Original Article

Factors associated with the prolongation of emergency department length of stay before and during the COVID-19 pandemic in a university hospital in Thailand

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Background: Prolonged emergency department length of stay (EDLOS) can lead to several undesired events and increased mortality among emergency patients. However, human resources, the capacity of receiving hospitals, and patient management flow at the emergency departments (EDs) may vary from site to site. The study aimed to investigate factors affecting EDLOS and determine the EDLOS of critical patients, including factors that could affect their EDLOS before and during the COVID-19 pandemic.

Methods: This was a retrospective study of critical patients who visited the ED of a 900-bed urban university hospital from January 16, 2020 to February 29, 2020 (pre-COVID-19 pandemic), and from July 1, 2020 to August 15, 2021 (during the peak of COVID-19 pandemic). Data were extracted from electronic medical records. Multiple logistic regression was performed to identify factors associated with EDLOS.

Results: Out of 2,009 patients, 1,938 patients met our study criteria. The median EDLOS was 4.2 [interquartile range (IQR), 2.3–7.5] hours. EDLOS during the COVID-19 pandemic was longer (median: 4.6, IQR, 2.8–7.5 hours) during and (median: 3.5, IQR, 2.3–6.2 hours) before the pandemic (P<0.001). Factors associated with EDLOS ≥4 hours pre-COVID-19 pandemic were diabetes mellitus and receipt of medical consultation. Factors associated with EDLOS ≥4 hours during the COVID-19 pandemic were ED visits during the day shift, X-ray imaging, and COVID-19 diagnosis.

Conclusions: EDLOS was significantly longer during the COVID-19 pandemic than before. Diabetes mellitus and receipt of medical consultation were factors affecting EDLOS ≥4 hours before the COVID-19 pandemic, whereas ER visits during the day shift, X-ray imaging, and COVID-19 diagnosis affected EDLOS ≥4 hours during the pandemic. Strategies to improve the consultation flow and X-ray imaging evaluations should be investigated.

Keywords: Emergency department length of stay (EDLOS); emergency department (ED); COVID-19

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Introduction

Emergency department (ED) crowding is a public health problem commonly found in many countries around the world. The National Health Service of the United Kingdom sets out the appropriate emergency department length of stay (EDLOS) as not exceeding 4 hours (1). Moreover, a study led by Mortimore *et al.* found that patients were more satisfied if they spent less time in the ED (<4 hours) (2).

In Thailand, the survey conducted by the National Institute for Emergency Medicine in 2016 indicated that an increasing number of patients are demanding ER services in public hospitals, from 12 million patients in 2001 to 24 million in 2012 and to 35 million in 2016 (3). A study conducted by Aphinives *et al.* that examined the factors associated with general non-trauma patients found that the average EDLOS was 6.1 hours (4). The factors that affected EDLOS were age, times of presenting to ED, patient comorbidities, and triage level. It has been found that EDLOS increases with increasing patient age and for patients who visit the ED during weekends. Moreover, a study led by Imsuwan *et al.* found that most of the patients who stayed in the ED for ≥4 hours required medical consultations and needed to be admitted to the hospital (5).

The outbreak of COVID-19 was first observed in December 2019, initially in Wuhan, Hubei Region of the People's Republic of China. A study by Lucero *et al.* found that the EDLOS was longer during the COVID-19 outbreak compared to before the outbreak (6). Therefore, the global pandemic has posed significant strain to public health systems around the world. The system capacity may vary among countries, including bed availability, hospital occupancy rate, patient characteristics, and management pattern. Thus, this research aimed to compare the EDLOS of critical patients, defined by the emergency severity index (ESI) 1–2 before and during the COVID-19 pandemic at an urban university hospital and identify factors affecting EDLOS ≥4 hours before and during the COVID-19 pandemic. We present this article in accordance with the STROBE reporting checklist (available at https://jphe.amegroups.com/article/view/10.21037/jphe-23-105/rc).

Highlight box

Key findings

- We found that emergency department length of stay (EDLOS) was longer during the COVID-19 pandemic than before. Factors associated with EDLOS ≥4 hours during the COVID-19 pandemic were identified as the need to consult specialists and for X-ray examinations, which differed significantly from the factors in the pre-COVID period.

What is known and what is new?

- The National Health Service of the UK recommends EDLOS of <4 hours, and patients are generally happier with shorter emergency department stays. Additionally, one study found that the EDLOS was longer during the COVID-19 pandemic than before.

What is the implication, and what should change now?

- Guidelines for decreasing times to obtain consultations with specialists and for shortening total X-ray examination times should be developed.

Methods

Study design and setting

This was a retrospective study using cross-sectional data from two distinct time periods. The inclusion criteria were patients who had been triaged as ESI 1–2 in the emergency room (ER) of a 900-bed urban university hospital in Bangkok, Thailand, between January 16, 2020 and February 29, 2020 (pre-COVID-19 pandemic) and between July 01, 2021 and August 15, 2021 (during the COVID-19 pandemic). The exclusion criteria were participants with incomplete medical records. After calculating the necessary sample size of ≥923 per group, the target sample size of the pre-COVID-19 and during COVID-19 groups was 950 per group. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was conducted with approval from the Institutional Review Board of Faculty of Medicine of Vajira Hospital, Navamindradhiraj University (COA 153/2563). Patients and the public were not involved in this research and individual consent for this retrospective analysis was waived.

Data abstraction and processing

The research team conducted medical chart abstraction and created a database of retrospective data on emergency patients. This data was divided into two periods: before the COVID-19 pandemic (16 January 2020–29 February 2020) and during the pandemic (1 July 2021–15 August 2021). The data provided a general profile of the patients, including age, sex, comorbidities, mode of arrival, triage information, diagnosis at ED, any fast-track activation for time-sensitive conditions such as ST-elevation myocardial

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infarction (STEMI), acute stroke, major trauma, or sepsis.

Outcome measurement

The primary outcome measure for this study was to compare the EDLOS of emergency patients before and during the COVID-19 pandemic. The secondary outcome included factors affecting prolonged EDLOS. The EDLOS was defined as the total time a patient spent in the ER measured from arrival to discharge or admission. The factors affecting EDLOS were numbers of specialty consultations, specialty types, modified early warning score (MEWS), numbers of interventions, laboratory tests, radiological tests, and bedside ultrasound. Data were collected using data collection forms and analyzed statistically. The emergency department working index (EDWIN) scores were measured every 4 hours by the supervised nurse to represent the ED overcrowding level.

Statistical analysis

The analysis and presentation of data were separated into two groups according to the types of data as follows: (I) qualitative data, including sex, comorbidities, mode of arrival, triage level, and diagnosis expressed as frequency and percentage, and (II) quantitative data, including age and time of visit expressed as the average, standard deviation, median and interquartile range (IQR) as appropriate. We analyzed the factors affecting EDLOS ≥4 hours by logistic regression analysis. The multivariable model was developed by including covariates with a P value <0.1 from univariable analysis, which adjusted for age, comorbidities, visiting hours, X-ray examination, numbers of procedures performed, specialty consultation, MEWS score, and diagnosis. Subsequently, the stepwise backward regression method was used to select the final model. The statistical analyses were performed in Stata version 15.1 software (StataCorp LLC, College Station, TX, USA) and considered statistically significant for P values <0.05.

Sample size

According to Aphinives's cross-sectional study, the mean and standard deviation of the time spent in interval care in the ED were 6.7±5.19 hours, with a 5% precision from the standard deviation (4). The sample size was calculated based on estimating an infinite population mean which resulted in the minimum required sample size of 1,537.

Results

A total of 2,009 emergency patients visited the 900-bed urban university hospital ER from January 16 to February 29, 2020 (pre-COVID-19 pandemic) and from July 1 to August 15, 2020 (during the COVID-19 pandemic) based on historical data search. After applying the inclusion criteria described above, 1,938 patients (96.5%) were included in the study. Sixty-five medical records were missing, and six patients refused treatment. The pre-COVID-19 pandemic group had 976 patients, and during COVID-19 pandemic group had 961 patients.

The majority of the patients were female (53%), and the median age was 61 years (IQR, 40–75 years). The predominant comorbidity was hypertension (38.9%) followed by diabetes (29.4%). Most of the patients traveled to the hospital by private vehicles (80.6%) and were seen during the late-night shift (00:01–08:00, 40.7%) followed by the afternoon shift (16:01–24:00, 38.3%). Sepsis (88.8%) was the most common diagnosis among time-sensitive presentations. We found that 61.5% of the patients had undergone more than two resources needed. Internal medicine (53.9%) was the most consulted specialty. The median MEWS score was 3 points (IQR, 2–5). The median EDWINS score was 1 point (IQR, 0.7–1.4), and the majority of EDWINS scores were <1.5 points (77%).

General and clinical data in the pre-COVID-19 pandemic and during the COVID-19 pandemic groups

The average patient age was lower in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group [60 (IQR, 35–74) *vs.* 63 (IQR, 46–75) years, P=0.001]. Patients in the pre-COVID-19 pandemic group had various chronic diseases, including diabetes (P=0.006), hypertension (P=0.002), end-stage kidney disease (P=0.04), and cerebrovascular disease (P=0.04), but the percentages of these diseases were lower than those in the during COVID-19 pandemic group. An exception was that more patients had chronic obstructive pulmonary disease (COPD) in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group, but this difference was not statistically significant (P=0.221) (*Table 1*).

In the fast-track subgroup in the ED, fewer patients had sepsis (P<0.001) but more had stroke (P=0.004) and trauma (P=0.01) in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group. There were more patients during the morning shift (P=0.01) and afternoon

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Table 1 General characteristics of the patients who visited emergency department pre-COVID-19 pandemic period and during the COVID-19 pandemic period

Variables	Total number of patients (n=1,938)	Pre-COVID-19 pandemic period (n=976)	COVID-19 pandemic period (n=962)	P value
Age (years), median [IQR]	61 [40–75]	60 [35–74]	63 [46–75]	0.001
Female, n (%)	1,023 (52.8)	528 (54.1)	495 (51.4)	0.25
Comorbidities, n (%)				
Diabetes mellitus	569 (29.4)	259 (26.5)	310 (32.2)	0.006
Hypertension	754 (38.9)	346 (35.5)	408 (42.4)	0.002
End stage kidney disease	61 (3.1)	23 (2.4)	38 (4.0)	0.04
Coronary artery disease	154 (7.9)	85 (8.7)	69 (7.2)	0.21
Cerebrovascular disease	69 (3.6)	26 (2.7)	43 (4.5)	0.04
COPD	51 (2.6)	30 (3.1)	21 (2.2)	0.221
Asthma	47 (2.4)	24 (2.5)	23 (2.4)	0.92
Cancer	118 (6.1)	61 (6.3)	57 (5.9)	0.77
Triage (ESI), n (%)				<0.001
1	373 (19.2)	121 (12.4)	252 (26.2)	
2	1,565 (80.8)	855 (87.6)	710 (73.8)	
Mode of arrival, n (%)				0.05
Private vehicle	1,562 (80.6)	788 (80.7)	774 (80.5)	0.95
Ambulances	288 (14.9)	154 (15.8)	134 (13.9)	0.96
Others	88 (4.5)	34 (3.5)	54 (5.6)	0.02
Fast track activation, n (%)				0.001
STEMI	11 (1.8)	6 (2.4)	5 (1.4)	0.36
Sepsis/septic shock	531 (88.8)	204 (82.6)	327 (93.2)	<0.001
Acute stroke	32 (5.4)	21 (8.5)	11 (3.1)	0.004
Major trauma	24 (4.0)	16 (6.5)	8 (2.3)	0.01
Visiting time, n (%)				<0.001
Morning shift (8:01–16:00)	407 (21.0)	228 (23.4)	179 (18.6)	0.01
Afternoon shift (16:01–24:00)	742 (38.3)	400 (41.0)	342 (35.6)	0.02
Late-night shift (00:01–08:00)	788 (40.7)	348 (35.7)	440 (45.7)	<0.001
X-ray examination, n (%)	1,399 (72.2)	630 (64.5)	769 (79.9)	<0.001
Computed tomography, n (%)	266 (13.7)	166 (17.0)	100 (10.4)	0.06
Ultrasonography, n (%)	547 (28.2)	335 (34.3)	212 (22.0)	<0.001
Number of resources needed, n (%)				<0.001
0	304 (15.7)	183 (18.8)	121 (12.6)	<0.001
1	443 (22.9)	265 (27.2)	178 (18.5)	<0.001
≥2	1,191 (61.5)	528 (54.1)	663 (68.9)	<0.001

Table 1 *(continued)*

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Table 1 *(continued)*

Variables	Total number of patients (n=1,938)	Pre-COVID-19 pandemic period (n=976)	COVID-19 pandemic period (n=962)	P value
Number of specialty consultation, n (%)				<0.001
0	592 (30.5)	365 (37.4)	227 (23.6)	<0.001
1	1,253 (64.7)	573 (58.7)	680 (70.7)	<0.001
≥2	93 (4.8)	38 (3.9)	55 (5.7)	<0.001
Type of specialty consultation, n (%)				
Cardiology	18 (0.9)	4 (0.4)	14 (1.5)	0.02
Neurosurgery	38 (2.0)	13 (1.3)	25 (2.6)	0.04
Pediatrics	56 (2.9)	39 (4.0)	17 (1.8)	0.003
Orthopedic surgery	46 (2.4)	28 (2.9)	18 (1.9)	0.15
General surgery	131 (6.8)	80 (8.2)	51 (5.3)	0.01
Internal medicine	1,044 (53.9)	447 (45.8)	597 (62.1)	<0.001
MEWS score, median [IQR]	3 [2–5]	3 [2–4]	3 [2–5]	0.14
EDWIN score, median [IQR]	1 [0.7–1.4]	1.3 [1–1.8]	0.8 [0.5–1.1]	<0.001
EDWIN score, n (%)				0.001
<1.5	1,490 (76.9)	655 (67.2)	835 (86.8)	<0.001
1.5–2	185 (9.5)	112 (11.5)	73 (7.6)	0.004
>2	259 (13.4)	207 (21.2)	52 (5.4)	<0.001

IQR, interquartile range; ESI, emergency severity index; COPD, chronic obstructive pulmonary disease; STEMI, ST-elevation myocardial infarction; MEWS, modified early warning score; EDWIN, emergency department working index.

shift (P=0.02) in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group. There were fewer patients during the night shift in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group (P<0.001).

There were more X-rays (P<0.001) and more ultrasound examinations (P<0.001) performed but fewer patients underwent two procedures in the during COVID-19 pandemic group than in the pre-COVID-19 pandemic group (P<0.001). There were fewer specialty consultations in the pre-COVID-19 pandemic group (P<0.001) but significantly more consultations by emergency physicians with pediatricians, surgeons, and internists in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group. The EDWIN scores were 1.3 and 0.8 points in the pre-COVID-19 pandemic group and during COVID-19 pandemic group, respectively (P<0.001).

There were reproductive diseases in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group (P=0.008). In contrast, there were more coronary artery diseases, urinary tract diseases, infectious diseases, musculoskeletal diseases, neurological diseases, and rheumatologic diseases in the pre-COVID-19 pandemic group than the during COVID-19 pandemic group (all significant) (*Table 2*).

The admission rate was lower in the pre-COVID-19 pandemic group than in the during COVID-19 pandemic group (58% *vs.* 71.3%), with statistical significance. In contrast, the patient transfer rate was higher in the pre-COVID-19 pandemic group than in the COVID-19 pandemic group (5.6% *vs.* 2.5%,) with statistical significance.

Comparison of the EDLOS between the pre-COVID-19 pandemic and during COVID-19 pandemic groups

The median EDLOS was longer in the during COVID-19 pandemic group than in the pre-COVID-19 pandemic

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Table 2 Diagnoses and dispositions of patients who visited emergency department pre-COVID-19 pandemic period and during the COVID-19 pandemic period

Variables	Total number of patients	Pre-COVID-19 pandemic period	COVID-19 pandemic period	P value
Diagnosis, n (%)				
Coronary artery disease	274 (14.1)	164 (16.8)	110 (11.4)	0.001
Endocrinologic disease	95 (4.9)	43 (4.4)	52 (5.4)	0.31
Gastrointestinal disease	194 (10.0)	109 (11.2)	85 (8.8)	0.09
Urinary tract disease	82 (4.2)	51 (5.2)	31 (3.2)	0.03
Reproductive system disease	90 (4.6)	33 (3.4)	57 (5.9)	0.008
Hematologic disease	11 (0.6)	6 (0.6)	5 (0.5)	0.78
Biliary tract disease	16 (0.8)	7 (0.7)	9 (0.9)	0.59
Infectious disease	244 (12.6)	167 (17.1)	77 (8.0)	<0.001
Musculoskeletal disease	87 (4.5)	59 (6.0)	28 (2.9)	0.001
Kidney disease	22 (1.1)	9 (0.9)	13 (1.4)	0.34
Neurological disease	222 (11.5)	130 (13.3)	92 (9.6)	0.01
Respiratory tract disease	1 (0.1)	1 (0.1)	0 (0.0)	0.32
Rheumatologic disease	247 (12.7)	1 (0.1)	246 (25.6)	<0.001
Toxicologic disease	6 (0.3)	4 (0.4)	2 (0.2)	0.35
Psychologic disease	7 (0.4)	5 (0.5)	2 (0.2)	0.06
Dispositions, n (%)				<0.001
Dead	19 (1.0)	3 (0.3)	16 (1.7)	0.002
Transferred to other facilities	79 (4.1)	55 (5.6)	24 (2.5)	<0.001
Discharged	587 (30.3)	352 (36.1)	235 (24.4)	<0.001
Admitted	1,252 (64.6)	566 (58.0)	686 (71.3)	<0.001

Table 3 Comparison of the EDLOS between the pre-COVID-19 pandemic and during COVID-19 pandemic

Variables	Pre-COVID-19 pandemic period	COVID-19 pandemic period	P value
EDLOS (hours), median (IQR)	3.5 (2.3–6.2)	4.6 (2.8–7.5)	<0.001

EDLOS, emergency department length of stay; IQR, interquartile range.

group [4.6 (IQR, 2.8–7.5) *vs.* 3.5 (IQR, 2.3–6.2) hours; P<0.001] (*Table 3*).

Factors affecting EDLOS of ≥4 hours in the pre-COVID-19 pandemic group and during COVID-19 pandemic group

The multiple regression analysis showed that spending ≥4 hours in the ED was 1.51 times more likely in the patients with pre-existing diabetes mellitus than in patients without diabetes mellitus [adjusted odds ratio (aOR) =1.51; 95% CI: 1.11–2.05); P=0.01]. Spending ≥4 hours at the ED was 1.48 times more likely in the patients who needed to consult an internal medicine physician than in the patients who did not (aOR =1.48; 95% CI: 1.12–1.95; P=0.01] (*Table 4*).

During the pandemic period, the results showed that the patients who visited the ER during the morning shift (08:00–16:00) were 1.6 times more likely to spend ≥4 hours at the ED than the patients who received services at other time periods (aOR =1.6; 95% CI: 1.23–2.08; P<0.001). The

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Table 4 Factors associated with EDLOS for 4 hours or more during the pre-COVID-19 pandemic

Variables	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	Adjusted OR (95% CI)	P value
ESI (2 *vs*. 1)	1.19 (0.81–1.75)	0.38	–	–
Age ≥60 years	1.55 (1.2–2)	<0.001	–	–
Female	0.98 (0.76–1.26)	0.86	–	–
Comorbidities				
Diabetes mellitus	1.63 (1.22–2.17)	<0.001	1.51 (1.11–2.05)	0.01
Hypertension	1.41 (1.09–1.84)	0.01	–	–
End stage kidney disease	1.29 (0.57–2.96)	0.54	–	–
Coronary artery disease	1.23 (0.79–1.92)	0.37	–	–
Cerebrovascular disease	0.62 (0.27–1.4)	0.25	–	–
COPD	0.78 (0.37–1.64)	0.51	–	–
Asthma	1.18 (0.53–2.66)	0.68	–	–
Cancer	1.23 (0.73–2.07)	0.43	–	–
Fast track activation	1.01 (0.76–1.34)	0.96	–	–
Visiting time				
Morning shift	1.27 (0.98–1.65)	0.08	–	–
X-ray examination	1.41 (1.08–1.84)	0.01	–	–
Computed tomography	0.97 (0.69–1.35)	0.84	–	–
Ultrasonography	0.78 (0.59–1.01)	0.06	–	–
Number of resources needed				
0	Reference			
1	1.36 (0.93–1.99)	0.12	–	–
≥2	1.41 (1–1.98)	0.05	–	–
Number of specialty consultation				
0	Reference			
1	1.08 (0.83–1.4)	0.58	–	–
≥2	1.55 (0.79–3.03)	0.2	–	–
Type of specialty consultation				
Cardiology	1.18 (0.17–8.41)	0.87	–	–
Neurosurgery	0.73 (0.24–2.26)	0.59	–	–
Pediatrics	0.58 (0.29–1.14)	0.11	–	–
Orthopedic surgery	0.55 (0.25–1.23)	0.14	–	–
Surgery	0.73 (0.45–1.16)	0.18	–	–
Internal medicine	1.59 (1.23–2.05)	<0.001	1.48 (1.12–1.95)	0.01

Table 4 *(continued)*

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Table 4 *(continued)*

Variables	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	Adjusted OR (95% CI)	P value
EDWIN score				
0–<1.5	0.9 (0.75–1.07)	0.24	–	–
1.5–2	1.12 (0.75–1.67)	0.59	–	–
>2	1.23 (0.9–1.68)	0.19	–	–
MEWS score	1.43 (0.98–2.09)	0.07	–	–
Diagnosis				
Coronary artery disease	1.15 (0.82–1.61)	0.42	–	–
Endocrinologic disease	0.93 (0.5–1.72)	0.82	–	–
Gastrointestinal disease	0.96 (0.64–1.43)	0.83	–	–
Urinary tract disease	1.59 (0.9–2.81)	0.11	–	–
Reproductive system disease	0.37 (0.16–0.82)	0.02	–	–
Infectious disease	0.9 (0.64–1.26)	0.53	–	–
Musculoskeletal disease	0.54 (0.31–0.95)	0.03	–	–
Neurological disease	1.13 (0.78–1.63)	0.53	–	–
Respiratory tract disease	1.15 (0.83–1.58)	0.41	–	–

EDLOS, emergency department length of stay; OR, odds ratio; CI, confidence interval; ESI, emergency severity index; COPD, chronic obstructive pulmonary disease; EDWIN, emergency department working index; MEWS, modified early warning score.

patients who needed X-rays were 1.8 times more likely to have an EDLOS ≥4 hours than the patients who did not need X-rays (aOR =1.8; 95% CI: 1.29–2.51; P<0.001). The patients diagnosed with COVID-19 were 1.38 times more likely to spend ≥4 hours in the ED than the patients who were not diagnosed with COVID-19 (aOR =1.38; 95% CI: 1.01–1.89; P=0.04) (*Table 5*).

Discussion

The median time spent in the ED for patients with ESI 1 and 2 was 4.2 (range, 2.4–7.4) hours. The EDLOS times were significantly different between the pre-COVID-19 and during COVID-19 pandemic groups. The time spent in the ED was longer in the during COVID-19 pandemic group than in the pre-COVID-19 pandemic group, which was consistent with previous research. showing that EDLOS during COVID-19 was 28 minutes longer than the median (6,7). Patients who had COVID-19 spent ≥4 hours in the ED, which was 1.38 times longer than the time spent by the patients who did not have COVID-19 (aOR =1.38; 95% CI: 1.01–1.89; P=0.04).

During the COVID-19 outbreak, the hospital followed a local guideline for critically ill patients diagnosed with COVID-19 requiring them to be treated in the negative pressure room of the ED. The treatments in the negative pressure room included aerosol-generating procedures which required all personnel to wear protective clothing before entering the treatment facility. A similar result from a tertiary care hospital in India found that COVID-19 positive patients who required oxygen therapy had the longest hospital stay (8). Additionally, those patients had to be admitted to an isolation ward with a limited number of beds, which may result in longer EDLOS.

Specialty consultation was associated with prolonged EDLOS, especially consultation with internal medicine department. This finding was emphasized by our study and correlated with the work by Yoon *et al.* which found that the effects of specialty consultation on length of stay prolongation were 9.6 hours for hematology, 4.3 hours for gastroenterology, and 4.2 hours for internal medicine (9). Moreover, our study found that the factors affecting

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Table 5 Factors associated with EDLOS for 4 hours or more during the COVID-19 pandemic

Variables	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	Adjusted OR (95% CI)	P value
ESI (2 *vs*. 1)	0.84 (0.62–1.13)	0.24	–	–
Age ≥60 years	1.34 (1.03–1.74)	0.03	–	–
Female	0.97 (0.75–1.25)	0.8	–	–
Comorbidities				
Diabetes mellitus	0.98 (0.75–1.29)	0.9	–	–
Hypertension	1.18 (0.91–1.53)	0.22	–	–
End stage kidney disease	0.73 (0.38–1.4)	0.35	–	–
Coronary artery disease	1.19 (0.71–1.98)	0.51	–	–
Cerebrovascular disease	0.92 (0.5–1.72)	0.8	–	–
COPD	0.6 (0.25–1.43)	0.25	–	–
Asthma	1.92 (0.75–4.91)	0.18	–	–
Cancer	0.99 (0.57–1.7)	0.96	–	–
Fast track activation	0.71 (0.54–0.93)	0.01	–	–
Service date				
Weekdays	Reference			
Public holidays	1.27 (0.97–1.68)	0.09	–	–
Visiting time				
Morning shift	1.64 (1.26–2.13)	<0.001	1.6 (1.23–2.08)	<0.001
X-ray examination	2.03 (1.48–2.79)	<0.001	1.8 (1.29–2.51)	<0.001
Computed tomography	0.97 (0.69–1.35)	0.84	–	–
Ultrasonography	1 (0.73–1.36)	0.98	–	–
Number of resources needed				
0	Reference			
1	1.36 (0.86–2.16)	0.19	–	–
≥2	1.88 (1.27–2.77)	0	–	–
Number of specialty consultation				
0	Reference			
1	1.36 (1–1.84)	0.05	–	–
≥2	1.07 (0.59–1.94)	0.82	–	–
Type of specialty consultation				
Cardiology	2.47 (0.69–8.93)	0.17	–	–
Neurosurgery	0.85 (0.38–1.88)	0.68	–	–
Pediatrics	0.46 (0.17–1.22)	0.12	–	–
Orthopedic surgery	0.66 (0.26–1.68)	0.39	–	–
Surgery	0.87 (0.49–1.54)	0.64	–	–
Internal medicine	1.55 (1.19–2.02)	<0.001	–	–

Table 5 *(continued)*

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Table 5 *(continued)*

Variables	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	Adjusted OR (95% CI)	P value
EDWIN score				
0–<1.5	–	–	–	–
1.5–2	0.73 (0.45–1.19)	0.21	–	–
>2	0.81 (0.46–1.42)	0.46	–	–
MEWS score	1.04 (0.71–1.52)	0.85	–	–
Diagnosis				
Coronary artery disease	1.19 (0.79–1.8)	0.41	–	–
Endocrinology disease	0.65 (0.37–1.14)	0.13	–	–
Gastrointestinal disease	0.69 (0.44–1.08)	0.11	–	–
Urinary tract disease	1.06 (0.51–2.21)	0.88	–	–
Reproductive system disease	0.58 (0.34–0.99)	0.05	–	–
Infectious disease	0.79 (0.49–1.25)	0.31	–	–
Musculoskeletal disease	1.42 (0.64–3.18)	0.39	–	–
Neurologic disease	0.77 (0.5–1.19)	0.25	–	–
Respiratory tract disease	1.46 (1.12–1.9)	0.01	–	–
COVID-19 infection	1.58 (1.16–2.14)	<0.001	1.38 (1.01–1.89)	0.04

EDLOS, emergency department length of stay; OR, odds ratio; CI, confidence interval; ESI, emergency severity index; COPD, chronic obstructive pulmonary disease; EDWIN, emergency department working index; MEWS, modified early warning score.

the time spent at the ED for ≥4 hours during the pre-COVID-19 pandemic were patients with pre-existing diabetes mellitus. This factor was influential because patients with diabetes often have other complications, such as heart failure or kidney failure, which may result in more time spent in laboratory testing. This finding is consistent with van der Veen *et al.*'s study, which found that two or more comorbidities caused patients to be in the ER for ≥4 hours (10).

Other factors associated with EDLOS ≥4 hours in the COVID-19 pandemic were visits to the ED during the morning shift, need to have X-rays, and COVID-19 diagnosis. During the COVID-19 pandemic, we found that patients who visited ER during the morning shift were associated with EDLOS ≥4 hours. The specific reasons for the longer EDLOS were that more specialty consultations and X-ray examinations during the daytime were required, which is consistent with the findings of a study by Lenghong and Chaou *et al.* (11,12).

In the present study, the patients in the during COVID-19 pandemic group who received X-ray examinations had an EDLOS ≥4 hours, in line with a study by van der Veen *et al.*, which found that X-ray examinations increased the duration of service at the ED and was consistent with the finding of Casalino *et al.* (10,13). In addition, the X-ray room of our hospital is far from the ED. Therefore, during the pandemic of COVID-19, patients had to be transported in a transfer stretcher with a negative pressure cover to prevent the spread of COVID-19. This process takes longer and increased the EDLOS during the COVID-19 pandemic. This finding suggests that the structure of healthcare facilities should be reorganized to improve the management of patient flow which may involve establishing a dedicated pathway for both COVID-19 and non-COVID-19 patients (14).

This study had several limitations. First, the outcomes of this study reflected from a single university hospital in Thailand. The flow of patients in ED may differ from those of other hospitals depending on the ED design, bed capacity, and local practices. Second, time stamps for each patient intervention were not recorded in our study. It would allow us to better understand which observation

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specifically had the greatest effect on lengthening EDLOS. Lastly, the aspect of human resources and staffing were not considered in this study. This may play a crucial role in managing patients in a timely manner. In the future, it is undeniable that the care of patients affected by COVID-19 and its complication will change significantly. Considering the changes in patients' quality of life, the persistence of symptoms, ongoing chronic lung problems, all of these factors would eventually impact the pattern of medical consultations and ED visits (15).

Conclusions

The median time in EDLOS at our 900-bed urban university hospital was 4.2 hours. Our results showed that EDLOS was longer during the COVID-19 pandemic period than in the pre-COVID-19 period. The factors associated with EDLOS ≥4 hours differed significantly between both COVID periods. The factors that affected EDLOS in the pre-COVID-19 period were the presence of diabetes mellitus and the need to consult internal medicine department. The factors that affected EDLOS during the COVID-19 pandemic were ER visits during the morning shift, the need for X-ray examination, and infection with COVID-19. In the future, guidelines for consulting specialists and for X-ray examinations should be developed.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jphe.amegroups.com/article/view/10.21037/jphe-23-105/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jphe.amegroups.com/article/view/10.21037/jphe-23-105/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was conducted with approval from the Institutional Review Board of Faculty of Medicine of Vajira Hospital, Navamindradhiraj University (COA 153/2563). Patients and the public were not involved in this research and individual consent for this retrospective analysis was waived.

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