

CHAPTER 4



ANALYSIS AND RESULTS

Although a total number of 80 cases of bone marrow transplantation have been performed in Chulalongkorn Hospital since 1991 to 1997, but only the cost of 56 patients could be collected. This is because some of the medical records of the patients have disappeared or were not completed. However, the remaining data could still provide useful information on resource consumption of the operation, and the methodology developed in this study can be used as a basis for future study of this subject.

According to the study design, only the provider costs of bone marrow transplantation from the day of admission to the day of discharge and follow up for 6 months are examined. After all the data are collected from different sources, an SPSS worksheet was created, and all the relevant cost items were input and calculated.

4.1 General Characteristics of the Subjects

The general characteristics of the study subjects are briefly shown in Table 4.1. The proportion of males and females receiving BMT was 1 : 1.15 which is not much different, the average age of the subjects was 30 and the principal indication for the transplantation was Acute myeloid leukemia (25.00%), followed by non - hodgkin lymphoma and acute non - lymphoblastic leukemia (21.43%)

The average length of stay from admission to discharge was 46 days. All 56 patients (100%) survived after the operation which is the most high risk of highest mortality rate during this period, 78.57% of transplanted patients survived after discharge for 6 months but less than 5 years. A study by Intragumtornchai et al, (1997) reported effectiveness of BMT in terms of five year survival and found

that 61% of total transplanted patients can survive more than 5 years which would represent 34 patients in this present study.

From the demographical information (Table 4.2) , most of the transplanted patients were from Bangkok (42.5%) , followed by the Central region (31.25%) , the Northern region (13.75%) , North - East region (7.5%) and Southern region (5%). The major occupation of the patients was the employee/business (35%) , the second was students (23.75%) , the third was unemployment (21.25%) , then civil servant / state enterprise (16.25%) and agriculture (3.75%)

Table 4.1 The General Characteristics of the Study Subjects

Characteristics	Mean \pm SD	Median	Mode	Range
1.Age (years)	30 \pm 11	30.5	33	5 – 55
2.Length of stay from admission to discharge (days)	46 \pm 19	43	30	25 – 126
Ratio of male to female = 1 : 1.15				
Diagnosis :				
(1) Aplastic anemia			10 cases(17.86%)	
(2) Chronic myeloid leukemia			6 cases(10.71%)	
(3) Acute myeloid leukemia			14 cases(25.00%)	
(4) Non – hodgkin lymphoma			12 cases(21.43%)	
(5) Acute non - lymphoblastic leukemia			12 cases(21.43%)	
(6) Multiple myeloma			1 case (1.79%)	
(7) Acute lymphoblastic leukemia			1 case (1.79%)	
Survival after transplanted			56 cases(100%)	
Survival > 6 months < 5 years			44 cases(78.57%)	
Survival > 5 years			61 % (Intragumtornchai,1995)	

Table 4.2 Demographical Information

Occupation	%	Region	%
1.Employee/own business	35.00	1.Bangkok	42.50
2.Civil servant/State enterprise	16.25	2.Central (East & West)	31.25
3.Agriculture	3.75	3.North	13.75
4.Student	23.75	4.North - East	7.50
5.Unemployment	21.25	5.South	5.00

4.2 Cost of Bone Marrow Transplantation.

4.2.1 The total direct provider cost of BMT at Chulalongkorn Hospital during 1991 to 1997 for 56 patients accounted for Bt.36,149,960 (Table 4.3)

4.2.2 The average cost or unit cost (cost per case treated) of BMT since the day of admission to the day of discharge and follow up for 6 months was Bt. 645,535 , ranging from Bt. 417,059 to Bt. 1,128,802 (Table 4.3) The costs for BMT vary according to length of stay in hospital which depends on many factors , for example, treatment of complications such as infection, host rejection. The longer stay in hospital, the higher the cost of BMT. It is generally found that autologous transplantation and PBSTC can significantly reduce length of stay because there will be less complications.

4.2.3 Cost per patient with intermediate effectiveness (cost per number of patients who survived after discharged for more than 6 months but less than 5 years) was Bt.821,590 (Table 4.3) which was higher than the average cost per case treated. That means that in order to get intermediate effectiveness of BMT , the hospital has to incur higher costs.

4.2.4 Cost per patient with effectiveness (cost per number of patients who survive more than 5 years) was Bt.1,063,234 (Table 4.3) which was much higher than the average cost per case treated so we can see that in order to get full effectiveness of BMT, the hospital has to incur much higher cost than for the lower level of outcome. We have to take into account that some of the patients received BMT but reported for follow up care for less than five years so we do not know the real rate of five year survival. Thus we have used the five year survival rate from the study of Intragumtornchai et al (1995) who studied the effectiveness of BMT in terms of five year survival and found that there would be 61% of total number of transplanted patients who can survive more than five years after transplantation.

Table 4.3 Cost at Each Level of Outcome

Items	Amount (Baht)
1. Cost per case treated (Unit cost)	645,535
2. Cost per intermediate effectiveness	821,590
3. Cost per full effectiveness	1,063,234
Total direct provider cost = 36,149,960 Baht	
Number of total transplanted patients = 56 cases	
Number of patients in Intermediate effectiveness = 44 cases	
Number of patients in effectiveness = 34 cases	

4.2.5 The Cost Components are described below :

In this study, we see that the average capital cost per patient and the recurrent cost per patient were Bt.57,300 and Bt.588,235 , respectively (Table 4.4). We found that the recurrent costs were the major components of the total provider cost, equal to 91.13% of the total provider cost , while the capital costs were only 8.87% (Figure 4.1). The capital cost was very small because some of the equipment costs were already included in the recurrent cost , used as the price cost of the service , for example , laboratory tests , stem cell and marrow collection in OR and Blood Bank, and radiology.

4.2.5.1 Capital Costs by Components

The capital costs, which were only 8.87 of total cost , were divided into 3 categories ; 15.67% for building cost , 63.47% for equipment cost, and 20.86% for long term training cost (Table 4.5).

4.2.5.2 Recurrent Costs by Components

For the recurrent costs , the largest component of total cost, 91.13% was classified to Personnel cost and Material cost , equal to 19.16% and 80.84% , respectively. We can see that most of the recurrent costs are material costs (Table 4.5). In material costs , the biggest component of costs was drug costs (63.27%), next were blood costs (10.13%), and supplies (9.82%). Of these drug costs were the most accurate item in the patient's medical record. In this study, we found that the total costs were much higher than usual if the patients had severe complications after the transplantation. The drug costs would be much higher as well (Table 4.6)

Table 4.4 The Average Cost by Type of Inputs (in Baht)

Type of input	Mean \pm SD	Range	%
Capital Cost	57,300 \pm 21,882	31,275 - 157,626	8.87
Recurrent :	588,235 \pm 134,862	385,784 - 971,176	91.13
Labor Cost	112,723 \pm 43,046	61,525 - 310,086	19.16
Material Cost	475,512 \pm 111,988	282,422 - 786,601	80.84
Total provider Cost	645,535 \pm 156,744	417,059 - 1,128,802	100

Figure 4.1 Percentage of Capital Cost and Recurrent Cost

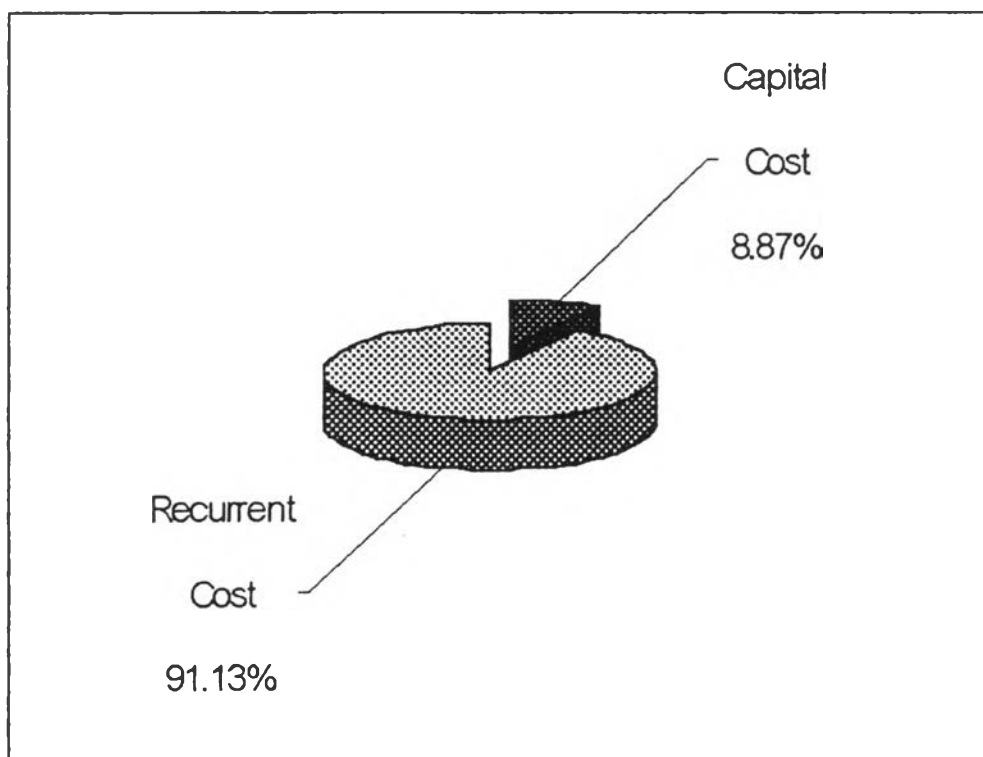


Table 4.5 The Capital Costs by Component (In Baht)

Items	Mean \pm SD	Range	%
1. Building	8,978 \pm 3,428	4,900 - 24,696	15.67
2. Equipment	36,368 \pm 13,888	19,850 - 100,044	63.47
3. Training	11,955 \pm 4,565	65,525 - 32,886	20.86
Total capital cost	57,300 \pm 21,882	31,275 - 157,626	100

Table 4.6 The Recurrent Costs by Component (In Baht)

Items	Mean \pm SD	Range	%
Personnel	112,723 \pm 43,046	61,525 – 310,086	19.16
Material cost :	475,512 \pm 111,988	282,422 – 786,601	80.84
1. Facilities	2,368 \pm 1,042	1,217 - 6,171	0.50
2. Drugs	300,833 \pm 80,588	178,988 - 498,869	63.27
3. TPN & Lipid	29,202 \pm 11,487	10,504 - 79,110	6.14
4. Lab test	22,766 \pm 6,765	11,680 - 45,060	4.79
5. Dx & Radiology	1,265 \pm 592	700 - 3800	0.27
6. Supplies	46,718 \pm 12,980	23,416 - 84,118	9.82
7. Blood	48,162 \pm 27,136	9,950 - 150,900	10.13
8. Anesthetic & OR	19,618 \pm 13,521.00	5,000 - 56,000	4.13
9. Food	4,580 \pm 1,749	2,500 - 12,600	0.95
Total recurrent cost	588,235 \pm 134,862	385,784 - 971,176	100

4.2.6 The Financial Sources of the Patients are described below :

From the total of 56 patients who had undergone the BMT, there were 3 types of payment :

A. Out - of - pocket : The patients who pay for their expenditure; some of them might have private insurance or have ability to pay from their own pocket. There were 30.35 % (17 cases) of the total.

B. Reimbursement : The patients with any public health insurance scheme (e.g. Civil servant medical scheme and Social security scheme) so the hospital can get reimbursement for the medical services. There were 35.71 % (20 cases) of the total.

C. Free : The patients who have no ability to pay for their medical expenditure and do not have any health insurance cover. These were the burden of the hospital which provide the transplantation. There were 33.94 % (19 cases) of the total in this category.

We have to assume in this study that the hospital allocated a specific budget for this BMT program so it can provide BMT service to any patient who cannot afford the expenditure of BMT. However , in normal situation, if there was no budget for BMT program then there would be 19 patients excluded from this study because they could not afford the costs. This would effect the costs and outcomes of this study.

4.3 Differences of Cost for BMT in Each Category.

- Sex : average cost of BMT for male and female in this study accounted to Bt.690,772 and Bt.596,945 ,respectively.

● Age : average cost of BMT in each age group was :

- a) 0 -14 years old : Bt.531,973
- b) 15 - 29 years old : Bt.649,019
- c) 30 - 44 years old : Bt.663,369
- d) 45 - 59 years old : Bt.623,050

● Diseases : average cost of BMT in each disease is as follows :

- a) Aplastic anemia : Bt.633,275
- b) Chronic myeloid leukemia : Bt.714,348
- c) Acute myeloid leukemia : Bt.624,862
- d) Non - hodgkin lymphoma : Bt.692,194
- e) Acute non - lymphoblastic leukemia : Bt.618,347
- f) Multiple myeloma : Bt.555,173
- g) Acute lymphoblastic leukemia : Bt.501,368

Costs of multiple myeloma and acute lymphoblastic leukemia were not the representative because there was only one case of each of these diseases.

● Type of transplantation : average cost for BMT and PBSTC accounts for Bt.651,474 and Bt.640,004 ,respectively.

As we said before , PBSTC is the appropriate choice of treatment to reduce costs incurred to the provider in providing transplantation and from the result above we can see that costs of PBSTC were lower than BMT because of shorter LOS , which were 48 days for BMT and 46 days for PBSTC.

● Type of payment of the transplanted patients : average cost of BMT in each type of payment can be shown as following :

- a) Out of pocket : Bt.641,227
- b) Reimbursement : Bt.616,897
- c) Free : Bt.679,533

4.4 Factors Relating to Costs.

We can see that costs for BMT are related to many factors which can affect variation in treatment and length of stay. The least square regression method was done to probe the possible factors which can affect the costs for BMT by using the following formula :

$$TC = c + aLOS + b Age + e Sex + f Cash + g Reimburse + h \text{ type of operation} + i \text{ Disease}$$

where TC = total provider cost for BMT

c = constant value

LOS = length of stay (day)

Age = age of each patient (year)

Sex = sex of each patient : 1 = if male , 0 = if otherwise

Cash = type of payment : 1 = if pay by cash , 0 = otherwise

Reimbursement = type of payment : 1 = if reimburse , 0 = otherwise

Disease = type of disease : 1 = if chronic disease , 0 = if otherwise

The results of the regression analysis are shown in Table 4.7. We can see that there was a significant positive relationship between the total provider cost and length of stay and sex. This did not correlate significantly with age , sex , type of payment and type of disease because the value of t – statistic shown in Table 4.7 so the length of stay and sex can affect the total provider cost of BMT significantly.

If we increase LOS by one day ,it would effect a total cost increase of Bt.6,719 and if the patient was a male , the total cost would increase Bt.60,775

Table 4.7 Results of Regression Analysis

Variable	Coefficient	T - Statistic	Prob.
C	265871.7	3.76	0.0005
LOS (day)	6719.04	7.44	0.0000
Age (year)	1078.26	0.85	0.3990
Sex	60774.70	2.00	0.0506
Cash	-2772.94	-0.07	0.9444
Reimbursement	48466.24	1.37	0.1762
Type of operation	8969.41	0.29	0.7664
Disease	-36468.77	-1.15	0.2540
R ²	0.593	Std.Error of regression	103253.4
Adjusted R ²	0.534	F - statistic	10.01

We also examined relationships between total cost and these variables which are type of disease, type of payment, and type of transplantation.

For type of disease, we classified hematologic disorders into 2 group : chronic disorders and acute disorders. We found that there was no relationship between type of disease and total cost.

For types of payment, we classified into 3 types : cash or out-of-pocket, reimbursement, and free. We found that there was no relationship between type of payment and total cost.

For types of transplantation, we classified into 2 types : BMT and PBSTC. We found that the value of t-statistic was very low and their probability value > 0.05 so there was no relationship between type of transplantation and total cost. This may be because of there were some error in this study.

4.5 Sensitivity Analysis

1.Length of stay in hospital : From Table 4.1, the average length of stay in the hematologic ward was 46 ± 19 days. The average length of stay at Chulalongkorn Hospital is only 11 days so we can see that the transplanted patients have to stay in hospital much longer than many others. Therefore, if we can reduce the length of stay to the minimum (27 days) then we can reduce the total cost by 10.93% (Table 4.7 , Figure 4.2). The greater the reduction of length of stay , the more the cost saving.

2.Increasing drug costs : From the result in Table 4.4 , drug costs were the largest element in material costs , accounted for 63.27%. As cost of drugs is increasing almost every year and it also depends on the economic situation so it is important to assess the effect of increasing drug costs on the total cost of BMT. If the costs of drugs increased by 25% (which is the expected amount in economic crisis now), this would increase the total cost by 11.65 % (Table 4.8 , Figure 4.3).

3.Increasing of candidacy cost : In this study ,we assumed that there was only one donor to be examined in the total provider cost (1 donor costs Bt.12,000) because of the incomplete data system of the Bone Marrow Transplantation Unit that there was no record about the number of donors. Actually , there were more than one donor, some patients had to wait for marrow or stem cell donation from many people and this will affect the total cost so that it will be much higher. So it is important to assess the effect of increasing candidacy cost of donor on the total cost. As the maximum number of donors were 9 , if we increased the number of donors to 9 , the total cost would be higher by 16.73% (Table 4.9 , Figure 4.4)

Table 4.7 Effect of Reducing Length of Stay (LOS) in Ward on Total Cost

Reduction of LOS (days)	LOS (days)	Average total cost (Bt.)	Cost saving (Bt.)	Reduction of total cost (%)
3	43	634,399	11,135	1.72
7	39	619,551	25,983	4.03
11	35	604,703	40,831	6.33
15	31	589,855	55,679	8.63
19	27	575,007	70,527	10.93

Figure 4.2 Effect of Reduction of LOS in Ward on Total Cost

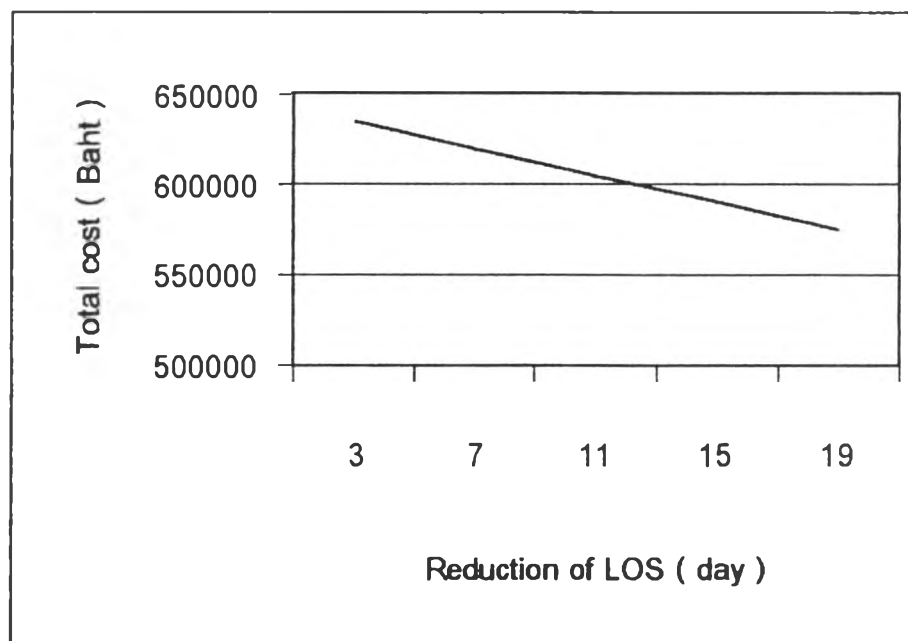


Table 4.8 Effect of Increasing Drug Cost on Total Cost

Drug cost increasing (%)	Average total cost (Bt.)	Additional cost (Bt.)	Additional of total cost (%)
20	705,701	60,167	9.32
25	720,743	75,209	11.65
30	735,785	90,251	13.98

Figure 4.3 Effect of Increasing Drug Cost on Total Cost

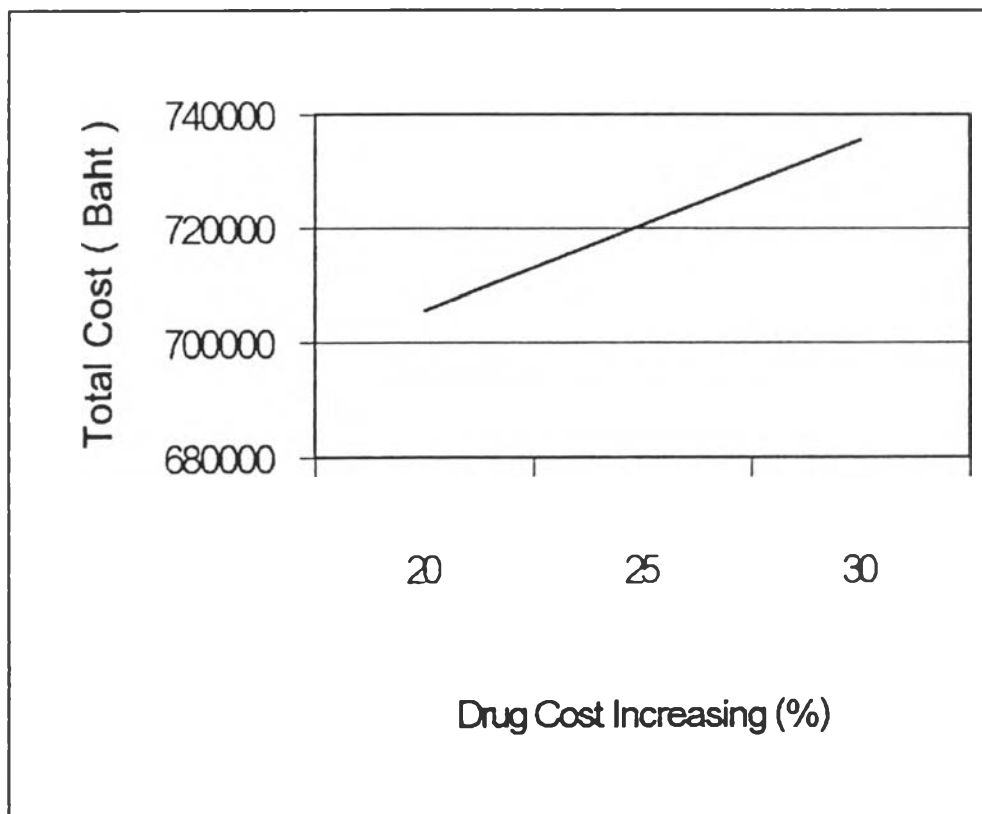


Table 4.9 Effect of Increasing Candidacy Cost on the Total Cost

Additional Donor (person)	Average total cost (Bt.)	Additional cost (Bt.)	Additional of total cost (%)
1	657,535	12,000	1.86
5	705,535	60,000	9.29
7	729,535	84,000	13.01
9	753,535	108,000	16.73

Figure 4.4 Effect of Increasing Candidacy Cost on Total Cost

