).

Among patients with trauma etiology, the total prehospital time was significantly longer in Group 2 than in Group 1, [23 (16, 31) vs. 22 (15, 30) minutes, p-value <0.001], and was significantly longer in Group 3 (24 (17, 32) minutes than in Group 2 (p-value<0.001). The number of patients who had a total prehospital time >60 minutes in Group 2 [10,044 patients (1.8%)] was significantly higher than that in Group 1 [9,382 patients (1.7%), (p-value <0.001)], and that in Group 3 [4,529 patients (2.2%)] was significantly higher than in Group 2 (p-value<0.001).

Table 4 EMS operation times of patients

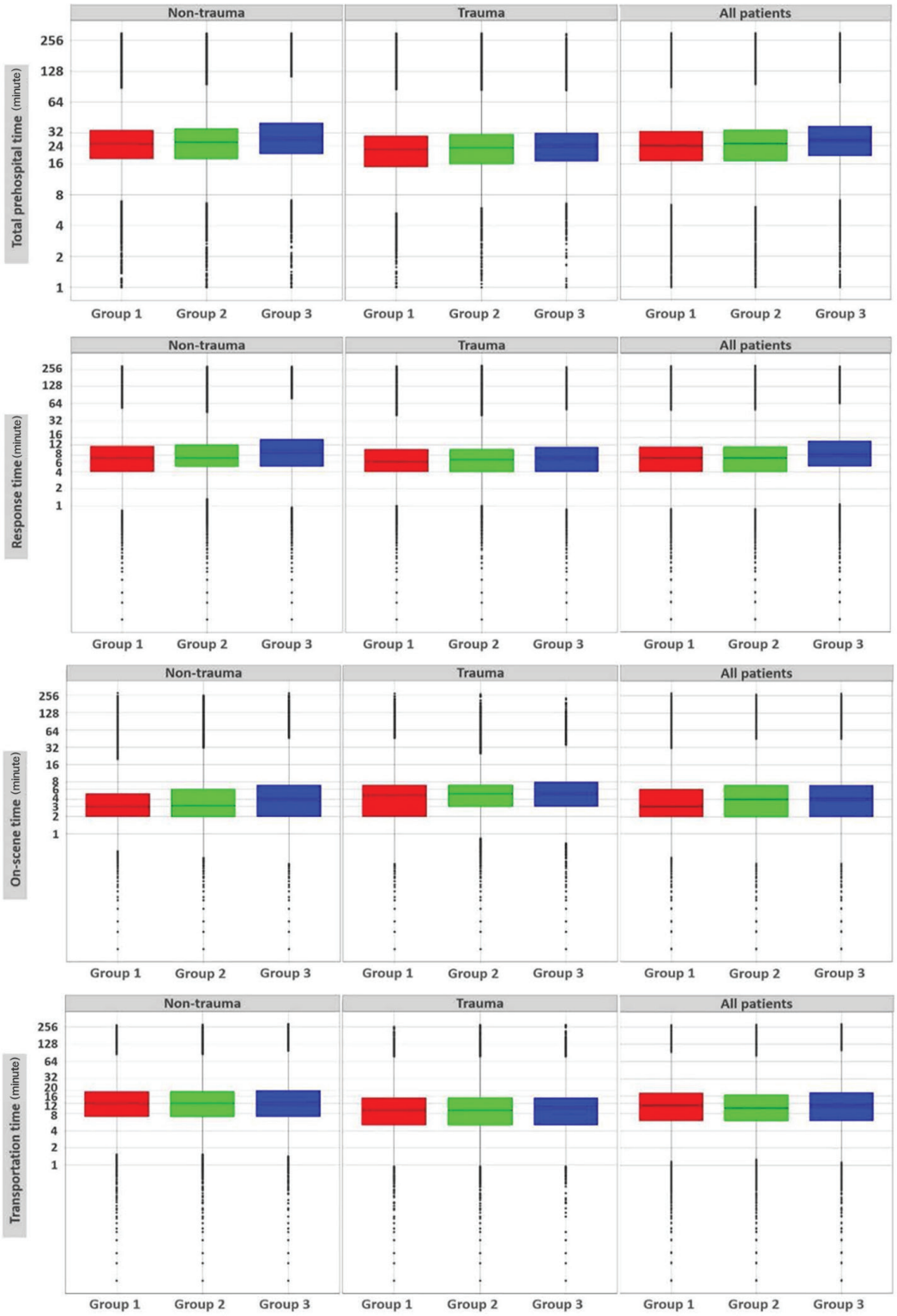
EMS operation times	Group 1 n=1,559,009	Group 2 n=1,553,464	p-value	Group 3 n=750,680	p-value*
Total prehospital time	24 (17,33)	25 (17,34)	<0.001	27 (19,37)	<0.001
Non-trauma	25 (18,34)	26 (18,35)	<0.001	28 (20,40)	<0.001
Trauma	22 (15,30)	23 (16,31)	<0.001	24 (17,32)	<0.001
Response time	7 (4,11)	7 (4,11)	<0.001	8 (5,14)	<0.001
Non-trauma	7 (4,11.3)	7 (5,12)	<0.001	9 (5,15)	<0.001
Trauma	6 (4,10)	6.6 (4,10)	<0.001	7 (4,11)	<0.001
On-scene time	3 (2,6)	4 (2,7)	<0.001	4 (2,7)	<0.001
Non-trauma	3 (2,5)	3 (2,6)	<0.001	4 (2,7)	<0.001
Trauma	4.6 (2,7)	5 (3,7)	<0.001	5 (3,8)	<0.001
Transportation time	11 (6,18)	10 (6,17)	<0.001	11 (6,18.4)	<0.001
Non-trauma	12 (7,19)	12 (7,19)	<0.001	12 (7,20)	<0.001
Trauma	9 (5,15)	9 (5,15)	<0.001	10 (5,15)	<0.001
Number of patients whose total prehospital time >60 minutes	34,881 (2.2)	39,138 (2.5)	<0.001	49,237 (6.6)	<0.001
Non-trauma	25,486 (2.5)	29,079 (2.9)	<0.001	44,685 (8.3)	<0.001
Trauma	9,382 (1.7)	10,044 (1.8)	<0.001	4,529 (2.2)	<0.001

EMS=Emergency Medical Services, IQR=interquartile range
Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic
All times were tested by Wilcoxon Rank-Sum test and displayed in median (IQR) minutes and data on several patients were tested by chi-square test and displayed in n (%)
*p-value between Group 2 and Group 3

Discussion

During the COVID-19 pandemic, Thailand undertook prohibitions and national measures; such as a curfew from 10 p.m. to 4 a.m., travel restrictions, and facility shutdowns; resulting in fewer people on the roads[14-18,21]. However, prehospital PUI screening and PPE use by EMS staff may have resulted in delayed prehospital time intervals. The impact of the COVID-19 pandemic on the EMS system remains unclear due to few published studies; although, it can be speculated that there were delays in the EMS prehospital time intervals caused by process changes. Previous studies found that EMS prehospital times for trauma patients were not significantly affected by the COVID-19 pandemic[21]. However, another study found that the COVID-19 pandemic affected EMS and delayed response, even in a minimally affected region[16]. The main finding of this study was that the COVID-19 pandemic affected the EMS system in Thailand by increasing prehospital time intervals; especially when the spread of the pandemic increased.

EMS is disrupted under unusual circumstances; including disasters and large-scale traffic accidents[26,27]. In this study, 12 months were used for comparison to reduce the pattern of seasonal variations. Although, no natural or man-made hazards were found to impede these transfers during the study period, the EMS prehospital time was delayed. Moreover, as the pandemic progressed, the total prehospital interval increased. The median total prehospital times in this study were 24 (17, 33), 25 (17, 34), and 27 (19, 37) minutes (p-value <0.001) before, during the first and second waves, and during the third wave of the COVID-19 pandemic, respectively.



Group 1=the pre-COVID-19 period, Group 2=the first and second waves of COVID-19 pandemic, Group 3=the third wave of the pandemic

Figure 3 Boxplots of emergency medical services operation times

According to this study, during the first and second waves of the COVID-19 pandemic, the on-scene time was significantly higher than that in the preceding period [3 (2,6) vs. 4 (2,7) minutes, p-value<0.001], which was a median of one minute longer. Healthcare staff were not well prepared for the newly emerging pandemic, which resulted in them spending more time taking care of patients at the scene. However, the present study found decreased transport time during the first and second waves compared to that before the pandemic, which might have been caused by to the non-congestion of traffic due to the national measures[14,15]. Conversely, transportation time was significantly longer during the third wave of the pandemic, as the reopened facilities caused people to return to more outdoor activities or an increase in road traffic. Additionally, the capacity of nearby hospitals was limited during the pandemic; many operations had long distances causing a delay in transportation time, as in a previous study[17]. The delay in the response time observed during the third wave of the pandemic may be explained by the increased spread of the COVID-19 pandemic, the self-protection preparation of EMS personnel, and the screening of COVID-19 risks; as discussed by Jarvis et al[21].

The number of patients whose total prehospital time interval was >60 minutes, which could be used to predict patient outcomes, significantly peaked during the third wave at 6.6% of the total population. This was up from 2.5% during the first and second waves of the COVID-19 pandemic. The number of patients with both non-trauma and trauma etiologies, whose total prehospital time was >60 minutes, significantly increased during the COVID-19 pandemic. Many patients were transported to distance-appropriate hospitals due to the unavailability of beds in the nearest hospitals during the pandemic. A previous study found that reaching definitive care within the first hour after a traumatic injury improved the mortality rate[7]. Similarly, an increase in in-hospital all-cause mortality in trauma patients with odds of death increased by 4.0% for each 10-minute increase in the prehospital time[28]. Nevertheless, this study did not collect data on mortality and outcomes of patients, and could not determine whether the clinical outcomes of patients worsened as a result of the delayed EMS prehospital time. Therefore, further studies are required to collect data on patient mortality and outcomes.

This study has several limitations. First, while public health measures were in place throughout the COVID-19 study period, the timing of the initiation and duration of the lockdown varied across the country. Second, information on several factors associated with EMS performance and transportation; such as information regarding the time intervals of PUI screening questions, PPE preparation, cleaning, and disinfection of vehicles and equipment during each operation, could not be obtained. This study did not consider travel distance, road type, or degree of urbanization. Third, the retrospective nature of the cohort study and selection bias, due to the exclusion of patients with incomplete data, could have led to inappropriate assessments. Finally, this study was conducted using data from the ITEMS. Bangkok, the capital city of Thailand, was dependent on the Erawan Bangkok EMS Center, which was not included in this study. Therefore, the results may not be generalizable to all areas, and this may have led to selection bias. However, the authors estimated that there would be no significant difference since the EMS policy in Thailand is the same. A recent study found that the Bangkok EMS operation period of both trauma and non-trauma groups during the COVID-19 pandemic period also increased[29]. Additional, well-designed studies on factors other than COVID-19 are warranted to improve our understanding of this component of prehospital delays.

Conclusion

The COVID-19 pandemic disrupted routine health services in Thailand; including prehospital emergency care. The EMS prehospital time intervals were significantly extended and included both trauma and non-trauma etiologies during the third wave of the pandemic when the EMS system was heavily affected compared to the preceding period. Appropriate pre-hospital strategies and monitoring should be developed to manage future pandemics.

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Conflicts of interest

There are no potential conflicts of interest to declare.

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