Research Article **AJCRAR (2021) 4:15**

American Journal of Cardiology Research and Reviews
(ISSN:2637-4935)

The Relationship between Administrative Factors and Effectiveness of ST-segment Elevation Myocardial Infarction Referral system among Thai Hospitals

Kitigon Vichairuangthum M.D. [1,2,3], Pisamai Jarujittipant Ph.D.[1], Kietchai Veerayannon Ph.D.[1]

[1] Management Program, Faculty of Political Science, North Bangkok University, Thailand. [2] Division of Cardiovascular disease, Royal Heart Center, Huahin Hospital, Phrachuap Khiri Khan, Thailand.[3] Division of Cardiovascular disease, Royal Heart Center, Suranaree university of Technology Hospital, Nakhon Ratchasima, Thailand.

ABSTRACT

Background: This descriptive study aimed to study the relationship between administrative factors and the effectiveness of the referral system of patients with acute ischemic heart disease in Thai hospitals. **Materials and methods:** The target population was 1,180 hospitals that serving heart disease in Thailand. Data were collected by using a questionnaire. A total of 1,022 response data were obtained. Administrative factors were analyzed using descriptive statistics, and the relationship was analyzed using multiple regression analysis (MRA) methods. **Results:** The study showed that the administrative factors which consisted of personnel, finance, supporting, and management factors had overall average readiness at a high level ($\bar{x}$ = 3.34, S.D. = 0.27). Except budget sufficiency was at a low level ($\bar{x}$ = 2.43, S.D. = 0.43). All factors were related to the mortality rate significantly, as follows: management factor (Adjusted R2 = 0.433), personnel factor (Adjusted R2 = 0.231), supporting factor (Adjusted R2 = 0.092) and financial factor (Adjusted R2 = 0.035). All factors were also significantly related to the timely cardiac catheterization rate, as follows: management factor (Adjusted R2 = 0.442), personnel factor (Adjusted R2 = 0.244), supporting factor (Adjusted R2 = 0.212) and financial factor (Adjusted R2 = 0.091). **Conclusion:** Thai Ministry of Public Health should provide adequate support for administrative factors, especially in terms of management, personnel, supporting factors, and budget sufficiency.

Keywords: Administrative Factors, Effectiveness, ST segment elevation myocardial infarction, Referral system, Thailand

***Correspondence to Author:**
Kitigon Vichairuangthum M.D., Management Program, Faculty of Political Science, North Bangkok University, Thailand.

How to cite this article:
Kitigon Vichairuangthum, Pisamai Jarujittipant, Kietchai Veerayannon. The Relationship between Administrative Factors and Effectiveness of ST-segment Elevation Myocardial Infarction Referral system among Thai Hospitals. American Journal of Cardiology Research and Reviews, 2021, 4:15.

eSciPub LLC, Houston, TX USA.
Website: https://escipub.com/

Introduction

Coronary heart disease is an acute life-threatening emergency and a major public health problem in the world and Thailand. According to statistics from the World Health Organization (WHO) in 2012, there were 7.4 million deaths worldwide from ischemic heart disease or 12.2% of all causes of death. In 2018, the number of deaths from coronary heart disease rose to 17.9 million, accounting for 31 % of the world's causes of death [1]. While data from the Thai Ministry of Public Health found that Thailand in 2017, the rate of death from coronary heart disease were 31.8 per 100,000 population, an increase from 2012, which had a mortality rate of only 23.45 per 100,000 population [2], which is a trend of increasing deaths from heart disease.

Acute ischemic heart disease is caused by a condition in which blood clots occlude in the coronary artery. This results in myocardial infarction, often presenting with immediate symptoms. Especially if abnormal electrocardiogram (ECG) abnormalities are found in the ST segment raised at least 2 contiguous leads, which is specifically called ST-Elevation Myocardial Infarction (STEMI) [3]. If the occluded artery is not opened in a short time, there will cause a chance of sudden death [4]. Treatment according to the guidelines of the European Heart Association 2017 edition [5] and the Heart Association of Thailand 2020 edition [3] have determined that this group of patients should receive coronary artery catheterization (Percutaneous Coronary Intervention; PCI) within 120 minutes [6], as if treated later than that time myocardial muscle may cause permanent injury and death [7-9]. Because most hospitals in Thailand do not currently have cardiac catheterization rooms especially in rural areas so an effective referral system is therefore very important. The Thai Ministry of Public Health divided the area of responsibility of the cardiac referral system into 13 health service areas according to the criteria of the Thai National Health Security Office (NHSO) [10] as shown in table 1, In 2018, the overall mortality rate of patients with acute STEMI was 9.84 %, even passing the Key Performance Index (KPI) target (less than 10 %), but still very high and tends to be higher from 2017, which found a mortality rate of 9.63 %. In 2018, there were nearly half (6 areas) of all service areas still experienced a higher mortality rate than the criteria (area 2; 10.94 %, area 3; 10.27 %, area 4; 12.79 %, area 5; 11.99 %, area 9; 11.72 %, area 10; 13.07%). According to the NHSO ‘s KPI goal of receiving treatment by Primary PCI within 120 minutes, more than 50 % as criteria. But in 2017, the overall timely catheterization rate of patients with acute STEMI was only 30 %.

The referral system for acute STEMI patients cannot operate effectively without the readiness of administrative factors including Personnel (Man), Finance (Money), Supporting factor (Material), and Management (Method), which are critical factors. Methodical management of these resource utilization ensures efficient and effective work [12-14]. The above data reflects the problems and research questions of referral system for patients with acute STEMI of hospitals in Thailand, Is there an administrative factors readiness? And what administrative factors affect the effectiveness of the mortality and timely cardiac catheterization rate of the acute STEMI referral system of hospitals in Thailand? The study results as a guideline for the development and improves the referral system for acute STEMI patients in Thailand.

Materials and methods

Study Design and Population

This research was a correlation study conducted for 3 months from October to December 2020. The research population is 1,180 hospitals under the Ministry of Public Health and private hospitals that are cardiology service units in Thailand.

Objectives

1. To study the current readiness of the administrative factors of the referral system

of patients with acute STEMI patients in Thai hospitals.

2. To study the administrative factors that affect the effectiveness of acute STEMI patients in Thai hospitals.

Data Collection and Analysis

Data collection

This research was a descriptive, correlation study. The questionnaire was used as closed-end questions with a 5-level rating scale on the readiness of administrative factors of personnel, finance, supporting factor, and management. By designating the hospital directors to be the representative of the hospitals. Secondary data during 2018-2019 on the mortality and timely cardiac catheterization rate of acute STEMI patients was collected from the report of the Thai Ministry of Health.

Table 1 Health service areas as specified by the National Health Security Office (NHSO).

Health service area	Provinces in responsibility
Area 1 Chiang Mai	Chiang Mai, Chiang Rai, Phayao, Mae Hong Son, Lampang, Lamphun, Phrae, Nan
Area 2 Phitsanulok	Phitsanulok, Tak, Phetchabun, Sukhothai, Uttaradit
Area 3 Nakhon Sawan	Nakhon Sawan, Kamphaeng Phet, Chai Nat, Phichit, Uthai Thani
Area 4 Saraburi	Saraburi, Ayutthaya, Lopburi, Sing Buri, Ang Thong, Pathum Thani, Nonthaburi, Nakhon Nayok
Area 5 Ratchaburi	Ratchaburi, Kanchanaburi, Prachuap Khiri Khan, Phetchaburi, Samut Songkhram, Nakhon Pathom, Suphanburi, Samut Sakhon
Area 6 Rayong	Rayong, Chanthaburi, Chachoengsao, Chonburi, Trat, Sa Kaeo, Prachinburi, Samut Prakan
Area 7 Khon Kaen	Khon Kaen, Kalasin, Maha Sarakham, Roi Et
Area 8 Udon Thani	Udon Thani, Sakon Nakhon, Nakhon Phanom, Nong Khai, Nong Bua Lam Phu, Loei, Bueng Kan
Area 9 Nakhon Ratchasima	Nakhon Ratchasima, Chaiyaphum, Buriram, Surin
Area 10 Ubon Ratchathani	Ubon Ratchathani, Mukdahan, Yasothon, Si Saket, Amnat Charoen
Area 11 Suratthani	Suratthani, Krabi, Chumphon, Nakhon Si Thammarat, Phangnga, Phuket, Ranong
Area 12 Songkhla	Songkhla, Trang, Narathiwat, Pattani, Phatthalung, Yala, Satun
Area 13 Bangkok	Bangkok

Source: National Health Security Office Ministry of Public Health. 2016: pages 40-45.

Data Analysis

Data was entered into excel version 13 and was analyzed using SPSS 25 according to the objectives as follows:

Objective 1 Study the current readiness of the administrative factors of the referral system of patients with acute STEMI patients in Thai hospitals by content analyzing with descriptive statistics, frequency, percentage, mean ($\bar{x}$) and standard deviation (S.D.) determine the criteria to analyze the mean of opinions ($\bar{x}$ range 4.21 - 5.00 means the highest level of readiness, $\bar{x}$ range 3.41 - 4.20 means a high level of readiness, $\bar{x}$ range 2.61 – 3.40 mean moderate

readiness, $\bar{x}$ range 1.81 – 2.60 mean low readiness, and $\bar{x}$ range 1.00 – 1.80 mean the lowest readiness) .The mortality and timely cardiac catheterization rate of patients with acute STEMI are presented by descriptive statistics, frequency, and percentage.

Objective 2 Study of administrative factors affecting mortality rate and timely cardiac catheterization rate of patients with acute STEMI of hospitals in Thailand by using Multiple Regression Analysis methods (MRA).

Results

From the analysis of opinions about the level of readiness in personnel, finance, supporting, and management factors from the director of hospitals in Thailand by questionnaire to all 1,180 hospitals, a total of 1,022 responses was obtained. It was found that most of the participants were male (98.7 %) and had an average age of over 50 years (46.1 %). 88.5% were specialist doctors. 41.6% have work experience in 6-15 years, as table 2.

Table 2 Number and percentage of the baseline characteristic of the participants.

Baseline characteristic	Number	Percentage
Gender		
Male	1,009	98.70
Female	13	1.30
Age		
Less than 30 years	1	0.09
30-40 years	95	9.29
41-50 years	455	44.52
More than 51 years	471	46.10
Education		
General Practitioner (GP)	118	11.50
Specialist	904	88.50
Working Experience		
Less than 6 years	105	10.30
6-15 years	425	41.60
16-25 years	414	40.50
More than 26 years	78	7.60
Total	**1,022**	**100**

Participants are 119 hospitals (11.64%) in the 13th health service area (Bangkok), followed by 93 hospitals (9.09%) in both 6th (Rayong) and 9 th health service area (Nakhon Ratchasima), and only 50 hospitals (4.89%) from 3rd health service area (Nakhon Sawan). 41.87% (428 hospitals) were hospitals in the area with moderate proportion of the number of cardiac catheterization centers to the number of hospitals in the area (5-10 %), 34.95% (357 hospitals) were representatives from the large proportion group (> 10%), 23.18% were representatives from small proportion group (< 5 %). Most (54. 40%) of the hospitals have size of 30-90 beds, 25.36% were large hospitals with more than 120 beds, most (56.75%) of hospitals have established periods of 30-60 years, 34.24% were the hospitals with less than 30 years of the establishment period, only 9.01 % were the hospitals with established more than 60 years. 87.86 % (898 hospitals) were hospitals without cardiac catheterization room and 85.22% were government hospitals (871 hospitals) as shown in table 3.

Table 3 Number and percentage of hospitals in the referral system classified by characteristics of hospitals.

	Number	Percentage
Health service area		
1	81	7.92
2	46	4.50
3	50	4.89
4	71	6.94
5	74	7.24
6	93	9.09
7	79	7.72
8	83	8.12
9	93	9.09
10	75	7.33
11	87	8.51
12	71	6.94
13	119	11.64
The proportion of the number of cardiac catheterization centers to the total number of hospitals in each area		
Small (<5%)	237	23.18
Moderate (5-10%)	428	41.87
Large (>10%)	357	34.95
The number of beds		
Less than 30	99	9.68
30-90	556	54.40
91-120	108	10.56
More than 120	259	25.36
The established period (year)		
Less than 30	350	34.24
30-60	580	56.75
More than 60	92	9.01
The existence of cardiac catheterization center		
No	898	87.86
Yes	124	12.14
Type of hospital		
Government	871	85.22
Private	151	14.78
Total	1,022	100

The opinion level of readiness concerning the overall administrative factors was at a high level ($\bar{x}$ = 3.54, S.D. = 0.27) when considering each factor, the personnel factor was at a high level. ($\bar{x}$ = 3.41, S.D. = 0.42), recruiting aspect was at a high level ($\bar{x}$ = 3.68, S.D. = 0.56), training aspect was at a moderate level ($\bar{x}$ = 3.07, S.D.= 0.53), and maintenance aspect was at a high level ($\bar{x}$ =3.89, S.D.= 0.28).

The financial factor was at a moderate level ($\bar{x}$ = 3.30, S.D. = 0.22). When considering each aspect, budget adequacy was at low level ($\bar{x}$ = 2.43, S.D. = 0.43), appropriateness of budget was at a high level ($\bar{x}$ = 3.62, S.D. = 0.31), audit and control system of budget were at the highest level ($\bar{x}$ = 4.22, S.D. = 0.25).

The Supporting factor was at a high level ($\bar{x}$ = 3.66, S.D.= 0.30) when considering each aspect, the medical equipment was at a high level ($\bar{x}$ = 3.63, S.D. = 0.51), the medicine and medical supply system was at a high level ($\bar{x}$ = 3.76, S.D. = 0.31), and ambulance was at a high level ($\bar{x}$ = 3.59, S.D. = 0.33).

The management factor was at a high level ($\bar{x}$ = 3.85, S.D. = 0.20) when considering each aspect, the referral process was at a high level ($\bar{x}$ = 4.06, S.D.= 0.41), risk management was at a high level ($\bar{x}$ = 3.56, S.D. = 0.48), working step was at the highest level ($\bar{x}$ = 4.66, S.D.= 0.22), route was at a high level ($\bar{x}$ = 4.18, S.D. =0.25), network was at a moderate level ($\bar{x}$ = 3.15, SD.=0.61), and technology was at a moderate level ($\bar{x}$ = 3.27, S.D.= 0.38) as shown in table 4.

Table 4 Mean, standard deviation and readiness of administrative factors of hospitals in Thai STEMI referral system.

Administrative factors	Mean	Standard deviation	Level of readiness
Personnel factor	**3.41**	**0.42**	**High**
Recruiting	3.68	0.56	High
Training	3.07	0.53	Moderate
Maintenance	3.89	0.28	High
Financial factor	**3.30**	**0.22**	**Moderate**
Budget adequacy	2.43	0.43	Low
Appropriateness of budget	3.62	0.31	High
Audit and control	4.22	0.25	Highest
Supportive factor	**3.66**	**0.30**	**High**
Medical equipment	3.63	0.51	High
Medicine and medical supply	3.76	0.31	High
Ambulance	3.59	0.33	High
Management factor	**3.85**	**0.20**	**High**
Process	4.06	0.41	High
Risk management	3.56	0.48	High
Working Step	4.66	0.22	Highest
Route	4.18	0.25	High
Network	3.15	0.61	Moderate
Technology	3.27	0.38	Moderate
Total	**3.54**	**0.27**	**High**

Analysis of the relationship between readiness factors of various administrative factors which consist of personnel, finance, supporting, and management factors that affect the mortality and timely cardiac catheterization rate by using the Multiple Regression Analysis (MRA), the results are summarized in table 5-8.

Table 5 Analysis of the relationship between readiness of personnel factor and (a) mortality rate (b) timely cardiac catheterization rate.

(a)

Personnel factor	**Mortality rate**		**β**	**t**	**p- value**
	Unstandardized B	**Coefficients Standard error (SEE)**			
Constant	12.529	0.782		16.017**	0.000
Recruitment	1.512	0.138	0.409	10.931**	0.000
Training	-2.272	0.142	-0.577	-16.044**	0.000
Maintenance	-0.689	0.250	-0.095	-2.752**	0.000

Adjusted R^2 = 0.231, F = 103.274, P- value = 0.000**

Note ** Significant level .01, * Significant level .05

(b)

Personnel factor	**Timely cardiac catheterization rate**		**β**	**t**	**p- value**
	Unstandardized B	**Coefficients Standard error (SEE)**			
Constant	11.223	6.631		1.692	0.091
Recruitment	5.322	1.173	0.168	4.538**	0.000
Training	14.538	1.201	0.432	12.108**	0.000
Maintenance	-6.734	2.122	-0.109	-3.174*	0.002

Adjusted R^2 = 0.244, F = 110.764, P- value = 0.000**

Note ** Significant level .01, * Significant level .05

Table 5 (a) shows the results of a multiple regression analysis of the relationship between personnel readiness factors, which consists of recruitment, training, and maintenance on the mortality rate, it was found that recruitment had positive influence on the mortality rate with statistically significant at the .01 level (β = 0.409, $p \leq .01$). Maintenance and training had negative influence on the mortality rate with statistically significant at the .01 level (β = - 0.577, $p \leq .01$; β = - 0.095, $p \leq .01$).

Table 5 (b) shows that recruitment, and training had positive influence on the timely cardiac catheterization rate with statistically significant at the 0.01 level (β = 0.168, $p \leq .01$; β = 0.432, $p \leq .01$).

Maintenance had negative influence on the timely cardiac catheterization rate with statistically significant at the .05 level (β = - 0.109, $p \leq .05$).

Table 6 Analysis of the relationship between readiness of financial factor and (a) mortality rate (b) timely cardiac catheterization rate.

(a)

Financial factor	**Mortality rate**		**β**	**t**	**p- value**
	Unstandardized B	**Coefficients Standard error (SEE)**			
Constant	10.104	1.269		7.961**	0.000
Budget adequacy	-0.897	0.148	-0.188	-6.054**	0.000
Appropriateness of budget	-0.313	0.207	-0.047	-1.509	0.131
Audit and control system	0.388	0.258	0.047	1.502	0.133

Adjusted R^2 = 0.035, F =13.208, P- value = 0.000**

Note ** Significant level .01, * Significant level .05

(b)

Financial factor	**Timely cardiac catheterization rate**		**β**	**t**	**p- value**
	Unstandardized B	**Coefficients Standard error (SEE)**			
Constant	-7.339	10.529		-0.697	0.486
Budget adequacy	11.388	1.229	0.280	9.269**	0.000
Appropriateness of budget	1.178	1.719	0.021	0.685	0.493
Audit and control system	5.811	2.145	0.082	2.710**	0.007

Adjusted R^2 = 0.091, F = 34.996, P- value = 0.000**

Note ** Significant level .01, * Significant level .05

Table 6 (a) shows the results of a multiple regression analysis of the relationship between financial readiness factors which consists of budget adequacy, appropriateness of budgets, audit and control system on the mortality rate, it was found that the adequacy of the budget had negative influence on the mortality rate with statistical significance at .01 level (β = - 0.188, p $\leq$ .01). But appropriateness and financial, audit and control system were no statistically significant influence on mortality.

Table 6 (b) shows that the adequacy of the budget, audit and control system had positive influence on the timely catheterization rate with statistical significance at .01 level (β = 9.269, p $\leq$ .01; β = 2.710, p $\leq$ .01). while appropriateness of budget had no influence to timely catheterization rate.

Table 7 Analysis of the relationship between readiness of supporting factor and (a) mortality rate (b) timely cardiac catheterization rate.

(a)

Supporting factor	Mortality rate		β	t	p- value
	Unstandardized B	Coefficients Standard error (SEE)			
Constant	15.237	0.901		16.917**	0.000
Medical equipment	-0.519	0.148	-0.127	-3.510**	0.000
Medicine and medical supply	0.060	0.216	0.009	0.275	0.783
Ambulance	-1.432	0.217	-0.227	-6.607**	0.000

Adjusted R^2 = 0.092, F = 35.372, P- value =0.000**

Note ** Significant level .01, * Significant level .05

(b)

Supporting factor	Timely cardiac catheterization rate		β	t	p- value
	Unstandardized B	Coefficients Standard error (SEE)			
Constant	-12.630	7.172		-1.761	0.079
Medical equipment	10.963	1.177	0.315	9.312**	0.000
Medicine and medical supply	-7.617	1.724	-0.135	-4.419**	0.000
Ambulance	14.099	1.725	0.262	8.171**	0.000

Adjusted R^2 = 0.212, F = 92.550, P- value =0.000**

Note ** Significant level .01, * Significant level .05

Table 7 (a) shows the results of multiple regression analysis of the relationship between readiness of supportive factors which consists of medical equipment, medicine and medical supply and ambulance on the mortality rate, it was found that the medical equipment and ambulance had negative influence on the mortality rate with statistically significant at .01 level (β = - 0.127, $p \leq .01$; β = - 0.227, $p \leq .01$). Medicine and medical supply were found that they had no statistically significant influence on the mortality rate.

Table 7 (b) shows that medical equipment and ambulance had positive influence on the timely cardiac catheterization rate with statistically significant at .01 level (β = 9.312, $p \leq .01$; β = 8.171, $p \leq .01$). Medicine and medical supply had negative influence with statistically significant at 0.01 level (β = - 4.419 $p \leq .01$).

Table 8 Analysis of the relationship between readiness of management factor and (a) mortality rate (b) timely cardiac catheterization rate.

(a)

Management factor	Mortality rate		β	t	p- value
	Unstandardized B	Coefficients Standard error (SEE)			
Constant	8.419			6.054**	0.000
Process	-0.302	0.122	-0.060	-2.471*	0.014
Risk management	1.538	0.104	0.353	14.842**	0.000
Working step	-0.077	0.222	-0.008	-0.347	0.729
Route	0.349	0.201	0.042	1.733	0.083
Network	-1.696	0.085	-0.495	-20.032**	0.000
Technology	0.004	0.129	0.001	0.029	0.977

Adjusted R^2 = 0.433, F = 130.861, P- value = 0.000 **

Note ** Significant level .01, * Significant level .05

(b)

Management factor	Timely cardiac catheterization rate		β	t	p- value
	Unstandardized B	Coefficients Standard error (SEE)			
Constant	-44.285			-3.745**	0.000
Process	-2.937	1.040	-0.068	-2.823*	0.005
Risk management	7.472	0.881	0.201	8.480**	0.000
Working step	-0.273	1.886	-0.003	-0.145	0.885
Route	3.309	1.713	0.047	1.931	0.054
Network	19.419	0.720	0.663	26.964**	0.000
Technology	1.507	1.099	0.033	1.371	0.171

Adjusted R^2 = 0.442, F = 133.991, P- value = 0.000 **

Note ** Significant level .01, * Significant level .05

Table 8 (a) shows the results of a multiple regression analysis of the relationship between readiness of management factor on the mortality rate, it was found that risk management had positive influence on the mortality rate with statistically significant at the .01 level (β = 0.353, $p \leq .01$), the referral network had negative influence on mortality with statistically significant at the 0.01 level (β = -0.495, $p \leq .01$), process had a negative influence on the mortality rate with statistically significant at the .05 level (β =-0.060, $p \leq .05$). But working step, technology and route had no influence statistically significant mortality.

Table 8 (b) shows that risk management, and network had positive influence on the timely

cardiac catheterization rate with statistically significant at the .01 level (β = 8.480, p ≤ .01; β = 26.964, p ≤ .01). Process had negative influence on the timely cardiac catheterization rate with statistically significant at the .05 level (β = -2.823, p ≤ .05), while working step, route, and technology were no statistically significant influence to timely cardiac catheterization rate.

Discussion

1. The current state of the readiness of administrative factors and the effectiveness in the referral system for patients with acute STEMI of hospitals in Thailand.

Administrative with the 4 M concept is essential to productive work. If there is a lack of good management, this will cause obstacles and result in unsuccessful work. All types of management are necessary to rely on the factors of personnel (Man), finance (Money), supporting factor (Material), and management (Method) as elements to promote and support work results to achieve goals [15]. From this research data, it was found that the referral system for patients with acute STEMI of hospitals in Thailand still has a problem of budget shortage. Similarly, with the study of Sriphontan (2017: 23-30) [16], which found the problem of referral system of cardiac patients in Thailand (Phanom sarakham province), there is a lack of funding sources and budgets to purchase quality medical equipment, as well as the results of the study of Wisaphan et al (2017: 199) [13], which conducted a qualitative study on the management model of Thai referral network (Chanthaburi Province), found that in addition to the problem of the budget adequacy, there is also the problem of planning for the use of the hospital's subsidy for work development, there are no plans/projects that provide specific details based on the referral center's role.

Effectiveness of the STEMI referral system of hospitals in Thailand in 2019 [17] based on mortality rates passed the mortality criteria (less than 10%) with the overall mortality rate at 8.46%, but if considering each area, it was found that 23 % (3/13) of all health service areas in Thailand has a mortality rate higher than the criteria, health service area 2 had the highest mortality rate (12.79%), while area11 had the lowest mortality rate (4.93%), consistent with the study by Srimahachota et al. had collected information about the overall treatment of acute coronary syndrome patients in Thailand collaborated with the Cardiology Association of Thailand for 2 times, 1st time (Srimahachota, S; et al. 2007: 10) [18], collecting data on 3,836 patients from 17 hospitals from 2002 to 2003, the overall in-hospital mortality was 17 % for acute coronary syndromes. The second study (Srimahachota, S; et al. 2012: 509) [7] was collected data on 1,102 patients from 39 hospitals between 2007 to 2008. The results show that in-hospital mortality of the coronary artery disease group was 5.3%, and after one year follow-up, the mortality rate increased to 14.1%, similar to historical data from the Ministry of Public Health. (Ministry of Public Health. 2018). It was found that in 2017 the mortality rate was 9.63% and in 2018, the mortality rate was 9.84 %, with 6 health care areas having higher mortality rates than criteria (area 2; 10.94 %, area 3; 10.27 %, area 4; 12.79 %, area 5; 11.99 %, area 9; 11.72 %, area 10; 13.07%). This 2019 study found a mortality rate of 8.46%. Compared to past mortality, there was a less likely mortality trend, service areas 5th and 10 th have improved mortality rate. But there are still health service areas that have exceeded the mortality criteria, especially 2nd, 3rd, and 4 th areas that represent problems that need urgent discovery and resolution.

Effectiveness of the STEMI referral system of hospitals in Thailand during the year 2018 [17] based on the overall rate of timely coronary catheterization rate was 51% with a median of 170 minutes. The most delay time was 363 minutes in the 10th health service area (Ubon Ratchathani). Sri Mahachota et al. had collected data on the overall treatment rate of acute angina patients in Thailand twice. Firstly, they study in 3, 836 patients from 17 hospitals from 2002 to 2003 [18] (Sri Mahachota; et al. 2007:

10), and the results revealed that the rate of timely coronary angiography was only 34%. Secondly, in a study in 2012 [7], the data were obtained from 1,102 patients at 39 hospitals between 2007 and 2008. The time it took from the hospital arrival until the coronary vessel was opened (Door to balloon time) was 127 minutes, and the rate of prompt coronary angiography was just 12.3 percent.

2. Administrative factors related to the effectiveness of the acute STEMI patients of hospitals in Thailand.

This study found that administrative factors which related to the mortality rate are management factor (Adjusted R^2 = 0.433), personnel factor (Adjusted R^2 = 0.231), supporting factor (Adjusted R^2 = 0.092) and financial factor (Adjusted R^2 = 0.035), respectively. And the administrative factors which related to timely cardiac catheterization rate are also management factor (Adjusted R^2 = 0.442), personnel factor (Adjusted R^2 = 0.244), supporting factor (Adjusted R^2 = 0.212) and financial factor (Adjusted R^2 = 0.091) respectively. Therefore, development for the readiness of these factors can improve the effectiveness of the STEMI referral system. The ministry of public health of Thailand should focus on development as follows, management factors should focus on 1) the referral process, 2) the referral network, and 3) the management of risks during transport. This is consistent with the previous study by Rojprasert (2013: 70) [19] suggested that the development of the management system for the Thai referral system at the policy level are 1) to develop an information system to be up-to-date, easy to use, convenient, and linking access to current information, 2) having to seek a coalition outside the ministry, 3) in case of government hospitals which affiliated with multiple ministries, the ministry which has the main mission should coordinate the referral policy, 4) The technology system must be established thoroughly that personnel can access information easily, conveniently, quickly, can link information online immediately and have flexibility in communicating information for referrals to patients.

The personnel factor should focus on 1) recruiting, 2) training and development, and 3) maintenance, since there was a statistically significant relationship ($p \leq .01$). The personnel factor is very important which accordance with the research of Puchakan (1991) [20] found that personnel is an important factor in management because personnel is a user of other factors. If the hospital has personnel with knowledge and abilities, they will make the organization progress.

The supporting factor should focus on the development of 1) medical equipment and 2) ambulances for referrals, because there was a statistically significant relationship ($p \leq .01$) consistent with the study of Wisaphan et al (2017: 199) [13] who said that the readiness of medical equipment, vehicles, in-vehicle equipment is an important factor in the management of referrals because it is a tool for working towards the specified destination.

The financial factor should focus on 1) budget sufficiency especially the remuneration for the performance of personnel and the budget for providing medical devices with good quantity and quality. This is correlated with the recommendation of Kwathai (2014) [21] has studied the performance of public health officials and found that the budget sufficient amount of money has a high level of relationship (63.30%) to the performance of health workers. Therefore, it can be concluded that money is another administrative resource that helps other mechanisms in the management system to be more flexible.

Conclusion

1. Ministry of Public Health of Thailand should provide the necessary medical equipment for the treatment of acute coronary artery disease such as more cardiac catheterization rooms throughout the country.

2. In addition to providing adequate cardiac catheterization Ministry of Public Health of Thailand should be developing policies to increase the readiness of administrative factors that significantly affect the effectiveness of the referral system such as focusing on the management factor by improving referral network, risk management, and referral process. For personnel factor, they should focus on staff training and compensation of personnel. For supporting factor, they should focus on increasing the medical equipment and ambulance. For the financial factor, they should increase the budget to support the cardiac referral system.

Conflicts of Interests

None.

References:

[1]. World Health Organization**.** Incidence of deaths in the world population from heart disease**.** 2018; Available from: https://who.int/global_hearts. [Accessed Dec. 8, 2020].

[2]. Thai Ministry of Public Health. Summary of the 2017 disease surveillance report, Bureau of Non-communicable Diseases, Department of Disease Control, Thai Ministry of Public Health, Bangkok, 2017.

[3]. The Association of Cardiologists of Thailand Under royal patronage. Guidelines for Care of Ischemic Heart Disease Patients in Thailand Revised Edition 202*0. 1nd edition*., Next step Publication, Bangkok, 2020: 12-23.

[4]. Kodama N, Nakamura T, Yanishi K, et al. Impact of Door-to-Balloon Time in Patients With ST-Elevation Myocardial Infarction Who Arrived by Self-Transport, Acute Myocardial Infarction - Kyoto Multi-Center Risk Study Group. Circulation Journal. 2017; 81: 1693-1698.

[5]. Ibanez B, James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017; 00: 1–66.

[6]. The Association of Cardiologists of Thailand Under royal patronage. 2016 Practice guidelines for Percutaneous Coronary Intervention (PCI)**.** The Association of Cardiologists of Thailand, Bangkok, 2016.

[7]. Srimahachota S, Boonyaratavej S, Kanjanavanit R, et al. Thai Registry in Acute Coronary Syndrome (TRACS) - An Extension of Thai Acute Coronary Syndrome Registry (TACS) Group: Lower In- Hospital but Still High Mortality at One-Year. Journal of the medical association of Thailand. 2012**;** 95(4): 508-518.

[8]. Wongpraparut N, Chotinaiwattarakul C, Panchavinnin P, et al. First Medical Contact to Device Time in the Thailand Percutaneous Coronary Intervention (PCI) Registry**.** Journal of the medical association of Thailand. 2014; 97(12): 1247-1253.

[9]. Langabeer JR, Dellifraine J, Fowler R, et al. Emergency medical services as a strategy for improving ST-elevation myocardial infarction system treatment times. Journal of emergency medicine. 2014; 46**:** 355 – 362.

[10]. Thai National Health Security Office. User Manual of Health Security Rights. Sahamit Printing and Publishing Co., Ltd. Bangkok, 2016.

[11]. Thai Ministry of Public Health. Provincial government inspection report form, the fiscal year 2018. Office of Policy and Strategy, Thai Ministry of Public Health. Bangkok; 2018.

[12]. Promraksa K, Poum A. An association between Administrative Factors, Administrative Processes and practicing for controlling hypertension among health workers who work in Health Promoting Hospital, Krabi Province. Journal of Health Science and Community Public Health. 2019; 2(1): 38-51.

[13]. Wisaphan Y, Promdit B, Sukadisai P. Referral Coordination Management Model Chanthaburi Province. J Prapokklao Hosp Clin Med Educat Center. 2017; 34(3): 194-205.

[14]. Yoddee S, Poum A. Administrative Factors and Administrative Process Associated with Practicing for Epidemiology Surveillance among Health Personnel in Health Promotion Hospital, Songkhla Province. Journal of Health Science and Community Public Health. 2018; 1(2):41-54.

[15]. Heinz W, Harold K. Manage A Global Perspective. Mc Graw Hill, New York; 1993.

[16]. Sripontun J, Pinnadilay W, Ratanawongsawat P, et al. The Development of Referral Models for Acute myocardial infarction STEMI in Mahasarakham hospital. Mahasarakham hospital Journal. 2017; 14(1): 23-30.

[17]. Thai Ministry of Public Health. Summary of information management of the THAI ACS Registry, the fiscal year 2019. Department of Medical Services, Thai Ministry of Public Health, Bangkok; 2019.

[18]. Srimahachota S, Kanjanavanit R, Boonyaratavej S, et al. Demographic, management practices and in-hospital outcomes of Thai Acute Coronary Syndrome Registry (TACSR): the

difference from the Western world. Journal of the Medical Association of Thailand. 2007; 90 (1): 1-11.

[19]. Rojprasert S. Development of a referral management system for medical treatment of hospitals in Government Inspectorate Area 2, Ministry of Public Health [Dissertation/ Ph.D.]. Bangkok: Valaya Alongkorn Rajabhat University; 2013.

[20]. Puchakarn S. Administrative elements that influence the continuity and continuity of the Student Leaders Program, Health Promotion Department in the Central Region [Dissertation/M.Sc. in Public Health Administration]. Bangkok: Graduate School Mahidol University; 1991.

[21]. Kwathai N. Administrative factors affecting the performance of officers. food sanitation public health Tambon Health Promoting Hospital Chaiyaphum Province [Dissertation/ M.A. in Public Health Administration]. Khon Kaen: Graduate School Khon Kaen University; 2014.