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Delayed Pre-hospital Time in Acute Coronary Syndrome Patients and Associated Factors in a Hospital in Southern Thailand

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Abstract

Background: **Acute coronary syndrome (ACS) is currently the leading cause of morbidity and mortality worldwide. The prognosis of ACS treatment outcome depends on the speed of reperfusion after a heart attack; wherein, one of the associated factors is pre-hospital time.**

Method: **A retrospective study was conducted in ACS patients, who visited the emergency room of a tertiary hospital; from 1st January to 31st December 2020. The primary outcome was pre-hospital time; and secondary outcome was factors associated with delayed pre-hospital time (≥2 h) that were analyzed by using logistic regression.**

Results: **The Median age of patients was 64 years (Q1, Q3 = 56, 73), with 75.8% being male. The median pre-hospital time was 2.5 h (Q1, Q3 = 1.0, 6.0), 63.4% of acute coronary events were delayed pre-hospital time, and 90.1% of events were transported to the hospital by private car. The factors significantly associated with delayed pre-hospital time consisted of adult patients [OR (95%CI) = 2.20 (1.05−4.61)], events occurring on weekdays [OR (95%CI) = 2.08 (1.04−4.14)] and inside their home [OR (95%CI) = 5.01 (1.67−15.06)], final diagnosis with NSTEMI [OR (95%CI) = 2.74 (1.24−6.05)], and taking isosorbide in previously diagnosed MI patients [OR (95%CI) = 4.32 (1.42−13.17)].**

Conclusion: **Patients with ACS still delayed seeking treatment, and underutilized emergency medical service systems. Interventions to increase awareness and knowledge of ACS is required to improve the treatment outcomes of ACS patients.**

Keywords: Acute coronary syndrome, Myocardial infarction, Pre-hospital time, Thailand

1. Introduction

Currently acute coronary syndromes (ACS) are the leading cause of morbidity and mortality worldwide; including in Thailand [1]. ACS can be divided into 3 groups, these being: ST-elevate myocardial infarction (STEMI), non ST-elevate myocardial infarction (NSTEMI) and unstable angina (UA). Clinical practice guidelines in management of ACS [2] suggest providing reperfusion therapy for all STEMI patients with a duration symptoms of ischemia ≤12 h; which consists of primary percutaneous intervention (PCI) or fibrinolytic agents. Choosing a treatment method depends on the hospital's capabilities, and the period before receiving primary PCI; both treatment methods were not difference in efficacy; if providing to STEMI patients within 3 h [2]. If STEMI patients receive reperfusion therapy within 1 h, survival rates rise up to 50%; however, if they receive it within 3 h, the survival rate decreases to 23% [2,3]. For NSTEMI and unstable angina, the treatment options are divided into 2 groups, according to risk for the patients. For the high-risk group, patients require urgent revascularization to reduce cardiovascular death and recurrent ischemic events; while low-risk patients should receive dual antiplatelet therapy within 24 h.

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Due to treatment results being dependent on total ischemic time many hospitals; including Songklanagarind hospital, utilize the STEMI fast track; which has been significantly associated with shortening of "STEMI diagnosis to fibrinolysis or wire crossing time" [4]. However, the mortality rate of ACS is still high [1], because pre-hospital time is one factor associated with total ischemic time of the cardiac muscles [3,5,6]. Previous studies have shown that reducing pre-hospital time is associated with better heart function [2]; conversely, delays in seeking treatment increases the mortality rate, risk of ACS complications and treatment complications [7].

Pre-hospital time is the time period between the onset of symptoms until arriving for care at the emergency room (ER) for ACS patients. The median pre-hospital time is diverse in each country; such as, 2.4 h in Australia and New Zealand [8], 2.3 h in China [7], and 2.2 h in Malaysia [9]. Additionally, the outbreak of COVID-19 has resulted in a significant increase of pre-hospital time, due to the patients fear of expose to COVID-19, or the added workload to the healthcare system [10]. Many factors were found to be significantly associated with longer pre-hospital times; such as, increasing of age [3,5,8,11−15], female gender [3,9,13,15], arriving at the hospital by private transportation (when compared with using an ambulance) [6,8,14−17], lack of health insurance [16,17], occurring ACS when staying at home [9,18] and atypical presentations [5,9,11]. On the other hand, diagnosis of STEMI (when compared with NSTEMI or UA) was associated with a shorter pre-hospital time [17,18]. Although, there have been a few studies conducted concerning this topic in Thailand [19], there has never been a study from Songklanagarind hospital; which utilizes STEMI fast track, and is a heart excellence center. Hence, this study was conducted to investigate pre-hospital time in ACS patients, who visited the ER of a tertiary hospital; with the secondary objective being to identify associated factors.

2. Methods

2.1. Study design

A retrospective study was conducted from 1st January to 31st December 2020; at the ER of Songklanagarind hospital, Songkhla, Thailand; this being a tertiary care hospital in Southern Thailand.

2.2. Study sample and sampling

This paper included all patients age ≥15 years old who visited the ER of Songklanagarind hospital during the study period with symptoms suspected of ACS [ICD-10 code of unstable angina (I20), acute myocardial infarction (MI) (I21), subsequent MI (I22), certain current complications following acute MI (I23), precordial pain (R07.2), other chest pain (R07.3), unspecified chest pain (R07.4), and epigastric pain (R10.1)]; and those who were finally diagnosed by an internist with ACS. This paper excluded medical records that did not mention pre-hospital periods, patients who were diagnosed with secondary MI, and those who were referred from another hospital. The sample size was calculated based on both the objectives of this study. For the first objective, we used an infinite population mean formula; which was $n = (Z^2sd^2)/d^2 = 178$; with mean ± S.D. of pre-hospital time from a previous study [19] being 294 ± 307 min and d (error) of 45 min. For the second objective, to find the factors associated with delayed pre-hospital time, we used G power (version 3.1.9.4) that chooses the odd ratio (OR) of significant factors from a previous study [9] which are OR = 4.00 for female gender, OR = 3.84 for atypical presentation and OR = 0.20 for occurring heart attack at public places (when compared with home); the maximum value was 245 patients. This study enrolled all patients who were compatible with our eligibility criteria.

2.3. Variables

The dependent variable was pre-hospital time; for answering of the secondary objective of associated factors, we categorized patients into 2 groups: these being delayed pre-hospital time compared with early pre-hospital time (≥2 h Vs < 2 h). The cutoff point of 2 h comes from the guidelines recommend for the same efficacy of both reperfusion therapies; if total ischemic time <3 h [2]. We then reserved 1 h for system delay's in our hospital, which should be less than 90 min in hospitals that can perform primary PCI. Independent variables were selected from the significance factors of a previous studies (age, gender, smoking status, marital status, type of underlying disease, time of symptom onset, presenting symptoms, transportation and final diagnosis); then we added 2 factors that we expected to have an association with delayed pre-hospital time; these being days of symptom onset and taking isosorbide dinitrate (ISDN) before going to the ER.

2.4. Data collection

The details of the medical records of each ACS visit were reviewed from the hospital information system, then we recorded pre-hospital time and

related factors in case record form. All researchers were trained in the meaning of each question before collecting the data.

2.5. Data management and analysis

The data was entered in Epidata (version 3.1, Denmark), with double entry basis, and analyzed using the R program (R Core Team 2021, Vienna, Austria). We analyzed the data of visits by treating each visit as an independent visit. Sociodemographic characteristics and details of acute coronary events were analyzed using descriptive analysis; categorical data are presented in terms of number (percentage), and continuous data were presented in median (Q1, Q3) when normal distribution assumption was not met. The basis of patient characteristics and acute coronary event data were compared between the 2 groups by Chi-square or Fisher's exact test. The associated factors with delayed pre-hospital time were identified by logistic regression analysis; with model variables in the final model obtained from AIC values in a backward stepwise algorithm. Then we conducted subgroup analysis in ACS patients with underlying old MI; the final model was completed by AIC in a backward stepwise algorithm, as before. Statistical significance was considered as a p-value < 0.05.

2.6. Ethics statement

The study protocol was approved by the Office of Human Research Ethics Committee (HREC), Prince of Songkla University (REC 63-369-9-1). Informed consent forms were not required, due to the retrospective medical record review study design.

3. Results

There were 273 visits, from 257 patients with ACS in this study. Baseline characteristics are shown in Table 1. Median age was 64 years (Q1, Q3 = 56, 73), and three-quarters were male. Most of them were in a relationship, had health insurance, were current smokers and had some underlying diseases. The most common underlying disease was hypertension, and nearly half of those that visited had previous history of MI.

The median (Q1, Q3) pre-hospital time was 2.5 h (1.0, 6.0); the distribution of pre-hospital time in acute coronary events that visited the ER within 1 day are shown in Fig. 1. Clinical characteristics of acute coronary events are shown in Table 2. Approximately, three quarters of acute coronary events occurred at a different time during weekdays, and these occurred within their residence. Most patients presented with pain; especially chest pain typical of ACS, and were transported to the ER by private car. Nearly one half of patients with underlying old MI took ISDN sublingual before going to the ER; and about one half of their visits were finally diagnosed with NSTEMI.

Table 1. Sociodemographic characteristics of participants (n = 273 visits).

Characteristic	number (%)
Age (years) [median (Q1-Q3) = 64 (56−73)]	
≥60	181 (66.3)
<60	92 (33.7)
Gender	
Male	207 (75.8)
Female	66 (24.2)
Marital status	
Couple	236 (86.4)
Single/Widow/Divorced	37 (13.6)
Health insurance	
Government Or State Enterprise Officer	171 (62.6)
Universal Coverage Scheme (Other hospital)	53 (19.4)
Universal Coverage Scheme (PSU)	26 (9.5)
Social Security Scheme (PSU)	10 (3.7)
Cash	9 (3.3)
Social Security Scheme (Other hospital)	4 (1.5)
Current smoking[a]	
Yes	193 (70.7)
No	65 (23.8)
NA	15 (5.5)
Underlying disease	
Yes	239 (87.5)
No	34 (12.5)
Type of underlying disease	
Hypertension	163 (59.7)
Old myocardial infarction	125 (45.8)
History of percutaneous coronary intervention	72 (57.6)
History of coronary artery bypass surgery	17 (13.6)
Dyslipidemia	115 (42.1)
Diabetes mellitus	94 (34.4)

[a] Current smoking: still smoking on the day of occurring acute coronary syndrome.

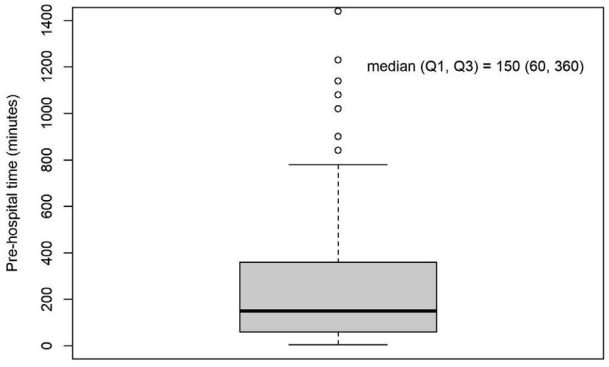

Fig. 1. Distribution of pre-hospital time (minutes) in patients who visited the emergency room within 1 day.

Table 2. Clinical characteristics of acute coronary events (n = 273 visits).

Clinical characteristics	number (%)
Days of symptom onset	
Weekdays	198 (72.5)
Weekend	64 (23.5)
Holidays	11 (4.0)
Time of symptom onset	
12.00 A.M.−05.59 A.M.	60 (22.0)
06.00 A.M.−11.59 A.M.	84 (30.8)
12.00 P.M.−05.59 P.M.	54 (19.8)
06.00 P.M.−11.59 P.M.	75 (27.4)
Place of symptom onset	
Home	215 (78.8)
Hospital	14 (5.1)
Vehicles	11 (4.0)
Workplace	3 (1.1)
Department store	2 (0.7)
NA	28 (10.3)
Symptom of onset	
Pain	253 (92.7)
Location of pain	
Midsternal	160 (63.2)
Midsternal radiate to left neck, shoulder, or arm	74 (29.3)
Epigastric pain	17 (6.7)
Left jaw	1 (0.4)
Left neck	1 (0.4)
Nature of pain/discomfort	
Pressure	220 (86.9)
Burning	11 (4.3)
Squeezing	6 (2.4)
Stabbing	6 (2.4)
Shooting	4 (1.6)
NA	6 (2.4)
Non-pain[a]	20 (7.3)
Taking isosorbide sublingual before going to emergency room [b] (n = 125)	
Yes	57 (45.6)
No	54 (43.2)
NA	14 (11.2)
Transportation to emergency room	
Private car	246 (90.1)
Ambulance	23 (8.4)
NA	4 (1.5)
Final diagnosis	
STEMI	72 (26.4)
NSTEMI	136 (49.8)
Unstable angina	65 (23.8)

[a] Non-pain included: dyspnea, nausea or vomiting, confusion, syncope and cardiac arrest.
[b] Only visits that had history of old myocardial infarction.

Approximately, 63.4% of acute coronary events (173/273 events) were in the delayed pre-hospital time group. Table 3 shows pre-hospital time and comparison between the early and delayed pre-hospital time groups, according to sociodemographic and clinical characteristics of acute coronary events. Events that occurred at home, and with the use of ISDN before go to the ER in patients with underlying old MI were significantly associated with delayed pre-hospital times (p-value < 0.001 and 0.028, respectively). Logistic regression of factors associated with delayed pre-hospital time in acute coronary events is shown in Table 4. The factors which were significantly associated with delayed pre-hospital time consisted of: adult patients (when compared with elderly patients) [OR (95%CI) = 2.20 (1.05−4.61)], occurring ACS on weekdays (when compared with weekends or holidays) [OR (95% CI) = 2.08 (1.04−4.14)], have heart attack at their home [OR (95%CI) = 5.01 (1.67−15.06)]; and final diagnosis with NSTEMI (when compared with STEMI) [OR (95%CI) = 2.74 (1.24−6.05)]. Table 5 show logistic regression of factors associated with delayed pre-hospital time in the subgroup of patients with underlying old MI. The factors that were significantly associated with delayed pre-hospital time were the same as in all acute coronary events; these being: adult patients [OR (95%CI) = 5.32 (1.27−22.24)], ACS occurring on weekdays [OR (95% CI) = 5.46 (1.61−18.59)], occurring in their home [OR (95%CI) = 13.52 (2.35−77.58)], and final diagnosis with NSTEMI [OR (95%CI) = 27.85 (3.14−247.42)] or UA [OR (95%CI) = 13.29 (1.73−101.92)] when compared with STEMI. The adding of one, associated factor in the old MI group was taking ISDN before going to the ER [OR (95%CI) = 4.32 (1.42−13.17)].

4. Discussion

ACS patients still had longer pre-hospital time and a large number arrived at the hospital by themselves; this may increase morbidity and mortality. Many factors were significantly associated with delayed pre-hospital time; consisting of: adult patients, events occurring on weekdays and at home, final diagnosis with NSTEMI or UA, and taking ISDN in previously diagnosed MI patients.

Most of the participants in our study were elderly and male, which is consistent with another study [11]. This may be because, ACS is an atherosclerotic process and estrogen in women has vasoprotective effects [20]. In addition, almost all of the patients had health insurance, so these ACS patients can access the hospital without concern in regards to medical expenses; which is one of the reasons some patients delay visiting the hospital [8,14,16,17].

The median of pre-hospital time in ACS patients in this study was 2.5 h, this is close to the results of previous studies in several countries; such as, Australia and New Zealand [8], Italy [12], the USA [14], China [7], Korea [6], Malaysia [9], and Bangkok, Thailand [19]. The delayed pre-hospital time may be due to patients lack of knowledge in ACS [19]; and

Table 3. Pre-hospital time and comparison between early (<2 h) and delayed (≥2 h) pre-hospital time groups; according to sociodemographic and clinical characteristics (n = 273 visits).

Characteristic	Pre-hospital time Median (Q1 - Q3) (minutes)	Delayed pre-hospital time[a]		
		No (n = 100) number (%)	Yes (n = 173) number (%)	p-value[b]
Age (years)				
≥60	150 (60−360)	67 (67.0)	114 (65.9)	0.958
<60	180 (60−360)	33 (33.0)	59 (34.1)	
Gender				
Male	180 (60−360)	76 (76.0)	131 (75.7)	1.000
Female	120 (60−345)	24 (24.0)	42 (24.3)	
Marital status				
Couple	60 (150−315)	90 (90.0)	146 (84.4)	0.192
Single/Widow/Divorced	90 (240−540)	10 (10.0)	27 (15.6)	
Type of underlying disease				
Hypertension	180 (60−360)	59 (59.0)	104 (60.1)	0.856
Old myocardial infarction	180 (60−360)	43 (43.0)	82 (47.4)	0.482
Dyslipidemia	150 (60−360)	46 (46.0)	69 (39.9)	0.324
Diabetes mellitus	180 (60−300)	31 (31.0)	63 (36.4)	0.364
Days of symptom onset				
Weekend/Holidays	120 (60−360)	31 (31.0)	44 (25.4)	0.394
Weekdays	180 (60−360)	69 (69.0)	129 (74.6)	
Time of symptom onset				0.676
12.00 A.M.−05.59 A.M.	240 (60−540)	18 (18.0)	42 (24.3)	
06.00 A.M.−11.59 A.M.	120 (60−270)	33 (33.0)	51 (29.5)	
12.00 P.M.−05.59 P.M.	150 (60−240)	21 (21.0)	33 (19.1)	
06.00 P.M.−11.59 P.M.	150 (60−390)	28 (28.0)	47 (27.2)	
Place of symptom onset (n=245)				
Non-home[c]	60 (30−120)	21 (23.3)	9 (5.8)	<0.001[f]
Home	180 (60−420)	69 (76.7)	146 (94.2)	
Symptom of onset				
Typical presentation of ACS[d]	150 (60,360)	86 (86.0)	148 (85.5)	1.000
Atypical presentation of ACS[e]	180 (60,330)	14 (14.0)	25 (14.5)	
Taking ISDN before going to emergency room (n=111)				0.028[f]
Yes	180 (90−360)	15 (37.5)	42 (59.2)	
No	150 (60−300)	25 (62.5)	29 (40.8)	
Transportation to emergency room (n=269)				
Private car	180 (60−360)	88 (91.7)	158 (91.3)	1.000
Ambulance	120 (60−315)	8 (8.3)	15 (8.7)	
Final diagnosis				0.410
STEMI	120 (60−240)	31 (31.0)	41 (23.7)	
NSTEMI	180 (60−360)	46 (46.0)	90 (52.0)	
Unstable angina	180 (60−480)	23 (23.0)	42 (24.3)	

ACS = acute coronary syndrome, ISDN = isosorbide dinitrate, STEMI = non ST-elevate myocardial infarction, NSTEMI = non ST-elevate myocardial infarction.

[a] Delayed pre-hospital time: pre-hospital time ≥2 h.

[b] Chi-squared test.

[c] Non-home: hospital, vehicles, work place, department store.

[d] Typical presentation of ACS: midsternal pain with or without radiate to left neck, shoulder or arm.

[e] Atypical presentation of ACS: epigastric pain, jaw or neck pain and non-pain (dyspnea, nausea or vomiting, confusion, syncope and cardiac arrest).

[f] p-value < 0.05.

during the study period the first occurrence of the pandemic (COVID-19) was happening in Thailand. As a result, ACS patients were hesitant to visit the hospital, due to fear of being infected with COVID-19, or adding to the workload of the healthcare system during the outbreak of COVID-19 [10]. Regarding the Thai ACS guidance's of 2020 [2]: STEMI patients who had total ischemic time less than 3 h should either be treated with primary PCI or fibrinolytic agents; with no difference in efficacy. If our participants were diagnosed with STEMI, about one third of them were able to receive both treatment options, at the same efficacy. This point is important in hospitals which have no capacity to perform primary PCI. In addition to lesser efficacy from receiving fibrinolytic agents of more than 3 h

Table 4. Logistic regression of factors associated with delayed pre-hospital time in acute coronary events (n = 189 visits).

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)	P(Wald's test)	P(LR-test)
Age (years)				
<60	1.73 (0.88−3.39)	2.20 (1.05−4.61)	0.037[b]	0.031[b]
Days of symptom onset				
Weekend/Holidays	1	1		
Weekdays	1.65 (0.87−3.16)	2.08 (1.04−4.14)	0.038[b]	0.038[b]
Place of symptom onset				
Non-home[a]	1	1		
Home	3.14 (1.16−8.54)	5.01 (1.67−15.06)	0.004[b]	0.003[b]
Final diagnosis				
STEMI	1	1		0.038[b]
NSTEMI	2.27 (1.08−4.78)	2.74 (1.24−6.05)	0.013[b]	
Unstable angina	2.23 (0.95−5.24)	2.35 (0.96−5.75)	0.061	

ISDN = isosorbide dinitrate, STEMI = non ST-elevate myocardial infarction, NSTEMI = non ST-elevate myocardial infarction.
[a] Non-home: hospital, vehicles, work place, department store.
[b] p-value < 0.05.

Table 5. Logistic regression of factors associated with delayed pre-hospital time in patients with old myocardial infarction (n = 94 visits).

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)	P(Wald's test)	P(LR-test)
Age (years)				
<60	1.44 (0.55−3.75)	5.32 (1.27−22.24)	0.022[b]	0.012[b]
Days of symptom onset				
Weekend/Holidays	1	1		
Weekdays	2.34 (0.89−6.15)	5.46 (1.61−18.59)	0.007[b]	0.005[b]
Place of symptom onset				
Non-home[a]	1	1		
Home	3.38 (0.98−11.72)	13.52 (2.35−77.58)	0.003[b]	0.002[b]
Final diagnosis				
STEMI	1	1		0.004[b]
NSTEMI	4.80 (1.06−21.75)	27.85 (3.14−247.42)	0.003[b]	
Unstable angina	4.80 (1.00−23.07)	13.29 (1.73−101.92)	0.013[b]	
Taking ISDN before going to emergency room	3.06 (1.22−7.68)	4.32 (1.42−13.17)	0.01[b]	0.006[b]

ISDN = isosorbide dinitrate, STEMI = non ST-elevate myocardial infarction, NSTEMI = non ST-elevate myocardial infarction.
[a] Non-home: hospital, vehicles, work place, department store.
[b] p-value < 0.05.

after onset, another point that is of concern is the referral time to better equipped hospitals for the administration of primary or rescued PCI.

Approximately three-quarters of patients had a heart attack while staying at home; similar to previous studies [6,16]. It may be due to more than half of our participants being retirees, had a heart attack in the evening or at night, and possibly due to the outbreak of COVID-19 during the study period; which may have increased the chances of the participants being at home. Most patients went to the ER with pain symptoms; especially pressure sensation at the midsternal area, with or without refer to left neck/shoulder/arm, which is a typical presentation of ACS. This is similar to previous studies [5,7]. This can cause patients to expedite their visit to the hospital, because they suspect the symptom to be a cardiac condition; according to health education regarding ACS in public campaigns. Most patients were transported to the ER by private vehicles; which is consistent with previous studies [7,19]. Using an ambulance was significantly associated with shorter pre-hospital time [6,8,14−17], by reducing the time of liaising with other medical personnel whilst transporting the patient to the hospital. Transportation via private vehicle to the hospital might be caused by the patient's preference, in that it is more convenient and reflects a lack in knowledge in early ACS management. In addition, it may be caused by patient fear of contact with health-care providers in the ambulance, or not wanting to add to the workload of the healthcare system during the outbreak of COVID-19 [10].

Our study found four factors that were significantly associated with delayed pre-hospital time in ACS patients; including in the old MI subgroup. Firstly, adult patients were significantly associated with delay presentation when compared with the elderly group; this result is contrary to previous studies [3,5,8,11−15]. It may be due to prevalence of

comorbid diseases, which are risk factors of cardiovascular disease (hypertension, diabetes mellitus or dyslipidemia) in our study were significant increasing with age [OR (95% CI) = 1.03 (1.01−1.05), p-value = 0.023]. The lesser comorbidities in younger adults may result in a lesser chance of receiving education from health care providers when conducting follow ups of chronic diseases, and they may pay little attention to public health media concerning ACS; therefore, they underestimate the risk of being ACS, and do not have adequate knowledge of ACS. Secondly, acute coronary events that occurred on weekdays were significantly associated with delayed pre-hospital time when compared with weekends or holidays. From the results the majority of our participants were elderly and transported to hospital by private car; additionally, elderly, Thai patients like to call their offspring to bring them to the hospital when they had abnormal symptoms. The delay in the weekday group may be due to their offspring needing to work; whereas, they can transport these patients to the hospital early on the weekend or during holidays. Thirdly, acute coronary events that occurred within the home were significantly associated with delayed pre-hospital time, the same as in previous studies [9,18]. Lastly, patients who had final diagnosis of NSTEMI or UA were significantly associated with delayed pre-hospital time; this is in accordance with previous studies [17,18]. This may be explained by the patients in our study, who had a final diagnosis of NSTEMI or UA, had underlying old MI significantly higher than the STEMI group [OR (95%CI) = 3.41 (1.87−6.23), p-value < 0.001]; wherein, collateral vessels in old MI patients helps decrease the severity of symptoms, resulting in delayed pre-hospital time. Nearly half of the patients with underlying old MI took ISDN before going to the ER. This was an additional factor that was significantly associated with delayed pre-hospital time in the old MI subgroup, which was the same as in previous study [11]. It may be due to these patients having had an experience wherein their symptoms could be relieved by taking ISDN; therefore, they take a 'wait and see' approach, instead of rushing off to hospital.

This is one of the few studies in Thailand that evaluated pre-hospital time in ACS patients. In addition, we included a new factor that had never been studied before: this being days of symptom onset. However, our study had some limitations. Firstly, the retrospective medical review study design caused a lack in some of the important data. For example; the reasons to delay in coming to the hospital for developing intervention; such as, thinking that it is unlikely to be harmful. Additionally, factors which may influence pre-hospital time; such as, the distance between the scene and hospital were missing. Secondly, this study was conducted in the ER of a tertiary care hospital; so the results may not be applicable to other hospital settings.

5. Conclusion

Patients with ACS still delayed in seeking treatment, and underutilized EMS systems. Adult patients, events occurring on weekdays and at home, final diagnosis with NSTEMI or UA, and taking ISDN in old MI patients were significantly associated with delayed pre-hospital time. Therefore, it is time to apply public education regarding ACS to the population for improved awareness and knowledge of ACS.

5.1. Recommendations

For improvement in pre-hospital time, public health systems should raise the awareness and knowledge of ACS for patients; such as, clinical manifestation of ACS to include atypical presentations. Additionally, informing patients that if they experience or suspect of having ACS, then they should not hesitate to call an ambulance immediately, for transportation to the hospital. We also suggest another way to education patients, apart from further health education in high risk populations within the hospital, is via public education; such as, using medical media to the general population, because everyone can be an ACS patient or rescuer of an ACS patient. Furthermore, physicians should also emphasize the limitations of taking ISDN in ACS patients, because it can lead to prolonged pre-hospital time [11]. In addition, each health care setting should develop appropriate protocols, in order to provide reperfusion therapy to ACS as quickly as possible. For clinical application; cutoff point of delayed pre-hospital time should be adjusted for each hospital setting; such as, the capacity to provide primary PCI or referral time to better equipped hospitals. For further research, we suggest a cross-sectional study design to assess some important data which may be associated with pre-hospital time; including, distance between scene and hospital, reasons for the delay in going to the hospital as well as choice of transportation to the emergency room when suffering a heart attack. In addition, we suggest increasing the sample size, so as to increase the statistical power of the study; and extend the study setting to other settings. This is especially for hospitals that cannot provide specific

treatment of ACS, and require time to refer patients to more capable hospitals.

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Declaration of competing interest

None.

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