Costs of Payment in Thai Acute Coronary Syndrome Patients

Worachat Moleerergpoom MD*, Rungsrit Kanjanavanit MD**,
Woravut Jintapakorn MD***, Piyamitr Sritara MD****

** Cardiology Unit, Department of Medicine, Police General Hospital, Bangkok*
*** Division of Cardiology, Department of Medicine, Maharaj Nakorn Chiang Mai Hospital, Chiang Mai*
**** Division of Cardiology, Department of Medicine, Songklanagarind Hospital, Songkhla*
***** Division of Cardiology, Department of Medicine, Ramathibodi Hospital, Bangkok*

Background: *Acute coronary syndrome (ACS) is a major health care syndrome that can financially burden patients throughout the world, including Thailand. Few studies purposed estimating the costs of treatment. The data from the ACS registry database represented the costs of hospital charges paid by ACS patients. Although these were not the actual treatment costs, the authors can approximately estimate the total expenditure for the first admission.*
Objectives: *First, calculate the cost of ACS to the patients, including diagnostic, demographic data, treatment modalities, type of payers, hospital profile, and outcomes. Second, find the appropriate model to identify the independent factors for predicting the treatment costs.*
Material and Method: *The present study collected data from the second and third phase of a national multicenter prospective registry of ACS in Thailand, Thai ACS registry (TACSR). 3,552 patients with new onset of ACS were analyzed.*
Results: *Median age was 67 years (range 26.5-105.5) with predominately male and median length of stay (LOS) was 7 days (range, 1-184). 42% referred from other hospitals. The median cost of the total population was 47,908 baht (range, 633-1,279,679). When classified into those of STEMI, NSTEMI, and UA, the costs were 82,848.5, 40,531 and 26,116 baht respectively, $p < 0.0001$. Patients in the government hospital had to pay the total cost with PCI and CABG, 152,081-161,374 baht and 203,139-223,747 baht respectively, while the private hospital charged almost twice as much. For the types of payers, private insurance including private employee security fund paid significantly more than others. Costs in patients paid by "30 baht national health scheme and social security fund" were significantly less than those of others. For modality of treatment in STEMI, primary PCI was significantly more costly than thrombolytics and no reperfusion therapy, 161,096.5 vs. 60,043.0 and 33,335.0 baht respectively, $p < 0.0001$. Early invasive groups in NSTEMI/UA had much higher median costs 145,794.0 baht when compared to those of the conservative group, 47,908 baht, $p < 0.0001$. Two multiple linear regression models according to the diagnostic group identified the independent factors for predicting cost. PCI, LOS, CABG, admission in a private hospital, Death, GP IIb/IIIa inhibitors use, major bleeding, coronary angiogram, thrombolytics use, age and diabetes were independent predictors for the cost in STEMI patients, $R^2 = 0.58$. For those of NSTEMI/UA, the independent predictors for the cost were PCI,LOS, CABG, admission in a private hospital, death, GP IIb/IIIa inhibitors use, major bleeding, coronary angiogram, age, ventricular arrhythmia, CHF and referred patients, $R^2 = 0.62$.*
Conclusion: *Costs in ACS patients were markedly different among diagnostic groups. The clinical risk factors were hospital type, type of payers, referred system, treatment procedures, drugs used and complications including outcome. Some of these factors could independently predict the costs.*

Keywords: *Costs of payment, Acute coronary syndrome, Thai ACS registry*

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Correspondence to : Moleerergpoom W, Cardiology Unit, Department of Medicine, Police General Hospital, Pratumwan, Bangkok 10330, Thailand. Phone & Fax: 0-2252-7120, E-mail: drworachat@hotmail.com

Acute coronary syndrome is a major global public health problem owing to high prevalence and significant morbidity and mortality. Consequently, because of its high hospitalization rates and high cost of treatment, it can negatively impact the economy in many countries including Thailand. The costs of treatment for ACS are difficult to estimate precisely because few available comprehensive data sources are suitable for that purpose[1,2]. The Thai Heart association created a national multi-center registry of ACS, including the costs of hospital charge paid by ACS patients. Therefore, the data from the ACS registry database were analyzed. Although these were not the actual treatment costs, the authors can approximately estimate the total expenditure for the first admission. The costs first will be analyzed to compare between various diagnostic groups of ACS patients stratified by patient profile, severity and complications of diseases, modality of treatments, hospital profile and outcomes; secondly, to identify which patient parameters and treatment procedures will independently affect costs.

Material and Method

Study design and data management

Data collected from phase 2 and 3 of the Thai ACS registry (TACSR), an observational prospective national multi-center study owned by Thai Heart Association, were analyzed. ACS registry data were extracted from medical records by trained critical care nurses and checked by principle investigators at each site. Web-based double data entries were used to prevent data entry error. Internal and external auditing at every site was regularly performed every 3-6 months. Data entering into the data-management center at the Thai Heart Association were cleaned and analyzed. All definitions of clinical parameters including co-morbidities and mortalities in the present study were recorded in ACS registry data source.

Patient selection

The inclusion criteria were the admitted patients with the discharge diagnosis of acute coronary syndrome. The index ACS symptoms, e.g. chest pain or angina equivalents, had to occur within 14 days before enrollment and accompanied by electrocardiographic ST segment deviations or T wave. At discharge, the patients were classified into one of the following categories: ST-segment-elevation myocardial infarction (STEMI), non-STEMI (NSTEMI) or unstable angina (UA). The authors excluded the patients who had to be re-admitted because of ACS. Diagnostic criteria for acute myocardial infarction (AMI) and unstable angina (UA) were symptoms felt to be consistent with cardiac ischemia within 24 hours of hospital presentation and at least one of the following: (1) increase in cardiac enzymes (based on laboratory values at local participating hospitals) (A) total creatine phosphokinase or creatine kinase MB fraction > 2 times upper limit of the hospital's normal range and/or (B) positive troponin I or T results (if performed). (2) ST segment elevation acute myocardial infarction (STEMI), defined as new or presumed new ST-segment elevation at the J point in 2 or more contiguous leads with greater than or equal to 0.2 mV in V1, V2, or V3 or greater than or equal to 0.1 mV in other leads or presence of a new left bundle branch block in the setting of positive cardiac enzyme results. (3) Non-ST-segment elevation myocardial infarction (NSTEMI), defined as occurrence of AMI in the setting of positive cardiac enzyme with accompanying electrocardiographic changes other than ST segment elevation. (4) UA Symptoms felt to be consistent with acute cardiac ischemia within 24 hours of hospital presentation with ST-T wave change and serial enzymes negative for myocardial infarction.

Clinical data collection

Baseline demographic (age, gender, DM, HT smoking status, dyslipidemia, history of CAD and previous treatment, history of stroke and family history of CAD) and presenting symptoms including in hospital outcomes were recorded. Costs (baht) are defined by total costs of hospital charges at first admission paid by ACS patients. The costs were the sum of hotel costs per admission, medical treatment, laboratory investigation, and invasive procedures. Costs were based on the treatment procedures, complications such as congestive heart failure, major bleeding (intra-cerebral hemorrhage, bleeding requiring transfusion or blood loss > 5 gm% of Hb.), arrhythmia (malignant ventricular arrhythmia and second and third degree A-V block), and stroke. Strategies of treatments were defined by the sum of all medical and invasive procedures performed on the patients. The authors compared the total costs between three treatment strategies in STEMI, Thrombolysis vs. Primary PCI vs. no reperfusion. NSTEMI and UA patients were classified to the conservative group. The early invasive group was comprised of patients who received revascularization within 7 days of onset of chest pain. Death was defined by patients dying during hospitalization from cardiac and non-cardiac causes.

Statistical analysis

Mann-Whitney U test was used for comparing the median costs and other continuous data between groups. Chi-square test or Fishers' exact test to evaluate the association between categorical data groups. Correlation between costs and other continuous variables were also determined by Pearson correlation coefficients. All variables identified by univariate analysis and could affect the costs, were further analyzed by multivariate analysis. Stepwise multiple linear regression and Coefficient of Determination (R^2) model was used to explore which clinical demographic, treatment strategies, complications and outcomes would be independent predictors of the costs. All p-values were based on two- tailed tests of significance level at $p < 0.05$.

Results

Of the 9,379 patients available, 3,552 with new onset ACS patients enrolled in phase 2 and 3 of ACS registry were collected. Baseline characteristics and clinical demographic data are shown in Table 1. Median age was 67 years (range 26.5-105.5) with mostly male 58.1%. 42% were referred from other hospitals. Diabetes, HT, smoking and dyslipidemia were the risk factors in 43.5%, 65.7%, 31.3% and 77.8% respectively. Median length of stay (LOS) was 7 days(range 1-184). For treatment strategies, thrombolytic drugs were used in 33% of STEMI. Coronary angiograms were performed in about half of the total ACS patients with a large proportion in STEMI groups, about 61.1% significantly more than in NSTEMI and UA, $p < 0.0001$. PCI and GP IIb/IIIa inhibitors also were intervened in 44.1% and 19.1% of this patient group with a significant higher rate than others. CABG was the treatment procedure in 8% of NSTEMI, a slightly higher rate than STEMI and UA, 4.8% and 5.9% respectively, $p = 0.002$. Cardiogenic shock was found in about 12.7% of the total patients population with the majority of cases in the STEMI group. Bleeding, arrhythmia (malignant ventricular

Table 1. Baseline characteristics and Median costs of payment in ACS patients

Characteristics	Discharge diagnosis			Total (n = 3,552)	p-value
	STEMI (n = 1,466)	NSTEMI (n = 1,417)	UA with ST-T change (n = 639)		
Median Age (year) (range)	63.7 (26.5-96.2)	69.4 (26.8-96.8)	66.5 (32.9-96.8)	67.3 (26.5-105.5)	<0.0001
Median Length of stay (day) (range)	6.0 (0.03-133.0)	8.3 (0.04-184.7)	6.3 (0.06-84.3)	7.0 (0.03-184.7)	<0.0001
Male n (%)	966 (65.9)	757 (53.4)	323 (50.5)	2,046 (58.1)	<0.0001
Referred n (%)	848 (57.8)	4.66 (32.9)	167 (26.1)	1,481 (42.0)	<0.0001
DM n (%)	487 (34.5)	731 (52.2)	281 (44.3)	1,499)43.5	<0.0001
HT n (%)	748 (51.6)	1,065 (75.4)	485 (76.0)	2,298 (65.7)	<0.0001
Smoking n (%)	597 (41.9)	328 (23.5)	150 (23.7)	1,075 (31.1)	<0.0001
Dyslipidemia n (%)	992 (73.8)	1,063 (79.5)	512 (82.8)	2,576 (77.8)	<0.0001
Killip class 2 n (%)	236 (16.1)	448 (31.6)	127 (19.8)	811 (24.8)	<0.0001
3 n (%)	106 (7.2)	212 (14.9)	38 (5.9)	356 (10.0)	<0.0001
4 n (%)	291 (19.8)	155 (10.9)	7 (1.1)	453 (12.7)	<0.0001
Thrombolytic drug use n (%)	487 (33.2)	4 (0.3)	0 (0)	497 (13.9)	<0.0001
LMWH use n (%)	501 (53.5)	602 (74.0)	217 (68.7)	1,320 (37.1)	<0.0001
Coronary angiogram n (%)	895 (61.1)	567 (40.0)	276 (43.2)	1,738 (49.3)	<0.0001
PCI n (%)	646 (44.1)	256 (18.1)	113 (17.7)	1,015 (28.8)	<0.0001
GP llb/llla Inhibitor use n (%)	280 (19.1)	46 (3.2)	21 (3.3)	347 (9.9)	<0.0001
CABG n (%)	71 (4.8)	113 (8.0)	38 (5.9)	222 (6.3)	0.002
Major bleeding n (%)	104 (7.1)	80 (5.6)	17 (2.7)	201 (5.7)	<0.0001
CVA n (%)	41 (2.8)	23 (1.6)	6 (0.9)	70 (2.0)	0.009
Ventricular arrhythmia n (%)	406 (27.7)	173 (12.2)	16 (2.5)	595 (16.9)	<0.0001
Death n (%)	266 (18.1)	214 (15.1)	22 (3.4)	502 (14.3)	<0.0001
Median cost of payment (baht) (min-max)	82,848.5 (740-995,712)	40,531.0 (1700-1,279,679)	26,116.0 (633-985,542)	47,908 (633-1,279,679)	<0.0001

Table 2. Costs of payment in ACS patients stratified by procedures and type of hospital

Diagnosis	Procedure	Government hospital		Private hospital		Total	
		Median (baht)	n (min-max)	Median (baht)	n (min-max)	Median (baht)	n (min-max)
STEMI	No cath	22,310	561 (740-610,812)	48,380	10 (20,724-257,635)	22,646	571 (740-610,512)
	Cath without PCI/CABG	45,437	191 (3,500-338,391)	80,844	4 (71,296-233,876)	45,978	195 (3,500-33,891)
	Cath with PCI	152,081	602 (7,967-823,246)	269,662	31 (169,142-756,478)	156,703	633 (7,967-823,246)
	Cath with CABG	223,282	49 (10,520-948,445)	467,257	5 (402,352-592,226)	249,624	54 (10,520-948,445)
	Cath with PCI and CABG	298,322	11 (200,306-995,712)	646,888	2 (601,823-691,953)	320,789	13 (200,306-995,712)
NSTEMI	No cath	22,542	824 (1,700-734,018)	50,166	26 (12,853-574432)	23,395	850 (1,700-734,018)
	Cath without PCI/CABG	41,145	208 (10,052-661,780)	253,683	2 (121,804-3,385,562)	41,369	210 (10,082-661,780)
	Cath with PCI	161,374	248 (27,339-1,026,844)	273,688	5 (157,446-354,373)	161,587	253 (27,339-1,026,844)
	Cath with CABG	248,640	95 (38,089-995,349)	555,661	6 (393,606-841,584)	263,036	101 (38,089-995,349)
	Cath with PCI and CABG	223,747	2 (154,026-293,467)	1,279,679	1 (1,279,679-1,279,679)	293,467	3 (154,026-1,279,679)
UA with ST-T change	No cath	13,217	350 (633-36,955)	43,240	13 (16,552-262,355)	13,701	363 (633-369,655)
	Cath without PCI/CABG	35,066	123 (8,068-429,649)	43,663	7 (24,636-97,354)	35,890	130 (8,068-429,649)
	Cath with PCI	156,886	105 (15,507-582,198)	361,143	7 (259,994-985,542)	164,516	112 (15,507-985,542)
	Cath with CABG	203,139	34 (106,335-550,720)		NA	203,139	34 (106,335-550,720)
	Cath with PCI and CABG		NA		NA		NA
	Total	45,634	3,403 (633-1,026,844)	185,927	119 (12,853-1,279,679)	47,908	3,522 (633-1,279,679)

NA: not available

arrhythmia, heart block) and CVA were complicated mainly in STEMI groups. In-hospital mortality of the entire group was 14.3%, significantly higher in the STEMI, 18.1% vs. 15.1% in NSTEMI and 3.4% in UA, $p < 0.0001$. Median costs were 82,848.5 baht in the STEMI group vs. 40,531.0 baht in the NSTEMI group and 26,116.0 baht in the UA group, $p < 0.0001$. Over all median cost was 47,908 baht (range 633-1,279,679).

Table 2 shows median costs of the patients who were admitted in government and the private hospitals. Government hospitals charged approximately 13,217-22,542 baht for all medical treatment, investigation and hotel cost without invasive procedures. Revascularization procedures were the highest cost item for treating ACS. Patients admitted in the government hospital, who underwent PCI including stents, had to pay about 152,081-161,374 baht and 203,139-248,640 baht for CABG and would pay twice as much in a private hospital. Statistical analysis could not be proposed due to the small number of patients available in private hospitals.

The median costs (Fig. 1) by the civil servant reimbursement and self-payers were relatively not different, 61,267 (n = 1606) and 71,370 (n = 289) baht respectively, which was higher than those by social security fund and 30 baht program of national health policy, 36,936 (n = 104) and 36,295 (n = 1,458) baht respectively, $p = 0.02$. The payment by the employee welfare and the private insurance (n = 65) were significantly higher than those of the previous groups $p < 0.0001$. The proportion of PCI were done in self-payers, civil servant reimbursement, social security fund, 30 baht national health scheme and private insurance, 34.3%, 31.9%, 25.0%, 24.1% and 41.5% respectively. The expense for treatment was higher in referred patients group than in non-referred group significantly as shown in Fig. 2. Congestive heart failure, the complication the most often found in ACS, was classified to Killip class (Fig. 3), demonstrating that cardiogenic shock did affect the costs significantly more than others. There were no significant differences among the median costs between Killip 1, Killip 2 and Killip 3. Fig. 4 shows that those patients who died had any one of these complications: ventricular arrhythmia, major bleeding and stroke. These were also significantly affected by higher costs of care. The median costs of the Primary PCI group (Fig. 5) were significantly much higher than the thrombolytics group, 161,096.5 vs. 60,043.0 baht, $p < 0.0001$. In spite of its high-cost management care in the STEMI group, surprisingly the in-hospital mortality was comparable between these

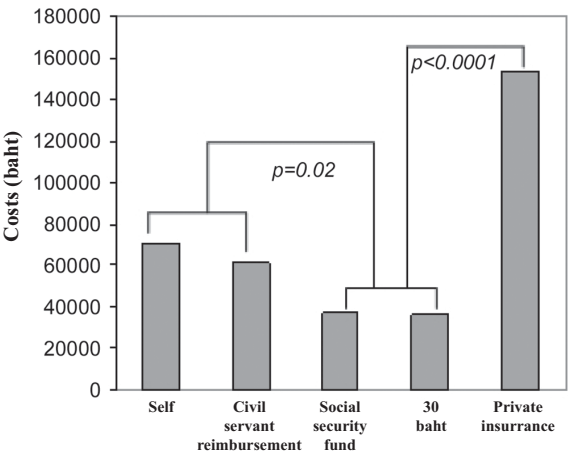

Fig. 1 Costs and type of payers

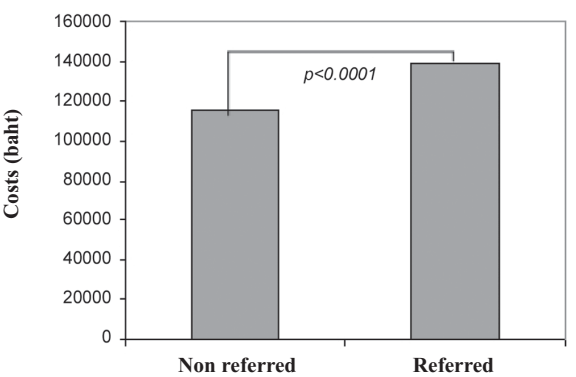

Fig. 2 Costs and referred pateints

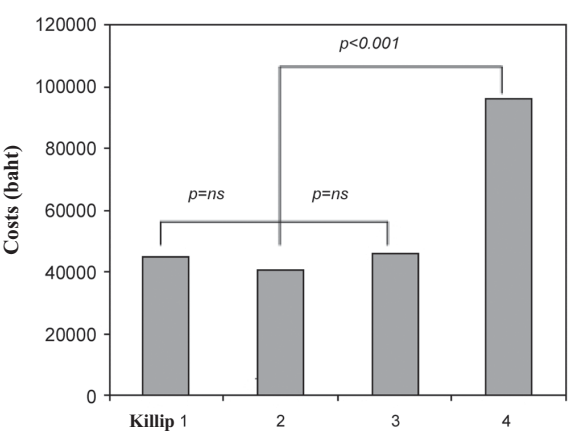

Fig. 3 Costs and Killip class

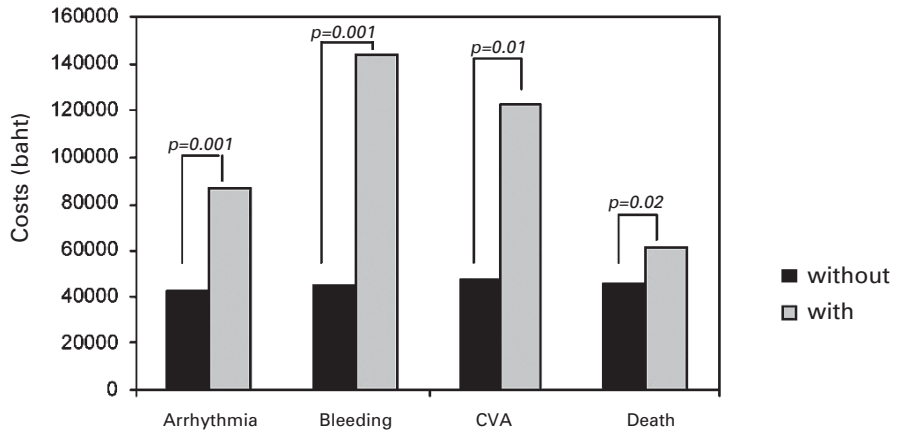

Fig. 4 Costs and complications/death

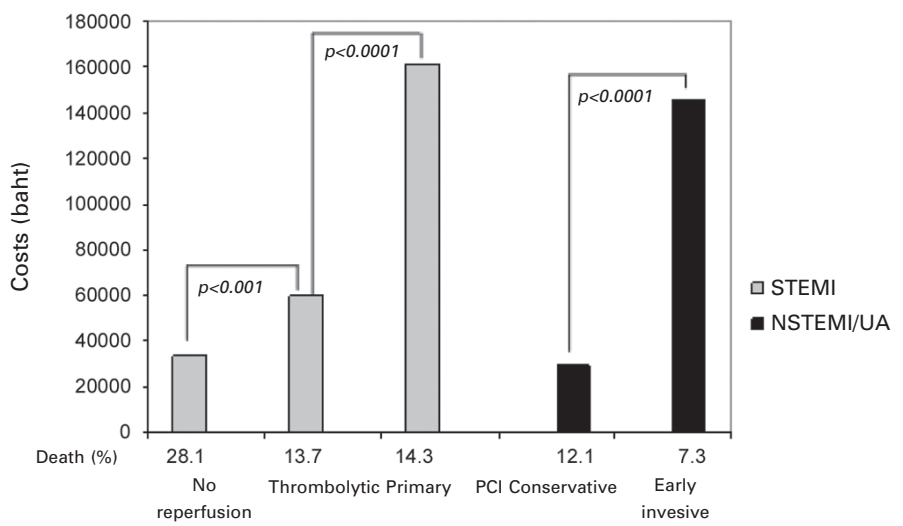

Fig. 5 Coste and Treatment strategies

two modalities, 14.5% vs. 13.4% ($p > 0.05$). However, 28.3% of patients, who paid significantly less and did not receive any reperfusion therapy, died during hospitalization. For the NSTEMI/UA group, early invasive modality, which had a much higher cost compared to the conservative group, could save more lives, 7.3% vs. 12.4%, $p < 0.001$. All clinical parameters, hospital profile, treatment procedures and outcome analyzed by univariate analysis that could affect the costs were further used to put into multiple linear regression analysis by a stepwise method. As shown in Table 3, with regard to the STEMI model, the most influential factor for this model was PCI with non-standardized coefficients of B = 116,445. It means that any ACS patients who underwent PCI will pay an additional 116,445 baht for the total cost during the admission period. Secondly, the length of stay (LOS) affected the cost in this model. However, CABG had the highest B coefficient with 147,232 baht and the second highest one was admission to a private hospital, which charged patients 124,447 baht more. For others, death, GP IIb/IIIa inhibitors, major bleeding, performing coronary angiogram, thrombolytic drug use, age and DM were independent factors associated with the costs with adjusted $R^2 = 0.57$. As shown in Table 4, PCI and CABG were also the most influence factors to explain

Table 3. Multiple linear regression model for predicting costs of payment in STEMI

Clinical parameters (n = 894)	Unstandardized Coefficients B	t	Sig.	95% CI for B	
				Lower Bound	Upper Bound
Constant	-50,595.52	-3.21	.001	-81,568.11	-19,622.93
PCI	116,445.59	13.14	< .0001	99,054.87	133,836.31
Length of stay (day)	4,233.69	14.59	< .0001	3,664.32	4,803.02
CABG	147,232.88	11.06	< .0001	121,118.12	173,347.64
Private Hospital	124,447.83	8.57	< .0001	95,958.10	152,937.56
Death	41,270.08	5.29	< .0001	25,963.68	56,576.48
GP IIb/IIIa Inhibitors use	30,156.23	3.68	< .0001	14,068.24	46,244.21
Major bleeding	29,729.33	2.65	.008	7,753.62	51,705.05
Coronary Angiogram	23,772.06	2.82	.005	7,203.46	40,340.66
Thrombolytic drugs	18,258.13	3.04	.002	6,482.22	30,034.05
Age (year)	518.09	2.31	.021	78.13	958.05
DM	12,048.63	2.07	.039	636.31	23,460.95

Adjust $R^2 = 0.58$

Table 4. Multiple linear regression model for predicting costs of payment in NSTEMI and UA

Clinical parameters (n = 1,129)	Unstandardized Coefficients B	t	Sig.	95% CI for B	
				Lower Bound	Upper Bound
Constant	-65,667.98	-4.56	< .0001	-93,937.17	-37,404.78
Coronary Angiogram	15,425.35	2.56	.011	3,613.18	27,237.53
Length of stay (day)	3,051.14	15.19	< .0001	2,656.99	344.29
PCI	137,169.95	18.33	< .0001	122,485.37	151,854.52
CABG	179,184.32	18.51	< .0001	160,192.87	198,175.77
Private Hospital	129,177.23	10.66	< .0001	105,397.87	152,956.58
Death	40,020.61	4.66	< .0001	23,161.88	56,879.33
GP IIb/IIIa inhibitors use	58,372.71	4.69	< .0001	33,929.26	82,816.15
Age (year)	794.91	3.83	< .0001	387.25	1,202.57
Ventricular arrhythmia	23,898.72	2.62	.009	6,036.28	414,761.15
Major bleeding	31,235.26	2.85	.005	9,702.35	52,768.18
Congestive heart failure	9,422.31	1.98	.048	65.25	18,779.37
Referred	9,629.16	1.97	.049	45.77	19,212.54

Adjusted $R^2 = 0.62$

the costs in NSTEMI/UA with non-standardized coefficients of B = 137,169 and 179,184 respectively. For others, admission to a private hospital, LOS, performing coronary angiogram, death, GPIIb/IIIa inhibitors use, age, cardiac arrhythmia, bleeding complication, CHF and referred patients were all factors that independently affected the costs in NSTEMI/UA with adjusted $R^2 = 0.62$.

Discussion

The costs analyzed in the present study were the sum of all medical services, investigation, treatment procedures and hotel costs that patients had to pay during the admission period. The Median costs among ACS patients groups were significantly different. STEMI had the highest cost, almost 2 times compared to those of NSTEMI and 4 times those of UA. The reason might be from its need for early reperfusion and higher rate revascularization procedures during the early period of admission and consequently had a higher use of antiplalete drugs, clopidogrel and GP IIb/IIIa, including anticoagulant drugs. Furthermore,

higher morbidity and mortality rate definitely explain high costs of care. Anukuoolsawat et al estimated the median direct health care costs for the first admission, the first year and at the end of follow up time in Ramathibodi Hospital to be 75,095, 120,298, and 139,426 baht respectively[1]. The direct medical costs for the first admission in the present study were much higher than that of the presented data, 47,908 baht. This direct health cost, defined as actual costs of medicine, hospital stay, cardiac intervention devices and service that were directly purchased and provided by the health care system. The hospital charges, mostly from the government hospital, for the patients in this registry, were lower than the direct health cost. Eisenstein et al estimated mean costs of ACS, in 1997, during admission, post acute phase and after 10 years of follow up were US$ 23,510, US$ 21,819 and US$ 48,253, respectively[3]. Data reported from a US-based study, first year direct medical cost for treating fatal AMI, non-fatal AMI and UA were US$ 17,532, US$ 15,540 and US$ 12,058 US, respectively[4]. More than 60% of patients of these studies underwent PCI compared with 30% of the present study. As shown in Table 2, the ACS patients had to pay approximately 150,000 and 220,000 baht for Government hospitals for the total expense, including PCI and CABG, respectively. In comparison, the actual costs with ACS during hospitalization, purposed by Piyasirisilp et al in Ramathibodi Hospital during the year of 2002-2003, were 200,000 baht for ACS with PCI and 220,000 baht for CABG[2]. Data from the 2001 National Health Care Cost and Utilization Project show mean charges of US$ 28,558 for PCI and US$ 60,853 for CABG while estimates of cost include more than US$ 12,000 and US$ 30,000 per procedure for PCI and CABG respectively[5]. Mc Collam et al proposed costs of care for new onset ACS who undergo coronary revascularization for the first year to be US$ 24,411 and US$ 43,455 for PTCA and CABG, respectively[6]. The cost of ACS with stenting and GP IIb/IIIa inhibitors in two major clinical Trials, ESPRIT[7] and CARLLAC[8] were US$ 10,722 and US$ 13,413, respectively. Cost effective analysis of routine epitibatide use for treatment in NSTEMI/UA ranged from 9,603-18,115 Euros per year life saved[9]. Although the authors did not have data about the category of stenting including drug-eluting stent, hospital charges in the present study, which included all procedures with GP IIb/IIIa inhibitor use and drug-eluting stent, were much lower than the direct costs as in the US. In RAVEL trial, drug-eluting stent will increase the cost by 1,284 Euros per procedure[9]. However, the follow up cost were reduced and cost-effectiveness was shown when compared to BMS[10]. A Type of payers might be the important factors in decision planning for further management, whether invasive procedure were done or not. A significantly less proportion of patients who paid through social security funds and 30 baht national health scheme had PCI performed, while a higher proportion of patients who paid through private insurance programs usually prefer to be admitted to a private hospital, had undergone these procedures. According to strategies of treatment, the median costs of payment of primary PCI with stents were significantly higher than those of the thrombolytics group but did not save lives during the hospital period in the present study. However, as is evident, significantly more patients in the non-reperfusion group died. In a pooled analysis of 23 randomized trials comparing PCI versus fibrinolysis for STEMI over both the short and the long terms, PCI was superior to fibrinolysis for almost all of the endpoints analysis[11]. Economic analysis has shown, as expected, the initial costs of primary PCI with stents were higher, but were offset by lower follow-up costs after a year[12,13]. In spite of its high cost- management, the early invasive group of NSTEMI/UA in the present study surprisingly showed better short-term outcomes. On the basis of multiple randomized trials, early invasive strategies found similar trends in benefit of death or non-fatal MI over the conservative strategies[14-18] and are now strongly recommended for high-risk patients[19]. There was some argument about these aggressive treatments and their cost effectiveness analyses. Although early invasive strategies had significantly higher initial costs from revascularization procedure, it might be more economically efficient due to both minimizing hospital stays and subsequent hospitalization from reactivated unrevascularized diseases[20]. After analyzing data from univariate methods, the authors used some variables that could explain the costs by developing two multivariate predictive models, STEMI and NSTEMI/UA, with multiple linear regression by the stepwise method as demonstrated in Table 3 and 4. There were similar predictors for both models; PCI, CAG, CABG, admission in a private hospital, GP IIb/IIIa inhibitors use, age, major bleeding, death, and LOS. For STEMI group, DM and thrombolytic drugs were the additional factors for predicting costs. In the NSTEMI/UA group, the CHF, referred patients and ventricular arrhythmia were the additional factors for predicting costs. Gender did not have an effect on either data. CHF, including cardiogenic shock, did not play a role in the STEMI model

due to its high correlation with death. Therefore, was excluded from this model. Etemad et al identified 13,731 patients and reported the majority of the predictor for high-cost managed care with ACS patients was similar as in the present study[21]. Accordingly, data observed from the non-standardized coefficients of B in the multiple linear regression models from the present study, those patients who were admitted with STEMI and NSTEMI/UA and PCI with or without stents had an additional payment of 116,445.59 and 137,169.95 baht, respectively. Owing to the 96.5% of the hospital charges in the present study were represented from those of the government hospital, these predicted values were approximately the same as the civil servant reimbursement values. Although coronary angiography is often viewed as a costly invasive procedure, the cost-effectiveness of routine treatment, guided by its results such as severe angina, strongly positive by exercise stress tests, or previous MI, compared favorably with other treatment strategies[22]. For GPIIb/IIIa inhibitors use, the actual costs were also similar to that from the predicted model from 95% CI 14,000-80,000 baht. Complicated patients, including death, directly affected the costs for both models. Referred patients were charged significantly more than others. This is explained by their complications and need for more invasive procedures. Anyway, these models have to be further used prospectively for testing accuracy. In unpublished data, it is estimated that there is approximately 52,000 admissions for ACS each year in Thailand. Therefore, the economic burden from the direct cost will be 4,000 million and 7,000 million baht for the first admission and the end of first year after acute events, respectively. These data did not include the indirect cost of loss productivity, which may be more than the direct cost for the long-term period. Economic analysis from many data contain important messages for health care purchasers and insurers, many of whom are currently marketing new insurance products with which patients pay more to see physicians or undergo procedures at more costly institutions.

Limitation of study

Data of costs analyzed were in the second and third phase of the registry and the costs available were only the sum of all categories so the authors could not analyze in detail such as IPD pharmacy, laboratory investigation, cardiac catheterization and subsequent procedures including type of stents and hotel cost. Thai ACS registry data were collected only during the hospitalization period so the authors did not have the total cost of payment during long-term period such as OPD visit and readmission event.

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References

1. Anukoolaswat P, Sritara P. Costs of lifetime acute coronary syndrome treatment at Ramathibodi hospital [abstract]. Presented at Annual Meeting of Thai Heart Association of Thailand. Bangkok, Thailand; 2006.
2. Piyasirisilp N, Sritara P, Tangchareonsathien V, Yamwong S, Cheepudomwit S. Hospital cost of acute coronary syndrome in Ramathibodi Hospital, 2002-2003. Thai Heart J 2004; 17: 67-75.
3. Eisenstein EL, Shaw LK, Anstrom KJ, Nelson CL, Hakim Z, Hasselblad V, et al. Assessing the clinical and economic burden of coronary artery disease: 1986-1998. Med Care 2001; 39: 824-35.
4. Russell MW, Huse DM, Drowns S, Hamel EC, Hartz SC. Direct medical costs of coronary artery disease in the United States. Am J Cardiol 1998; 81: 1110-5.
5. Nagle PC, Smith AW. Review of recent US cost estimates of revascularization. Am J Manag Care 2004; 10(11 Suppl): S370-S376.
6. McCollam P, Etemad L. Cost of care for new-onset acute coronary syndrome patients who undergo coronary revascularization. J Invasive Cardiol 2005; 17: 307-11.
7. Cohen DJ, O'Shea JC, Pacchiana CM, Levine G, Sarembock I, Slater J, et al. In-hospital costs of coronary stent implantation with and without eptifibatide (the ESPRIT Trial). Enhanced Suppression of the Platelet IIb/IIIa Receptor with Integrilin. Am J Cardiol 2002; 89: 61-4.
8. Bakhai A, Stone GW, Grines CL, Murphy SA, Githiora L, Berezin RH, et al. Cost-effectiveness of coronary stenting and abciximab for patients with acute myocardial infarction: results from the CADILLAC (Controlled Abciximab and Device Investigation to Lower Late Angioplasty Complications) trial. Circulation 2003; 108: 2857-63.
9. Brown RE, Henderson RA, Koster D, Hutton J, Simoons ML. Cost effectiveness of eptifibatide in acute coronary syndromes; an economic analysis of Western European patients enrolled in the PUR-

SUIT trial. The platelet IIa/IIb in unstable angina: receptor suppression using integrilin therapy. Eur Heart J 2002; 23: 50-8.
10. van Hout BA, Serruys PW, Lemos PA, van den Brand MJ, van Es GA, Lindeboom WK, et al. One year cost effectiveness of sirolimus eluting stents compared with bare metal stents in the treatment of single native de novo coronary lesions: an analysis from the RAVEL trial. Heart 2005; 91: 507-12.
11. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. Lancet 2003; 361: 13-20.
12. Lieu TA, Gurley RJ, Lundstrom RJ, Ray GT, Fireman BH, Weinstein MC, et al. Projected cost-effectiveness of primary angioplasty for acute myocardial infarction. J Am Coll Cardiol 1997; 30: 1741-50.
13. Machecourt J, Bonnefoy E, Vanzetto G, Motreff P, Marliere S, Leizorovicz A, et al. Primary angioplasty is cost-minimizing compared with pre-hospital thrombolysis for patients within 60 min of a percutaneous coronary intervention center: the comparison of angioplasty and pre-hospital thrombolysis in acute myocardial infarction (CAPTIM) cost-efficacy sub-study. J Am Coll Cardiol 2005; 45: 515-24.
14. Cannon CP, Weintraub WS, Demopoulos LA, Vicari R, Frey MJ, Lakkis N, et al. Comparison of early invasive and conservative strategies in patients with unstable coronary syndromes treated with the glycoprotein IIb/IIIa inhibitor tirofiban. N Engl J Med 2001; 344: 1879-87.
15. FRagmin and Fast Revascularisation during instability in coronary artery disease investigators. Invasive compared with non-invasive treatment in unstable coronary-artery disease: FRISC II prospective randomised multicentre study. Lancet 1999; 354: 708-15.
16. Fox KA, Goodman SG, Klein W, Brieger D, Steg PG, Dabbous O, et al. Management of acute coronary syndromes. Variations in practice and outcome; findings from the Global Registry of Acute Coronary Events (GRACE). Eur Heart J 2002; 23: 1177-89.
17. Mahoney EM, Jurkovitz CT, Chu H, Becker ER, Culler S, Kosinski AS, et al. Cost and cost-effectiveness of an early invasive vs conservative strategy for the treatment of unstable angina and non-ST-segment elevation myocardial infarction. JAMA 2002; 288: 1851-8.
18. Effects of tissue plasminogen activator and a comparison of early invasive and conservative strategies in unstable angina and non-Q-wave myocardial infarction. Results of the TIMI IIIB Trial. Thrombolysis in Myocardial Ischemia. Circulation 1994; 89: 1545-56.
19. Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, et al. ACC/AHA 2002 guideline update for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction - summary article: a report of the American College of Cardiology/American Heart Association task force on practice guidelines (Committee on the Management of Patients With Unstable Angina). J Am Coll Cardiol 2002; 40: 1366-74.
20. Mark DB, Lee TH. Conservative management of acute coronary syndrome: cheaper and better for you? Circulation 2002; 105: 666-8.
21. Etemad LR, McCollam PL. Predictors of high-cost managed care patients with acute coronary syndrome. Curr Med Res Opin 2005; 21: 1977-84.
22. Kuntz KM, Tsevat J, Goldman L, Weinstein MC. Cost-effectiveness of routine coronary angiography after acute myocardial infarction. Circulation 1996; 94: 957-65.

ค่าใช้จ่ายในการรักษาพยาบาล ของผู้ป่วย acute coronary syndrome ในคนไทย

วรชาติ โมฬีฤกษ์ภูมิ, รังสฤษฎ์ กาญจนะวณิช, วรวุฒิ จินตภากร, ปิยะมิตร ศรีธรา

ภูมิหลัง: *ภาวะ acute coronary syndrome เป็นภาวะที่มีความสำคัญในลำดับต้น ๆ ของสาธารณสุขทั่วโลกรวมทั้งประเทศไทย ซึ่งก่อให้เกิดภาวะสูญเสียทางเศรษฐกิจอย่างมหาศาล การศึกษานี้จึงเป็นการวิเคราะห์ค่าใช้จ่ายในการรักษาพยาบาล จากการนอนโรงพยาบาลครั้งแรกของผู้ป่วยกลุ่มนี้*

วัตถุประสงค์: *เพื่อหาค่ากลาง ของค่ารักษาพยาบาลทั้งหมด ที่ผู้ป่วยจำเป็นต้องจ่ายให้โรงพยาบาลด้วยภาวะ ACS และหาปัจจัยต่าง ๆ ทางคลินิก และการรักษาที่มีผลต่อค่าใช้จ่ายของผู้ป่วย*

วัสดุและวิธีการ: *เป็นการวิเคราะห์ผลของข้อมูลผู้ป่วย 3,552 คน ที่เก็บในช่วงเฟสที่ 2 และ 3 ของการศึกษา Thai ACS registry*

ผลการศึกษา: *มีค่าเฉลี่ยกลางอายุเท่ากับ 67 ปี (26.5-105.5) ผู้ชาย 65.9% ค่าเฉลี่ยกลางของระยะการนอนโรงพยาบาล 7 วัน (1-184) และ 42% เป็นผู้ป่วยที่ได้รับการได้รับส่งต่อมาจากโรงพยาบาลอื่น ค่าเฉลี่ยกลางของค่าใช้จ่ายในการนอนโรงพยาบาล ของผู้ป่วยทั้งหมด เท่ากับ 47,908 บาท (633-1,279,679) แบ่งเป็นผู้ป่วย ST segment elevation MI เท่ากับ 82,848.5 บาท non ST segment elevation MI เท่ากับ 40,531 บาท unstable angina เท่ากับ 26,116 บาท มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ผู้ป่วยที่ต้องมีการทำหัตถการคือ การทำ PCI มีค่าเฉลี่ยกลางการใช้จ่ายในโรงพยาบาลรัฐบาลทั้งหมด 152,081-161,374 บาท และ การทำ CABG 203,139-223,747 บาท ซึ่งต่ำกว่าค่าใช้จ่ายในโรงพยาบาลเอกชน ประมาณ 2 เท่า ถ้าแบ่งกลุ่มตามสิทธิเบิกจ่าย พบว่าค่าใช้จ่ายของกลุ่มที่ทำประกันและต้นสังกัดบริษัทเอกชนมีค่าใช้จ่ายสูงที่สุด รองลงมา กลุ่มที่จ่ายเองรวมทั้งต้นสังกัดของข้าราชการ และรัฐวิสาหกิจ ส่วนกลุ่มประกันสังคม และประกันสุขภาพ 30 บาท มีค่าใช้จ่ายต่ำสุด ถ้าจัดค่าใช้จ่ายตามวิธีการรักษาผู้ป่วย STEMI ผู้ป่วยในกลุ่ม thrombolysis มีค่าเฉลี่ยกลางของค่าใช้จ่ายในกลุ่ม STEMI เท่ากับ 60,043.00 บาท กลุ่ม primary PCI เท่ากับ 161,096.50 บาท และกลุ่ม no reperfusion เท่ากับ 33,335.00 บาท มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ส่วนกลุ่ม NSTEMI/UA แบ่งเป็น กลุ่ม early invasive เท่ากับ 145,794.00 กลุ่ม conservative เท่ากับ 47,908 บาท และ จากการใช้สมการวิเคราะห์ความถดถอยเชิงพหุ เพื่อดูว่าปัจจัยอิสระใดที่มีผลกระทบต่อค่าใช้จ่ายในการรักษาพยาบาลผู้ป่วยพบว่า ภาวะ STEMI มีปัจจัยที่เป็นปัจจัยอิสระ คือ การทำ PCI ระยะเวลาที่นอนโรงพยาบาล การทำ CABG การนอนในโรงพยาบาลเอกชน การเสียชีวิต การใช้ยา GP IIb/IIIa inhibitors การเสียเลือด การทำฉีดสี ดูหลอดเลือดหัวใจ การได้ยา thrombolytics อายุ และ เบาหวาน โดยมีค่า R^2 = 0.58 ส่วนภาวะ NSTEMI/UA ได้แก่ การฉีดสีดูหลอดเลือดหัวใจ ระยะเวลาการนอนโรงพยาบาล การทำ PCI การทำ CABG การนอนโรงพยาบาลเอกชน การเสียชีวิต การใช้ยา GP IIb/IIIa inhibitors อายุ ภาวะหัวใจเต้นผิดจังหวะ การเสียเลือด ภาวะหัวใจล้มเหลว และผู้ป่วยที่ได้รับการส่งต่อ มีค่า R^2 = 0.62*

สรุป: *ค่าเฉลี่ยกลางของค่าใช้จ่าย มีความแตกต่างกันระหว่างกลุ่มโรค วิธีการรักษา ประเภทของโรงพยาบาล สิทธิการเบิกจ่าย ภาวะแทรกซ้อนต่าง ๆ และ ปัจจัยต่าง ๆ เหล่านี้ เป็นปัจจัยอิสระที่มีผลต่อค่ารักษาพยาบาล จากการวิเคราะห์สมการความถดถอยเชิงพหุ*