Original research

THE RELATIONSHIP BETWEEN ORGANIZATIONAL FACTORS AND TIMELY CARDIAC CATHETETRIZATION RATE IN ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION PATIENTS OF HOSPITALS IN THAILAND

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Abstract: *Introduction*: This descriptive study aimed to study an association between the level of readiness of administrative factors and the timely cardiac catheterization rate of patients with acute ischemic heart disease in hospitals in Thailand.
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. The statistics used to analyze the data were frequency, percentage, mean, standard deviation, and correlation was analyzed by multiple regression analysis.
Results: The organizational 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). While budget sufficiency was at a low level ($\bar{x}$ = 2.43, S.D. = 0.43). All factors were significantly related to the timely cardiac catheterization rate, as follows: management factor (Adjust R2 = 0.442), personnel factor (Adjust R2 = 0.244), supporting factor (Adjust R2 = 0.212) and financial factor (Adjust R2 = 0.091).
Conclusion: Therefore, the Thai Ministry of Public Health should provide adequate support for organizational factors, especially in terms of budget sufficiency.

Keywords: Administrative Factors, Organizational Factors, Timely catheterization rate, ST segment elevation myocardial infarction, Referral system, Thailand

INTRODUCTION Coronary heart disease is a life-threatening emergency and a serious public health issue globally, particularly in Thailand. According to World Health Organization (WHO) estimates from 2012, ischemic heart disease was responsible for 7.4 million deaths worldwide, accounting for 12.2 % of all causes of death. The number of fatalities from coronary heart disease increased to 17.9 million in 2018, accounting for 31% of all causes of death worldwide [1]. According to data from the Thai Ministry of Public Health, the rate of death from coronary heart disease in Thailand in 2017 was 31.8 per 100,000 population, a rise from 2012, when the rate was only 23.45 per 100,000 population [2].

Acute ischemic heart disease is caused by blood clots occluding the coronary artery. This causes a myocardial infarction, which frequently presents with immediate symptoms. Especially if electrocardiogram (ECG) anomalies in the ST segment rose, at least two consecutive leads are discovered, which is known as ST-Elevation Myocardial Infarction (STEMI) [3]. If the obstructed artery is not opened quickly, sudden death is a risk [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 cardiac catheterization (Primary Percutaneous Coronary Intervention; Primary PCI) within 120 minutes [6] as if treated later than that time myocardial may cause permanent injury and death [7,8,9].

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An effective referral system is very important because most hospitals in Thailand do not have cardiac catheterization centers, especially in rural areas. 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, according to the NHSO has set a target (Key Performance Index: KPI) rate of receiving treatment by Primary Percutaneous Coronary Intervention (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 % [11].

The referral system for acute STEMI patients cannot operate effectively without the readiness of organizational factors, including Personnel (Man), Finance (Money), Supporting Factors (Material), and Management (Method), which are critical factors. Methodical management of these resource utilization ensures efficient and effective work [12,13,14]. Considering the problems mentioned above, we planned this study with the following research questions: Are the Administrative/organizational factors of hospitals in Thailand, for acute STEMI patients, readiness or not? Which Administrative/organization factors affect the timely catheterization rate of this referral system?

MATERIAL AND METHODS

Study Design and Population

This research was a correlation study conducted for three 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 of the Thai Ministry of Public Health.

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

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

OBJECTIVES

1. To study the level of readiness of the organizational factors of the STEMI referral system in Thai hospitals.
2. To study the organizational factors that affect the timely cardiac catheterization rate of 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 organizational factors of personnel, finance, supporting factors, and management by designating the hospital directors to represent the hospitals. Secondary data during 2018-2019 on the mortality rate of acute STEMI patients were collected from the Thai Ministry of Health report.

Data Analysis

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

Objective 1: To study the level of readiness of the organizational factors of the STEMI referral system in Thai hospitals by content analysis with descriptive statistics, frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.) Interpreting the questionnaire results using an interval scale by dividing the level of readiness of organizational factors as follows; the average score of 4.21 - 5.00 means "highest level of readiness," average score of 3.41 - 4.20 means " high level of readiness," average score of 2.61 – 3.40 mean "moderate readiness," average score of 1.81 – 2.60 mean "low readiness," and the average score of 1.00 – 1.80 mean "lowest readiness. " The timely cardiac catheterization rate of patients with acute STEMI is presented by descriptive statistics, frequency, and percentage.

Objective 2. To study organizational factors affecting 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 readiness in personnel, finance, supporting, and management factors from the directors 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 respondents 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. All respondents had a current position as a hospital director, as Table 2.

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

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

Respondents were 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) were hospitals in the area with a moderate proportion of the number of cardiac catheterization centers to the number of hospitals in the area (5-10 %), 34.95% (357) were representatives from the large proportion group (> 10%), 23.18% (237) were representatives from small proportion group (< 5 %). Most (54. 40%) of the hospitals have the 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% (350) were the hospitals with less than 30 years of the establishment period, only 9.01 % (92) were the hospitals with established more than 60 years. 87.86 % (898) were hospitals without cardiac catheterization room, and 85.22% (871) were government hospitals, as shown in Table 3.

	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 (years)		
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

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

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

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

The supporting factor had a high level of readiness ($\bar{x}$ = 3.66, S.D.= 0.30). When considering each aspect, medical equipment had a high level of readiness ($\bar{x}$ = 3.63, S.D. = 0.51), medicine and medical supply system had a high level of readiness ($\bar{x}$ = 3.76, S.D. = 0.31), and ambulance had a high level of readiness ($\bar{x}$ = 3.59, S.D. = 0.33).

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

Administrative factors	Mean	Standard deviation	Level of readiness
Personnel factors	3.41	0.42	High
Recruiting	3.68	0.56	High
Training	3.07	0.53	Moderate
Maintenance	3.89	0.28	High
Financial factors	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 factors	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 factors	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

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

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

Table 5 shows that recruitment, training, and maintenance were correlated with timely cardiac catheterization rate with statistically significant.

Table 6 shows that the adequacy of the budget, audit, and control system correlated with timely catheterization rate while appropriateness was not related to timely catheterization rate.

Personnel factors	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*

Adjust R^2 = 0.244, F = 110.764, P- value = 0.000**
Note ** Significant level p ≤ 0.01, * Significant level p ≤ 0.05

Table 5 Analysis of the relationship between readiness of personnel factor and timely cardiac catheterization rate.

Financial factors	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**

Adjust R^2 = 0.091, F = 34.996, P- value = 0.000**
Note ** Significant level p ≤ 0.01, * Significant level p ≤ 0.05

Table 6 Analysis of the relationship between readiness of financial factor and timely cardiac catheterization rate.

Supporting factors	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**

Adjust R^2 = 0.212, F = 92.550, P- value =0.000**
Note ** Significant level p ≤ 0.01, * Significant level p ≤ 0.05

Table 7 Analysis of the relationship between readiness of supporting factor and timely cardiac catheterization rate.

Table 7 shows that medical equipment, medicine, medical supply, and ambulance correlated with timely cardiac catheterization rate.

Table 8 that process, risk management, and network were correlated with timely cardiac catheterization rate while working step, route, and technology were not related to timely cardiac catheterization rate.

development, there are no plans/projects that provide specific details.

Effectiveness of the STEMI referral system of hospitals in Thailand during the year 2018 [17], the overall rate of timely coronary catheterization rate was 51% with a median of 170 minutes. The longest delay was 363 minutes in the 10th health service area (Ubon

Management factors	**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

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

Note ** Significant level p ≤ 0.01, * Significant level p ≤ 0.05

Table 8 Analysis of the relationship between readiness of management factor and timely cardiac catheterization rate.

DISCUSSION

1. The readiness of organizational factors and the timely cardiac catheterization in the acute STEMI referral system 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]. This research data found that the referral system for patients with acute STEMI of hospitals in Thailand still facing a lack of budgets. 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 provide quality medical equipment, as well as the results of the study of Wisaphan et al. (2017: 199) [13], which study the management model of the referral network of Thailand **(Chanthaburi Province)** by qualitative research, found that in addition to the problem of the sufficiency of the budget, there is also the problem of planning for the use of the hospital's budget for work

Ratchathani). Sri Mahachota et al. had collected the data about the overall treatment rate of patients with acute angina in Thailand 2 times. Firstly, they study in 3, 836 patients from 17 hospitals from 2002 to 2003 [18] (Sri Mahachota; et al. 2007: 10), and the results found that the rate of timely coronary angiography was only 34%. Secondly, in a study in 2012 [7], the data were collected from 1,102 patients, 39 hospitals between 2007 and 2008. The time from the hospital arrival until the coronary vessel was opened (Door to balloon time) was 127 minutes, the rate of timely coronary angiography was only 12.3 %.

2. Administrative factors affected the timely cardiac catheterization rate of the acute STEMI patients of hospitals in Thailand.

This study found that administrative factors which related to timely cardiac catheterization rate are: management factor (Adjust R2 = 0.442), personnel factor (Adjust R2 = 0.244), supporting factor (Adjust R2 = 0.212) and financial factor (Adjust R2 = 0.091) respectively. Therefore, development for the readiness of these factors can improve the timely cardiac catheterization rate in STEMI patients. 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.

Personnel factors should focus on 1) recruiting, 2) training and development, and 3) maintenance. The personnel factor is very important; according to Puchakan (1991) [20], personnel is critical in management because personnel is users of other factors. If the hospital has personnel with knowledge and abilities, they will make the organization progress.

Supporting factors should focus on the development of 1) medical equipment, 2) medicine and medical supply, and 3) ambulance for referrals 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 compensation for the performance of personnel and the budget for providing medical devices with good quantity and quality. And 2) Audit and control system. This is correlated with the recommendation of Kwathai (2014) [21] has studied the performance of public health officials and found that the sufficient budget 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.

RECOMMENDATION

1. Ministry of Public Health of Thailand should provide the necessary medical equipment to treat acute coronary artery disease, such as more cardiac catheterization rooms throughout the country.
2. In addition to providing adequate cardiac catheterization, the Ministry of Public Health of Thailand should be developing policies to increase the readiness of organizational factors that significantly affect timely cardiac catheterization rates, such as focusing on the management factor by improving referral network and risk management, and referral process. For personnel factors, they should focus on staff training and compensation of personnel. For supporting factors, 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

The research received no specific grant from any funding agency in public, commercial or not-for-profit sectors. The author declared no conflicts of interest.

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