

CHAPTER 4

ANALYSIS AND RESULTS

In this chapter the results are presented the effect of patient, physician, and hospital characteristic on inpatient charge of open-heart surgery and burden of payment for medical treatment to the hospital. The analysis is structured as follows:

- (1) Descriptive analysis of characteristic of factors determines inpatient charge of open-heart surgery.
- (2) Estimated model of characteristic of factor determines inpatient charge of open-heart surgery.
- (3) Evaluation of inpatient charges for open-heart surgery.

4.1 Descriptive Analysis of Characteristics of Factors Determine Inpatient Charge

According to the methodology design in previous chapter, the inpatient charge will be determined by the patient characteristic, physician characteristic, and hospital characteristic. This section provides all characteristics of determinant affecting the inpatient charge.

The data is selected from 906 cases of open-heart surgery that were admitted to public hospital and university hospital in Thailand in fiscal year 2001. The characteristics of patient, physician, and hospital are presented as following:

Table 4.1 Sex and inpatient charge of open-heart surgery

Sex	Number of cases	Average charge	% of total cases
Male	503	103,223.90	55.5
Female	403	84,487.35	44.5
Total	906	94,889.63	100

The table 4.1 shows that 55.5% of patients are males and the remaining are females. The average charge of male and female are 103,223.90 bahts, 84,487.35 bahts respectively. The males' charge is higher than females' one.

Table 4.2 Ages and Inpatient Charge of Open-heart Surgery

Age	Number of cases	Average charge	%of total cases
0 – 12	127	73,543.54	14.0
13 – 40	223	66,947.07	24.6
41 – 60	269	93,917.75	29.7
> 60	297	126,957.86	31.7
Total	906	94,889.63	100

Table 4.2 shows that 14% of patients are under 13 years old and 24.6%, 29.7%, and 31.7% of patient are between 13-40 years old, 41-60 years old, and over 60 years old respectively. Average charge of patients with less than 13 years old, between 13-40 years old, 41-60 years old, and over 60 years old are 73,543.54 bahts, 66,947.07 bahts, 93,917.75 bahts, and 126,957.86 bahts respectively.

Table 4.3 Severity of Illness and Inpatient Charge of Open-heart Surgery

Severity of illness	Number of cases	Average charge	% of total cases
One diagnosis	446	83,264.59	49.2
Two diagnosis	261	92,264.89	28.8
Three diagnosis	199	124,386.26	22.0
Total	906	94,889.63	100

Table 4.3 shows that 49.2%, 28.8%, and 22.0% of the patient are treated in one diagnosis, two diagnoses, and three diagnoses respectively. It notes that 49.2% of patients have severity of illness under one diagnosis.

Average charge of three diagnoses, two diagnoses, and one diagnosis are 124,386.26 bahts, 83,264.59 bahts, and 922,64.89 bahts, respectively.

Table 4.4 Intensity of Operative Procedure and Inpatient Charge of Open-heart Surgery

Intensity of operation	Number of cases	Average charge	% of total cases
One procedure	698	87,739.37	77.1
Two procedures	173	120,846.68	19.1
Three procedures	14	107,333.50	1.5
Four procedures	21	110,418.29	2.3
Total	906	94,889.63	100

Table 4.4 shows that 77.1%, 19.1%, 2.3%, and 1.5% of patients are operated in one procedure, two procedures, four procedure, and three procedure respectively.

Average charge of two procedures, four procedures, three procedures, and one procedure are 120,846.68 bahts, 110,418.29 bahts, and 107,333.50 bahts, and 87,739.37 bahts, respectively.

Table 4.5 Patient types of Payment and Inpatient Charge of Open-heart Surgery

Type of payment	Number of cases	Average charge	% of total cases
Out of pocket	142	100,935.11	15.7
Civil Servant Medical Benefit	112	58,807.13	12.3
MOPH subsidized	510	103,617.15	56.3
Social security scheme	142	85,958.27	15.7
Total	906	94,889.63	100

Table 4.5 shows that 84.3% of patients have privilege for healthcare services. The biggest group of privilege for healthcare services of open-heart surgery is Ministry of

Public Health subsidized (health card, social welfare card) 56.3%. 15.7% and 12.3% of patients have social security insurance, and out of pocket or life insurance respectively.

Average charge of Ministry of Public Health subsidized, out of pocket, social security scheme, and civil servant medical benefit are 103,617.15 bahts, 100,935.11 bahts, 85,958.27 bahts, and 58,807.13 bahts respectively.

Table 4.6 Types of Hospital and Inpatient Charge of Open-heart Surgery

Hospital type	Number of cases	Average charge	% of total cases
Regional hospital	61	65,136.98	6.7
Special hospital	39	87,450.05	4.3
University hospital	806	97,501.36	89.0
Total	906	94,889.63	100

906 cases of open-heart surgery are selected for this study 89%, 6.7%, and 4.3% of patient cases are admitted in university hospital, regional hospital, and special hospital respectively.

Average charge of university hospital, special hospital, and regional hospital are 97,501.36 bahts, 87,450.05 bahts, and 65,136.98 bahts respectively.

Table 4.7 Operation type and Inpatient Charge

Operation type	Number of cases	Average charge	% of total cases
Ordinary open heart	308	82,384.51	34.00
Coronary artery bypass graft	194	72,468.96	21.40
Complex congenital operation	404	115,189.61	44.60
Total	906	94889.63	100

Table 4.7 shows that 34%, 21.40%, and 44.60% of patient operated open-heart are surgery by ordinary open heart, coronary artery bypass graft, and complex congenital operation respectively.

Average charge of coronary artery bypass graft, ordinary open heart, and complex congenital operation are 115,189.61 bahts, 82,384.51 bahts, and 72,468.96 bahts respectively.

4.2 Estimation of Model

This section presents the estimation results of general linear regression model for the characteristics of patient, physician practice, and hospital regarding inpatient charge of open-heart surgery. The general linear regression model will be used to estimate the relationship between inpatient charge and the explanatory variables. This estimated regression expected to be used as the criteria that can reflect the relationship between various existing conditions and the charge. The estimated charge will then be calculated for each type of inpatient. By using this concept of charge, it is expected that criteria of charge and reimbursement charge can be obtained by the standardized condition being constructed finally.

The model of the characteristics of patient, physician practice, and hospital as proximate to inpatient charge of open-heart surgery are estimated by general linear regression model as following:

$$\begin{aligned} \text{IPCHAG} = & a_0 + a_1 \text{SEX} + a_2 \text{AGE1} + a_3 \text{AGE2} + a_4 \text{AGE3} + a_5 \text{LOS} + \\ & a_6 \text{SEVERE1} + a_7 \text{SEVERE2} + a_8 \text{INTENSE1} + a_9 \text{INTENSE2} + \\ & a_{10} \text{INTENSE3} + a_{11} \text{PTTYP1} + a_{12} \text{PTTYP2} + a_{13} \text{PTTYP3} + \\ & a_{14} \text{PROC1} + a_{15} \text{PROC2} + a_{16} \text{TYPHOS2} + a_{17} \text{TYPHOS3} + e \end{aligned}$$

Table 4.8 Estimated Regression Models of Determinant Factors for Inpatient Charge of Open-heart Surgery (model 1)

Variable	Coefficient	Std. Error	t-statistic	Prob.
(Constant)	47810.41	24586.349	1.945	0.052
SEX	-5756.276	3812.044	-1.51	0.131
AGE1	-53418.198	7428.934	-7.191	0.000*
AGE2	-35927.142	6805.454	-5.279	0.000*
AGE3	-21867.628	5196.388	-4.208	0.000*
LOS	2376.239	69.899	33.996	0.000*
SEVERSE1	-1662.872	5040.175	-0.33	0.742
SEVERSE2	-5419.462	5259.164	-1.03	0.303
INTENSE1	5166.608	13029.684	0.397	0.692
INTENSE2	24108.184	13402.205	1.799	0.072
INTENSE3	19294.466	18868.507	1.023	0.307
PTTYP1	7479.354	7021.028	1.065	0.287
PTTYP2	-8721.026	7296.26	-1.195	0.232
PTTYP3	19867.181	5672.508	3.502	0.000*
PROC1	-5456.087	18478.862	-0.295	0.768
PROC2	-3068.368	19248.744	-0.159	0.873
TYPHOS2	-25964.321	12010.647	-2.162	0.031**
TYPHOS3	24664.373	8211.98	3.003	0.003**
R Square	.627	Std. Error of regression		54284
Adjusted R Square	.619	F – Statistic		87.641

Note: " * " the probability significant at 1% level

"**" the probability significant at 5% level

Where	AGE1	=	0-12 years old
	AGE2	=	13-40 years old
	AGE3	=	41-60 years old
	LOS	=	Length of stay
	SEVERES1	=	Patient with one diagnosis
	SEVERSE2	=	Patient with two diagnosis
	INTENSE1	=	Patient with one operation
	INTENSE2	=	Patient with two operation
	INTENSE3	=	Patient with three operation
	PTTYP1	=	Out of pocket
	PTTYP2	=	Civil servant medical benefit scheme
	PTTYP3	=	Ministry of Public Health subsidized
	PROC1	=	Ordinary open heart
	PROC2	=	Coronary artery bypass graft
	TYPHOS2	=	Special hospital
	TYPHOS3	=	University hospital

The results of regression analysis from SPSS version 10.0 program to determine which following independent variables have relation with inpatient charge of open-heart surgery in fiscal year 2001 is showed in table 4.8. The independent variables are sex of patient, age of patient, length of stay, number of diagnosis, number of operative procedure, privilege for open-heart surgery, type of operation, and type of hospital. Correlation analysis and multicollinearity diagnostic test found that there are no correlation and multicollinearity with the other independent variables. As table 4.8, the factors that significantly relate to inpatient charge of open-heart surgery are age, length of stay, privilege for open-heart surgery, and type of hospital.

The factors that are significantly related to inpatient charge of open-heart surgery are AGE1, AGE2, AGE3, LOS, PTTYP3, TYPHOS2, and TYPHOS3.

To check if Proc3 is significant, model 2 is introduced.

Model 2:

- Replacement of dummy variables of number of diagnosis with SEVERE2 and SEVERE3
- Replacement of dummy variables of number of operative procedure with INTENSE1, INTENSE3, INTENSE4
- Other variables are constant
- And estimation of the regression model again, as formulas:

$$\begin{aligned} \text{IPCHAG} = & a_0 + a_1 \text{SEX} + a_2 \text{AGE1} + a_3 \text{AGE2} + a_4 \text{AGE3} + a_5 \text{LOS} + \\ & a_6 \text{SEVERE2} + a_7 \text{SEVERE3} + a_8 \text{INTENSE1} + a_9 \text{INTENSE3} + \\ & a_{10} \text{INTENSE4} + a_{11} \text{PTTYP1} + a_{12} \text{PTTYP2} + a_{13} \text{PTTYP3} + \\ & a_{14} \text{PROC2} + a_{15} \text{PROC3} + a_{16} \text{TYPHOS2} + a_{17} \text{TYPHOS3} + e \end{aligned}$$

As a result in table 4.9 the factors that significantly relate to inpatient charge of open-heart surgery are age, length of stay, number of operative procedure, type of payment, and type of hospital.

Table 4.9 Estimated Regression Models of Determinant Factors for Inpatient Charge of Open-heart Surgery (model 2)

Variable	Coefficient	Std. Error	t-statistic	Prob.
(Constant)	64799.636	13775.106	4.704	0.000*
SEX_GR	-5756.276	3812.044	-1.51	0.131
AGE1	-53418.198	7428.934	-7.191	0.000*
AGE2	-35927.142	6805.454	-5.279	0.000*
AGE3	-21867.628	5196.388	-4.208	0.000*
LOS	2376.239	69.899	33.996	0.000*
SEVERSE2	-3756.59	4368.299	-0.86	0.390
SEVERSE3	1662.872	5040.175	0.33	0.742
INTENSE1	-18941.577	5018.931	-3.774	0.00*
INTENSE3	-4813.718	15589.612	-0.309	0.758
INTENSE4	-24108.184	13402.205	-1.799	0.072
PTTYP1	7479.354	7021.028	1.065	0.287
PTTYP2	-8721.026	7296.26	-1.195	0.232
PTTYP3	19867.181	5672.508	3.502	0.000*
PROC2	2387.719	5491.164	0.435	0.664
PROC3	5456.087	18478.862	0.295	0.768
TYPHOS2	-25964.321	12010.674	-2.162	0.031**
TYPHOS3	24664.373	8211.98	3.003	0.003**
R Square	.627	Std. Error of regression	54284	
Adjusted R Square	.619	F – Statistic	87.641	

Note: " * " the probability significant at 1% level

"**" the probability significant at 5% level

Where

SEVERES1	=	Patient with one diagnosis
INTENSE4	=	Patient with four operation
PROC3	=	Complex congenital operation

The factors that are significantly related to inpatient charge of open-heart surgery are AGE1, AGE2, AGE3, LOS, INTENSE1, PTTYP3, TYPHOS2, and TYPHOS3.

Sex

The coefficient of SEX has negative coefficient but is not significant inpatient charge and t-statistic is very low. This result is indicated that SEX variable does not affect to inpatient charge of open-heart surgery.

Age

From table 4.9, ages of patients are significantly related with inpatient charge of open-heart surgery and have negative relationship at confidence level 1%. Ages of patient are dummy variables and classified into 4 group, 0-12 years old (AGE1), 13-40 years old (AGE2), 41-60 years old (AGE3), 60 years up (AGE4).

Age of patient is significantly related with inpatient charge of open-heart surgery in negative direction. If age of patient is 0-12 years old the average inpatient charge will decrease 53,418.198 bahts. If age of patient is 13-40 years old the average inpatient charge will decrease 35,927.142 bahts, while 41-60 years old will decrease 21,867.628 bahts.

Length of stay

Lengths of stay is significantly related with average inpatient charge of open-heart surgery and has positive relationship at confidence level 1%. From the result in

table 4.9 if length of stay increase 1 day, the average inpatient charge will increase 2,376.239 bahts.

Severity of illness

The severity of illness (SEVERSE) has negative coefficient but is not significant inpatient charge equation and t-statistic is very low. This result is explained that severity of illness is not affected inpatient charge.

Intensity of operative procedure

The intensity of operative procedure (INTENSE) are significantly related with average inpatient charge of open-heart surgery and have negative relationship at confidence level 1%. The intensity of operative procedure are dummy variables and classified into 4 level, one operation (INTENSE1), two operations (INTENSE2), three operations (INTENSE3), and four operations (INTENSE4).

The patient with only one operative procedure (INTENSE1) is significantly related with average inpatient charge of open-heart surgery in negative direction. If the number of operative procedure is one operation the average inpatient charge will decrease 18,941.577 bahts.

Patient types of payment

Patient type of payment is significantly related with average inpatient charge of open-heart surgery and has positive relationship at confidence level 1%. The patient type of payment are dummy variables and classified into 4 groups, out of pocket (PTTYP1), civil servant medical benefit scheme (PTTYP2), Ministry of Public Health subsidized (PTTYP3), social security scheme (PTTYP4).

Ministry of Public Health subsidized (PTTYP3) is significantly related with average inpatient charge of open-heart surgery in positive direction. If the type of payment is Ministry of Public Health subsidized the average inpatient charge will increase 19,867.181 bahts.

Types of operation

From table 4.9, all types of operation have negative coefficient but are not significant different from zero. This result implies that operation types are not effect inpatient charge of open-heart surgery.

Types of hospital

From table 4.9, levels of hospital are significantly related with inpatient charge of open-heart surgery and have positive relationship at confidence level 1%. The levels of hospital are dummy variables and classified into 3 level, regional hospital (TYPHOS1), special hospital (TYPHOS2), and university hospital (TYPHOS3).

Special hospital (TYPHOS2) is significantly related with inpatient charge of open-heart surgery in negative direction. If the hospital is a special hospital the average inpatient charge will decrease 25,964.321 bahts. University hospital (TYPHOS3) is significant related with inpatient charge of open-heart surgery in positive direction. If the hospital is university hospital the average inpatient charge will increase 5,456.087 bahts.

The overall result of the linear regression model suggests that the estimated coefficient with length of stay, Ministry of Public Health subsidized, and university hospital are positive. This implies that the probability the patient operated heart increase with any positive change in each those attributes. The positive change means that if for example, the patient stays in the university hospital, or Ministry of Public Health subsidized, and then it was more likely to charge of open-heart surgery more than patient stays in the special hospital. On the other hand, the coefficients associated with

age, intensity of operative procedure, and special hospitals are negative effects to inpatient charge of open-heart surgery.

The correction of forecasting of inpatient charge of open-heart surgery with all independent variable was 62%. It seems to be high because seven out of seventeen independent variables were significant.

Model 1 and Model 2 found that type of operation are not significantly related with inpatient charge of open-heart surgery. However, We cannot assist that type of operation never effects to inpatient charge. According to correlation matrix test, we found that there is no multicollinerity. Nevertheless, data in this study are further tested and compared with factors that affect to operation, for example, length of stay, type of hospital, and intensity of operative procedure.

Table 4.10 Comparison of Types of Operation and Length of Stay

Operation	N	Minimum	Maximum	Mean	Std.
Ordinary open heart	308	1	139	14.89	12.41
Coronary artery bypass graft	194	4	672	22.99	50.26
Complex congenital operation	404	1	123	19.02	16.77

Table 4.10 shows that minimum average length of stay is 15 days in ordinary open heart. At the same time, minimum average length of stay of coronary artery bypass graft and complex congenital operation are 23 days and 19 days respectively.

Table 4.11 Comparison of Types of Operation in Different Level Hospital

Hospitals	% of Ordinary Open Heart	% of Coronary Artery Bypass Graft	% of Complex Congenital Operation
Regional hospitals	2.9	24.7	1.0
Special hospitals	0.6	14.4	2.2
University hospitals	96.4	60.8	96.8

The percentage of ordinary open differs in different level of hospitals. From 100 cases, regional hospitals treat about 2.9 cases. Special hospitals treat about 0.6 cases, while university hospitals treat about 96.4 cases from 100 cases. Special hospitals have percentages of operation cases lowest of 0.6, which may indicate that the proportion of operation cases in special hospitals are usually referring patients out to a higher level of hospital for more complex care. The capability of treating complex cases in regional hospitals and special hospitals are lower than university hospitals.

Table 4.12 Comparison of Percentage of Intensity of Operative Procedure in Different Operation

Operation	Percentage of One Procedure	Percentage of Two Procedure	Percentage of Three Procedure	Percentage of Four Procedure
Ordinary open heart	74.7	24.3	1.0	-
Coronary artery bypass graft	62.4	24.2	4.1	9.3
Complex congenital operation	85.9	12.6	0.7	0.7

Our research selects 100 operation cases from each operation with one operation. We found that numbers of one, two, three, four procedures are 74.7, 24.3, 1.0 and 0.0 cases in ordinary open heart respectively. The number of one, two, three, four procedures are 62.4, 24.2, 4.1, and 9.3 cases in coronary artery bypass graft and 85.9, 12.6, 0.7 and 0.7 cases in complex congenital.

The percentage of numbers of operative procedure differs according to different operation. Numbers of operation of Ordinary open heart are 3 times, while numbers of Coronary artery bypass graft and complex congenital operation are 4 times. Consequently, we can summary that numbers of operation depend on complexity of operation.

4.3 A Revised Model of Inpatient Charge

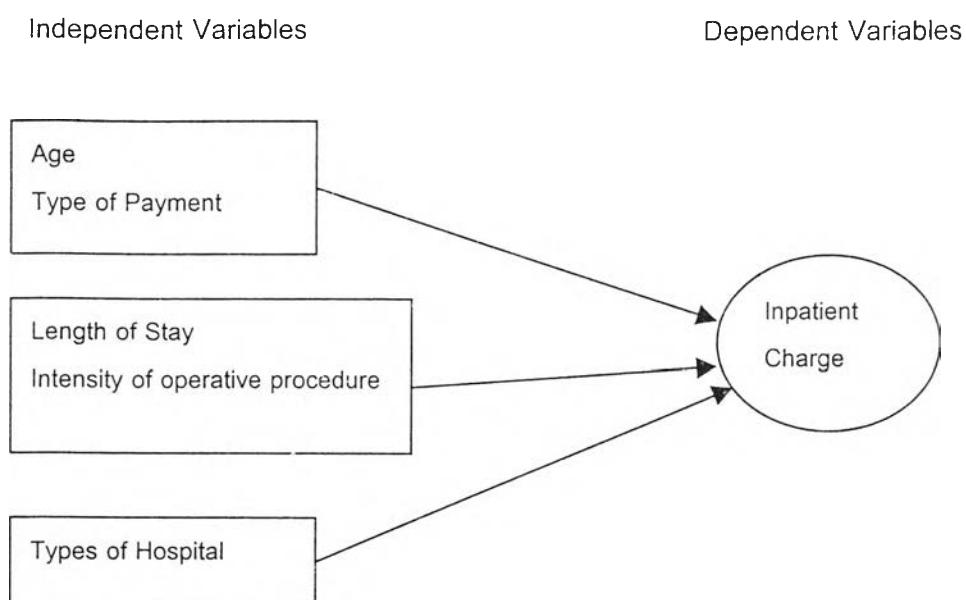


Figure 4.1 Relationships between Patient Characteristics, Physician Characteristic, Hospital Characteristics and Inpatient Charge

It can be concluded that eight explanatory variables are involved for inpatient charge (Inchg). Length of stay (LOS), MOPH subsidized patient type (PTTYP3), and university hospitals (TYPHOS3) have positive effects while a special hospital (TYPHOS2), intensity of operative procedure (INTENSE1), and age of patient 0-12 years old (AGE1). 13-40 years old (AGE2), 41-60 years old (AGE3) have negative effect on inpatient charge. Hence, firstly, the more patients stay in a hospital, the higher inpatient charges. Secondly, a patient is subsidized by the Ministry of Public Health, either being eligible for the low - income scheme, Health Card Scheme or any other MOPH subsidized patient, the higher inpatient charge. Thirdly, the more age a patient is, the higher inpatient charge. And finally, the higher level of hospital a patient stays, the higher inpatient charges a patient pay.

4.4 Analysis of evaluation of inpatient charges for open-heart surgery

In this study, type of surgery can be divided into 3 groups, for example, ordinary open-heart, coronary artery bypass graft and complex congenital operation. Consequently, cost of surgery and inpatient charge are compared and analyzed in same level of hospitals. The comparison of average cost of surgery in Ratchawithi hospital and average charge in Chest Disease Center is shown in table 4.12

Table 4.13 Comparisons of Average charge with Average Cost of Open-heart Surgery in the Same Level Hospital

Operation	Ratchawithi hospital Average cost (baht)	Chest Center Hospital Average charge (baht)
Ordinary open heart	82,578.19	57,372
Coronary artery bypass graft	95,389.82	72,695.68
Complex congenital operation	169,592.83	140,036.6
Total	112,355.98	87,450.05

Table 4.13 shows that the average costs in Ratchawithi hospital are higher than average charge in this study. Ordinary open heart, coronary artery bypass graft and complex congenital operation in Ratchawithi hospital are 82,578.19 bahts, 95,389.82 bahts and 169,592.83 baht are respectively higher than average charge in this study (57,372 bahts, 72,695.68 bahts, and 140,036.6 bahts).

Table 4.14 Descriptive statistic of the variables in different operation

Variables	Ordinary Open Heart	Coronary Artery Bypass Graft	Complex Congenital Operation
Average age	40	19	55
Average length of stay	12	9	68

Table 4.14 shows that average age varies according to different operation. Maximum of average age is 55 years in complex congenital operation, 40 years in ordinary open heart, and 19 years in coronary artery bypass graft.

At the same time, average length of stay also varies according to different operation. Maximum of average length of stay is 68 days in complex congenital operation, 12 days in ordinary open heart, and 9 days in coronary artery bypass graft.

Tables 4.15 Descriptive statistic of the percentage variables in different operation in special hospital

Variables	Proc. 1	Percentage	Proc. 2	Percentage	Proc. 3	Percentage
Sex	Male	53.3	Male	100	Male	75
Severity of illness	One diagnosis	86.7	Three diagnosis	100	One diagnosis	50
Intensity of operative procedure	1 procedure	86.7	2 procedures	100	1 procedure	100
Type of payment	MOPH	100	MOPH	100	SSO	75
Procedure	1	100	2	100	3	100
Type of hospital	Special	100	Special	100	Special	100

Note: Proc1= ordinary open heart

Proc2= coronary artery bypass graft

Proc3= complex congenital operation

Table 4.15 shows that most of operative sex is male in open-heart surgery. We found that percentages of male are 53% in ordinary open heart, 100% in coronary artery bypass graft and 75% in complex congenital operation.

In term of severity of illness, we found that 86.7% of patients with one diagnosis are in ordinary open heart, 50% of patients with one diagnosis are in complex congenital operation, while 100% of patients with three diagnoses are in coronary artery bypass.

In term of intensity of operative procedure, we found that 86.7% of patients with one procedure are in ordinary open heart, 100% of patients with one procedure are in complex congenital operation, and 100% of patients with two procedures are coronary artery bypass graft.

In term of type of payment, we found that 100% of patients with ordinary open heart and coronary artery bypass graft; Ministry of Public Health will subsidize payment. 75% of patients with complex congenital operation, Social Security Scheme will subsidize payment.

Table 4.16 Comparison of Average Cost with Average Charge and Estimate Charge of Ratchawithi Hospital

Operation	Average Cost	Average Charge	Estimated Charge
Ordinary open heart	85,578.19	62,554.00	26,592.37
CABG	95,389.82	68,235.00	42,455.79
Complex Congenital	169,592.83	97,835.75	125,605.00

Table 4.16 shows that average cost is higher than average charge and estimated charge in every operation of this study because charge is determined according to charge item of National Standardizing Price of the Ministry of Public Health 1994. Moreover, we found that average cost, average charge and estimated charge directly vary to complexity of operation. We can summary that charges and costs are positive relationships. This table of the comparison implies that the model is quite consistent with the average cost. If the model is used to guide for the charge and/or reimbursement the current average charge seems to be under estimated for the complex congenital operation but it puts too heavy weight on the ordinary open heart operation.