CHAPTER 4

RESULTS AND ANALYSIS

Although a total of 30 cases of heart transplantation have been performed in Chulalongkorn Hospital since 1987, only the cost of 12 patients could be collected. This is due to that only the medical records of the patients who are still alive could be got from different departments. However, the remaining data could still provide us some useful information on the resource consumption of the operation, and the methodology developed in this study could be used as a basis for future indepth study of this subject.

According to the study design, only the provider costs of heart transplantation from the day of operation to the day of discharge are studied. After all the data are collected from different sources, the Lotus123 worksheet has been created, and all the relevant cost items are input and calculated.

General Characteristics of the Subjects

The general characteristics of the study subjected are described in Table 4.1.

Table 4.1 Characteristics of the 12 patients in the study

Characteristics	Mean ± SD	Median	Mode	Range
Age (year)	38 ± 11	37	41	16-57
Length of stay from operation to discharge	60 ± 25	51	68	27-113
Length of stay in ICU	9 ± 5	7	7	4-21
Length of stay in ward	52 ± 22	42	42,61	22-102
Operating time (hour)	4.6 ± 1.3	4	4	3-7

Ratio of male to female = 3:1

Diagnosis:

(1) Dilated cardiomyopathy	8	(67%)
(2) Ischemic Heart Disease	2	(17%)
(3) Others	2	(16%)

Survival > 3 months 12 (100%)

Most of the patients (75%) receiving heart transplantation in this study are males. and the principal indication for the operation was dilated cardiomyothy. The average length of stay from operation to discharge was 60 days. The average operating time is 4.6 hours. All the studied subjects survived over 3 months after operation, which is the most difficult time with the highest mortality rate during this period. The length of stay both in the hospital and in the surgical ward vary, which are due to the actual condition of the patients, occurrence of rejection, infections and other complications.

Average Costs

1. The comparability of the costs

In this study, all the unit costs are estimated based on the price of 1994. The actual consumptions of different resources are obtained from different departments. For example, quantity of drug used by the specific patient is retrieved from the medical record; supplies consumed for a specific patient are obtained from the records of the operating room, the ICU and the ward, the using time of the equipment are from the corresponding departments. Based on the actual consume of resource by the specific patient and the unit costs, total costs are calculated. Therefore, the costs of different patients in different years are comparable and there is no need to discount.

2. The average cost

Of the 12 patients, the average cost was Bt288,262, ranging from Bt205,802 to Bt460,251 (see Table 4.2). The costs for the patients vary, which are mainly due to treatment of infections, rejection and other complications. In analyzing the component of cost, it was found that the length of stay, both in special care and regular nursing unit, account for the most of the cost.There are many factors that influence the length of stay, it is generally believed that better immuno-suppressive agents, such as cyclosporine, will markedly reduce the length of the hospital stay and resulting with fewer complications and lower costs. Patient selection criteria are also very important in influencing the costs, for example, older and more severe patients are now undergoing the procedure. Some of these cases have proven to be both complicated and incurred more cost.

Table 4.2 Average costs and length of stay of the studied subjects

Patient No.	Costs(Bt)	Length of Stay*
1	219,562	43
2	257,652	68
3	460,251	105
4	404,025	113
5	277,090	64
6	258,463	48
7	368,363	53
8	245,075	51
9	232,872	38
10	268,452	47
11	205,802	27
12	261,537	68
Mean	**288,262**	**60**

* From the day of operation to the day of discharge

3. Cost by Components

In the context of this study, costs components among the patients are varied and the variations are different among the categories. From Table 4.3, we could see that average capital and recurrent costs are Bt 24,738 and Bt 263,524, respectively (see Table 4.3).

Table 4.3 The average cost by type of inputs (in Bt, 1994's price)

Type of input	Mean ± SD	Range	%
Capital Cost	24,738 ± 5,381	17,989-37,228	8.58
Recurrent cost	263,524 ± 71,503	171,512-414,835	91.42
Total provider cost	**288,262 ± 75,777**	**205,802-460,251**	**100.00**

In the study, we found that recurrent costs are the major parts of the aggregate costs, which accounts for 91% of the total costs, while the capital costs are only 9% (Figure 4.1). There are quite a few factors that may contribute to the low profile of capital categories, but one main factor is that some of the equipment costs are already included in different recurrent cost components, such as the laboratory

tests, diagnosis and radiology costs.

Table 4.4 Capital cost by components (in Bt, 1994's price)

Cost Category	Mean ± SD	Range	%
Vehicle	583 ± 493	0-1,000	2.35
Building space	6,642 ± 2,858	2,374-12,524	26.84
OR Equipment	7,443 ± 3,233	4,907-16,549	30.08
ICU Equipment	10,067 ± 3,631	7,179-19,277	40.69
Total capital cost	**24,738 ± 5,381**	**18,727-37,228**	**100.00**

In this study, capital costs only account for less than 9% of the total costs, of which, the costs for ICU equipment are the biggest item. It may be because that cost of building and other equipment are lower that of the other studies. There is also possibility of under-estimation for some of the capital items, such as cost for occupying OR or surgical ward. Another reason is that some of the capital costs are already included in the costs of laboratory tests, radiology etc. All those factors will result in the lower capital costs in this study.

Compared with capital costs, the recurrent costs take up about 91% of the total costs, which is shown in Table 4.5.

Figure 4.1 Percentage of Capital and Recurrent Costs

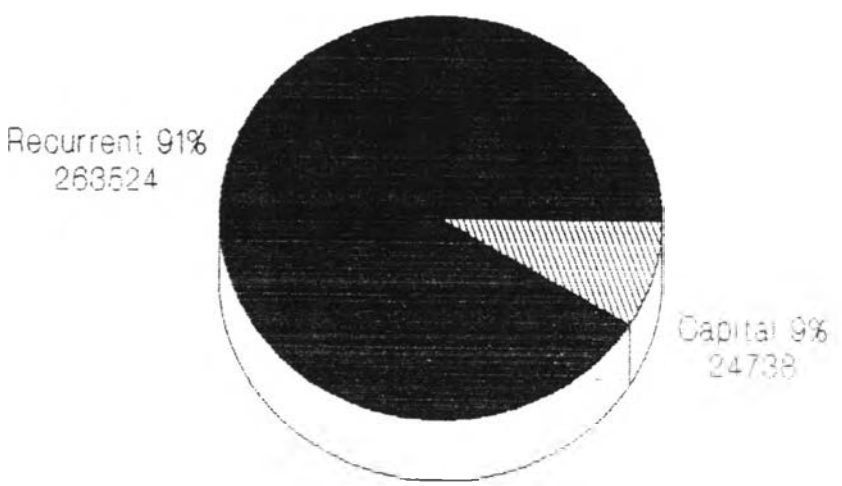


Table 4.5 Recurrent cost by component (in Bt, 1994's price)

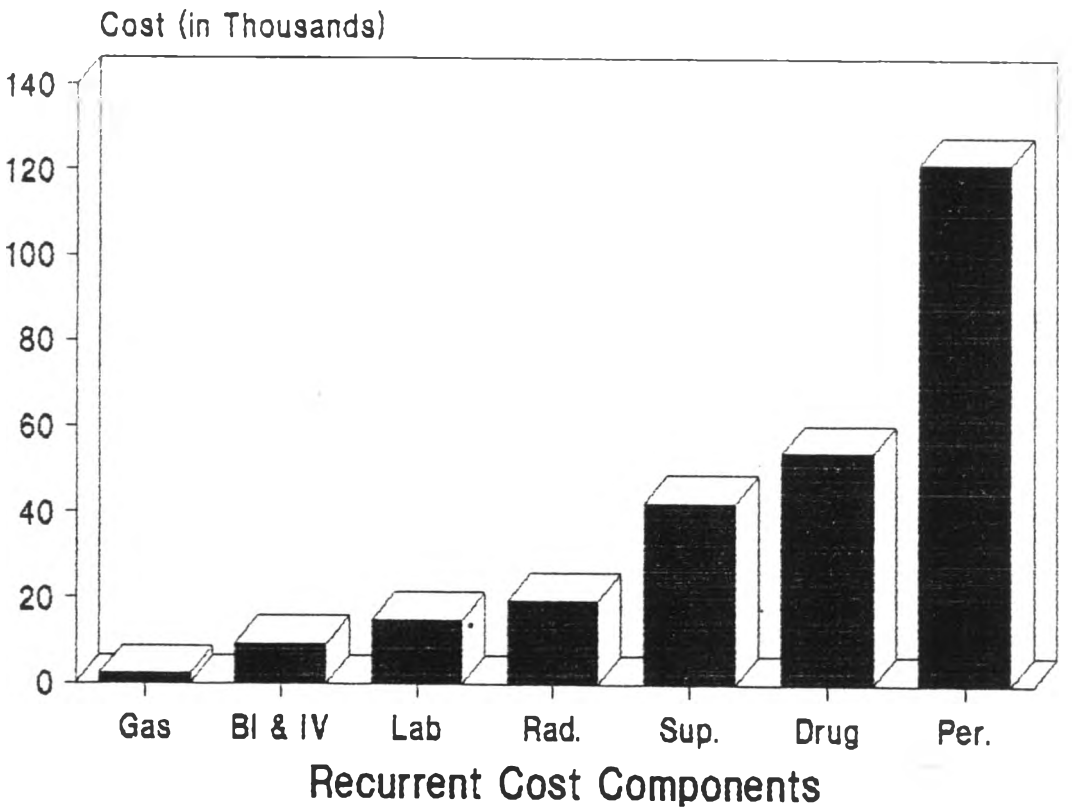
Cost Category	Mean ± SD	Range	%
Gas Mixture	2,148 ± 1640	626-6,900	0.81
Blood & IV infusion	9,146 ± 4402	4,605-18,235	3.47
OR Personnel	10,346 ± 2507	7,306-14,602	3.92
Laboratory	14,763 ± 6263	8,652-27,946	5.60
Diagnosis & Radiology	19,394 ± 9843	5,750-40,000	7.35
ICU Personnel	37,241 ± 19687	16,864-88,536	14.13
Supplies	42,460 ± 5004	37,587-50,213	16.11
Drugs	54,025 ± 31448	26,175-147,283	20.05
Ward Personnel	74,003 ± 31385	31,460-145,860	28.08
Total Recurrent cost	**263,524 ± 71503**	**179,700-423,023**	**100.00**

In recurrent costs,the three biggest components of costs are personnel costs, drug costs and supplies respectively (See also Figure 4.2). Personnel costs are the highest among all the cost components, totally about 43% of the total. This is the direct cost, which will not be charged to the patient. Especially in the ICU and the ward, some patients stayed long time and consume a considerable amount of manpower resource. For example, the longest length of stay after operation is 128 days before the initial discharge. In this situation, the doctors and nurses should contribute a lot of their time to take care of the patient, especially in the ICU period.

Drug costs was the second among the recurrent cost components. This part is the direct cost and is the most accurately recorded in the hospital data. During our analysis, we found that the costs of some patient will be much higher than other patients if they had infections and complications after the operation. In this case, the drug costs would run much higher. On the other hand, the important immunosuppressive drug "cyclosporine" is very expensive and is the main cost item in the drug category.

Like the drug costs, the costs of supplies are also one of the most important parts of the aggregate costs. The supplies are mainly consumed in the operation room and the intensive care units and are the essential items during the operation. Those items include the disposable items of oxygenator, reservoir, tube pack, bubbles tab and gas filter which are very expensive.

Figure 4.2 Recurrent Cost by Components



4. Cost by resource-area service of activities

For the heart transplantation patients, they consume the resources mainly in three locations of activity: the operating theater, the intensive care unit and the surgical ward, here we included only resource-area used which are building or space of activities, personnel service, area-equipment. Different activities occur in each of the locations. The following is to allocate the allocable cost into different area of activities in order to understand which one consumes the most resources and in which categories (See Table 4.6).

Table 4.6 Costs by resource-area service of activities for heart transplantation (in Bt, 1994's price)

Activity	Mean ± SD	Range
OR & Anesthesia	17,917 ± 5,276	12,373-24,288
ICU	53,196 ± 23,637	23,895-111,803
Ward	79,022 ± 33,514	48,864-155,754

Among the three area of activities, the cost occurred in the surgical ward is the highest, while cost in the OR was the least. The patients stayed in the surgical ward for the longest time after operation, thus the costs in this area of activity are the highest. However, even though the time spend in OR was only several hours, the costs were already quite high, as most of the technologically sophisticated procedures were undertaken in this phase. ICU also a unit consumed a considerable amount of resource, especially for those postoperative critical patients who had to stay in the ICU for a longer time.

Factors Relating to Costs

Obviously, costs for heart transplantation are related to many factors which can affect variation in treatment of choice and length of stay. The least square regression method was simply employed to probe the possible factors which affects the aggregate cost by using the following formula.

$$y = a + bx_1 + cx_2$$

Where:
y = total provider cost
x_1 = length of stay in ICU (day)
x_2 = length of stay in ward (day)

The result of the regression analysis was as following (Table 4.7).

Table 4.7 Result of multiple regression of cost with other related factors

Dependent Variable: Cost

Variable	Coefficient	S.E.	2-Tail Significance
C	126302.8	26114.3	0.001
ICU stay (day)	9878.3	2630.5	0.005
Ward Stay (day)	1443.5	559.7	0.030
R^2	0.846	S.E. of regression	34334.64
Adjusted R^2	0.811	F-statistics	24.725

The above regression results showed that there were positive relationship between the total provider cost and length of stay in ICU and length of stay in ward. We can see that if the length of stay in ICU increase by one day it will effect the total cost increase for Bt9,878. The total cost will increase Bt1,443 if the length of stay in ward increase by one day.

Effect of reduction in length of stay in ICU and ward on total cost.

Considering to the result of lease square regression analysis, we found that the length of stay in ICU and ward affect the total cost significantly. With respect to the length of stay in ICU and ward, the sensitivity analysis was undertaken to evaluate the effect of reducing the length of stay on the total cost.

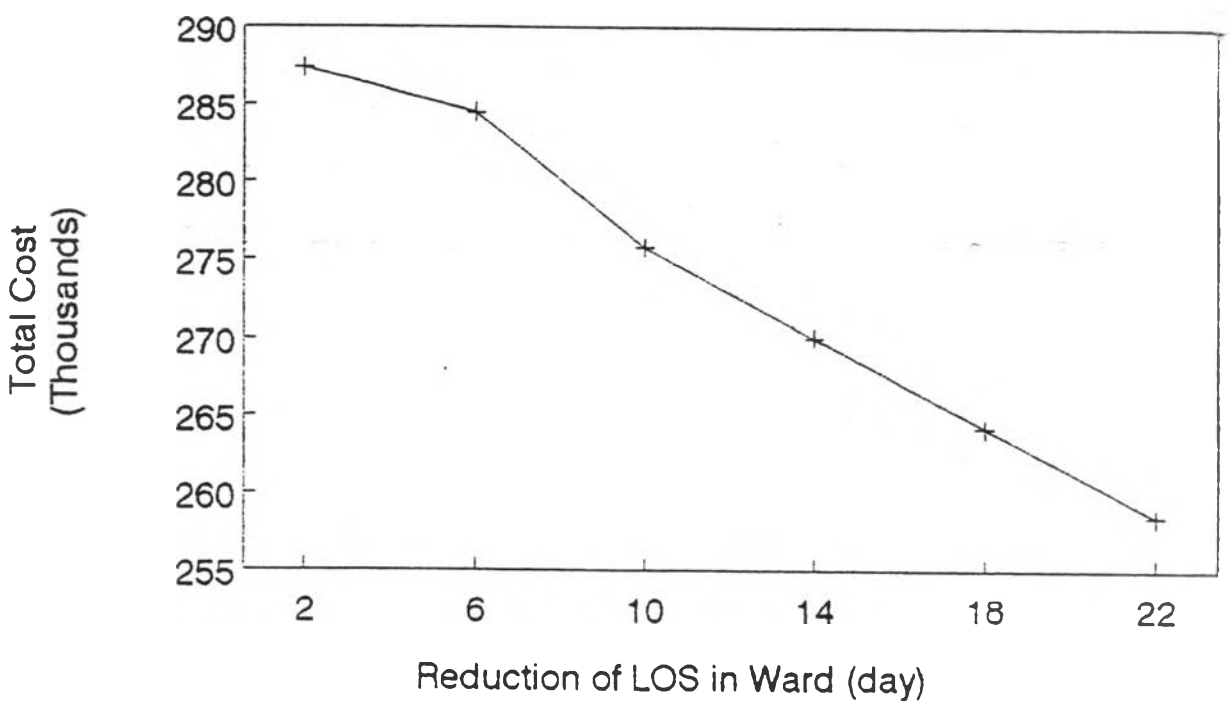
Since the during the stay in ward is the period of routien service care for heart surgery patient, if we could reduce the length of stay in this period which critical care is not needed, the hospital cost could be saved. And the personnel cost is the most important cost component to the total cost, if we could reduce the length of stay, we could also reduce the personnel cost.

From Table 4.1, the average length of stay in ward is 52 $\pm$ 22. days. If we could reduce the length of stay in ward to 30 days which is the minimum length of stay, we can save the total costs by 10% as shown in Table 4.8 and Figure 4.3.

Table 4.8 Effect of reducing the length of stay (LOS) in ward on total cost

Reduction of LOS(day)	LOS (day)	Total cost	Cost saving	Reduction of total cost(%)
2	50	287,337	2.886	1.00
6	48	284,451	5.772	2.00
10	42	275.793	14,430	4.97
14	38	270,021	20,202	6.96
18	34	264,249	25,974	8.95
22	30	258,477	31,746	10.94

Figure 4.3 Effect of Reduction of LOS in Ward on Total Cost



From Table 4.1, the average length of stay in ICU is 9 ± 5. If we could reduce the length of stay in ICU to the minimum days. the cost could be saved by 17% of the total cost as shown in Table 4.9 and Figure 4.4.

Table 4.9 Effect of reducing the length of stay (LOS) in ICU on total cost

Reduction of LOS(day)	LOS (day)	Total cost	Cost saving	Reduction of total cost(%)
1	8	280,347	9.876	3.40
2	7	270,471	19,752	6.80
3	6	260,595	29.628	10.20
4	5	250,719	39,504	13.61
5	4	240,843	49.380	17.01

Figure 4.4 Effect of Reduction of LOS in ICU on Total Cost