

## Cost analysis of heart transplantation at Chulalongkorn University Hospital

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**Objective :** *To examine the cost of heart transplantation from the day of surgery to the day of discharge.*

**Design :** *Retrospective cross-sectional study*

**Setting :** *Cardiovascular-thoracic surgery Unit, Department of Surgery, Chulalongkorn University Hospital.*

**Population :** *Patients undergone heart transplantation at Chulalongkorn Hospital from the year 1987 to 1994*

**Method :** *Costs model were developed for retrospective determination of direct costs of individual consumable cost categories and the apportionment of resource item costs. The costs were calculated per patient based on individual treatment with respect to volumn and unit cost.*

**Result :** *The total cost of heart transplantation from the day of operation to the day of discharge averaged Bt. 288, 262 in 1994 prices. As much as 91% of the total costs were recurrent and 9% were the capital costs, the drug cost of 20% and the supply cost was 16% respectively.*

**Key words :** *Cost analysis, Heart transplantation.*

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สุวิมล ภาวนานันท์. การวิเคราะห์ต้นทุนการผ่าตัดเปลี่ยนหัวใจที่โรงพยาบาลจุฬาลงกรณ์.  
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วัตถุประสงค์ : เพื่อศึกษาต้นทุนทางตรงของการผ่าตัดเปลี่ยนหัวใจในด้านของผู้ให้บริการ  
นับตั้งแต่วันที่ทำการผ่าตัดจนถึงวันกลับบ้าน

รูปแบบการวิจัย : การศึกษาจากข้อมูลย้อนหลัง

สถานที่ : แผนกศัลยศาสตร์หัวใจและทรวงอก โรงพยาบาลจุฬาลงกรณ์

ตัวอย่างประชากร : ผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนหัวใจที่โรงพยาบาลจุฬาลงกรณ์ ตั้งแต่ปี  
พ.ศ. 2530 - พ.ศ. 2537

วิธีการคิดต้นทุน : ใช้การคิดต้นทุนตามสัดส่วนของการใช้ทรัพยากรในแต่ละที่ที่เกี่ยวข้องกับ  
การรักษาพยาบาลผู้ป่วย โดยแบ่งต้นทุนเป็น 2 ประเภทคือ ต้นทุนลงทุน  
และต้นทุนแปรผัน โดยคำนึงถึงปริมาณและราคาต่อหน่วย

ผลการศึกษา : ต้นทุนทางตรงทั้งหมดของโรงพยาบาลในการผ่าตัดเปลี่ยนหัวใจเฉลี่ยรายละ  
288,262 บาท เป็นต้นทุนแปรผัน 91% และต้นทุนลงทุน 9% ในกลุ่ม  
ของต้นทุนแปรผันพบว่าต้นทุนบุคลากร 46% ต้นทุนยา 20% และต้นทุน  
เวชภัณฑ์ 16%

วิจารณ์และสรุป : ต้นทุนที่ศึกษาเป็นเพียงส่วนหนึ่งของต้นทุนทั้งหมดที่เกิดขึ้น ซึ่งไม่รวมต้นทุน  
ที่เกิดขึ้นก่อนและหลังผ่าตัด อย่างไรก็ตามแม้ว่าการผ่าตัดเปลี่ยนหัวใจจะต้อง  
ใช้เทคโนโลยีและต้นทุนที่สูงมาก ซึ่งโรงพยาบาลต้องเป็นผู้แบกรับภาระถึง  
78% จากผลการศึกษาครั้งนี้ แต่ก็จำเป็นสำหรับโรงพยาบาลมหาวิทยาลัย  
ที่จะต้องให้การรักษานิดนี้

Heart transplantation has become established as a standard heart surgery procedure. Present technology and pharmacology have led to improved rates of survival and quality of life, making cardiac transplantation a realistic therapeutic procedure for patients with end-stage heart disease.<sup>(1)</sup> In Asia, the first successful heart transplantation was performed in Thailand in December 1987 at Chulalongkorn Hospital<sup>(2)</sup> up till December 1994, there have been 30 patients who have undergone heart transplant. The one year survival rate has been 70%, two year of 61% and five year 35%.

Because the cost of heart transplantation is very high, there has been much debate about affordability from societal and provider viewpoint.

Therefore the objective of this study was :

1. To design a model for heart transplant costing from the day of surgery to the day of discharge,
2. To examine the total direct cost of heart transplant from the day of operation to the day of discharge.
3. To identify the components of costs for heart transplant and their proportions.

## Method

Only the internal costs incurred directly in the institute were included so that the costs for the procedure from the day of operation to the day of discharge are focused. These cover the costs in three areas where the patient could stay, i.e., the operating room, the intensive care unit (ICU) and the surgical ward.

As this was the cross-sectional study,

data were collected retrospectively from the medical records of the patients transplanted from 1987 to 1994 and who survived until initial discharge. There were 22 patients who met the inclusion criteria, but the medical records of 12 of these patients were complete.

The cost data about treatment, laboratory tests, and medical and nursing services were compiled from each patient's medical record. Some data was collected from the records of the unit which provided the service to the patients, including operating room, intensive care unit and the surgical ward. The costs of drugs, medical supplies and equipment were taken from the pharmacy and purchasing department. The cost was adjusted to a fiscal year 1994 base.

To calculate the average hospital cost for each patient, the cost to the hospital for each individual service that the patient received was identified, permitting each patient to bear a share of both the direct service costs and the overhead costs on the basis of the level of services which the patient received.

The total hospital cost was included labour cost, material cost (drugs & supply cost), laboratory test, special treatment and allocated expenditure of the capital cost items.<sup>(3)</sup>

## Costing method

1. Identification of activities for the heart transplantation procedure which consist of 4 main activities:

- Donor acquisition.
- Operations in both donor and recipient.
- Intensive care during the immediate

postoperative period.

- Routine care for the cardiac patient in the surgical ward until discharge.

## 2. Identification of resources

The resources cost were classified as to capital costs (equipment, building, and vehicles) and recurrent costs (personnel, blood & fluid infusion, drugs, medical supplies, laboratory tests, diagnostic radiology, and gas mixture).

## 3. Determination of units of measure.

The units of measurement were broadly classified into time scales, volume, weight, distance, space and numbers.

## 4. Estimation of unit costs of items.

Unit costs or prices of items means the price of items expressed as physical or natural units. Market values could be collected for most of the input items.

## 5. Cost allocation criteria.

If a given capital item was shared for different activities, appropriate disaggregation of this cost was followed based on allocation criteria.

## 6. Valuation into monetary terms.

Costs were normally valued in units of local currency based on prevailing prices of the items.

## 7. Calculation of costs incurred.

If the data on the unit cost and number of units were available, simple multiplication of these variables gave the actual cost. For composite cost measurements such as personnel, equipment and the hospital area service, an allocation percentage has been used to disaggregate the cost.

## Data analysis

Average cost was calculated by deviding the total cost by the total number of the patients. Regression analysis was used to find the relationship between the total cost and the variable of cost components include length of stay in the hospital.

## Results:

The general characteristics of the study samples are shown in Table 1.

Most of the patients (75%) who received a heart transplant in this study were male, and the principle indication for operation was dilated cardiomyopathy. The average length of stay from operation to discharge was 60 days. The average operating time was 4.6 hours. All study patients survived at least 3 months after the operation, This is the most difficult time with the highest mortality rate. Of the 12 patients, the average cost was calculated to be Bt. 288,262, with ranges from Bt.205,802 to Bt. 460,251. The total costs for each patient considerably varied, and this was mainly due to treatment of infection, rejection and other complications. In analyzing the cost components, it was found that the length of stay, both in special care and in the regular nursing unit, accounted for the majority of the costs.

In the context of this study, the cost components among the patients are varied and the variations are different among the categories. From Table 2, it can be seen that the average capital cost was Bt. 24,738, which accounts for only 9% of the aggregate cost while the average

Table 1. Characteristics of the 12 patients in the study.

Characteristics	Mean	Range
Age (years)	38	16-57
Length of stay from operation to discharge (days)	60	27-113
Length of stay in ICU (days)	9	4-21
Length of stay in ward (days)	52	22-102
Operating time (hours)	4.6	3-7
Ratio of male:female	3:1	
Diagnosis:		
Dilated cardiomyopathy	67%	
Ischemic heart disease	17%	
Other	16%	
Survival > 3 months	100%	

Table 2. Average cost by type. (in 1994 Baht).

Type	Mean	Range	%
Capital cost	24,738	17,989-37,228	9.0
Recurrent cost	263,524	171,512-414,835	91.0
Total cost	288,262	205,802-460,251	100.0

recurrent costs were Bt. 263,524. This accounts for 91% and is easily the major part of the total cost.

For recurrent costs, the three most significant components were personnel, drug costs and supplies cost (see Table 3). Personnel costs were the highest among all of the cost compo-

nents, comprising about 46% of the total. Drug cost was second highest among the recurrent cost components. We found that the drug expenses of some patients would be much higher than other patients if they had infections or other complications after the operation.

**Table 3.** Recurrent cost by components (in 1994 Baht).

Cost category	Mean	%
Anesthesia	2,148	0.81
Blood & IV infusion	9,146	3.47
Laboratory	14,763	5.60
Diagnosis & Radiology	19,394	7.35
Supplies	42,460	16.11
Drugs	54,025	20.05
Personnel	121,590	46.13
Total recurrent cost	263,524	100.00

**Table 4.** Results of multiple regression analysis with other related factors.**Dependent variable: Cost**

Variable	Coefficient	S.E.	2-tail significance
C	126302.8	26114.3	0.001
ICU stay (days)	9878.3	2630.5	0.005
Ward stay (days)	1443.5	559.7	0.030
R2	0.846	S.E. of regression	34334.64
Adjusted R2	0.811	F-test	24.725

Obviously, there are many factors that relate to the cost of heart transplant which can cause variations in choice of treatment and length of stay. The least square regression method was employed to probe the possible factors which affect the aggregate cost. The results of the re-gression analysis were as follows (Table 4).

The above regression results showed that there was a positive relationship between the total provider cost and the length of stay in the ICU and length of stay in the ward. We can see that if the length of stay in the ICU increased by one day, it increased the total cost by Bt. 9,878, and the total cost would be increased by

Bt.1,443 if the length of stay in the ward increased by one day.

### Discussion

Heart transplantation is a very costly medical treatment. In this study, the provider cost for heart transplant from the day of the operation to the day of discharge averaged about Bt.288,262 at the 1994 prices, which is equivalent to more than US\$ 11,530 currency exchange rate. Compared with Western countries where most operations of this type are undertaken, this is not so high a figure. But Thailand is still a developing country and budgets for health care are still limited. In 1994, the health care expenditure was about Bt.1,500 per capita, which means that one heart transplant would consume the yearly health care budget for about 192 persons.

When we look at the micro level, we can see that it is a considerable burden to the hospital to bear the cost of heart transplantation for patients who cannot pay the bill. From our study, it was determined that among the 12 patients who received heart transplantation in Chulalongkorn Hospital, the costs incurred by the hospital were about 78% of the total cost. This is by no way a small burden to the government hospital which is already suffering from financial constraints.

### Policy implications

The ultimate goal of cost analysis is to serve the health care planners and administrators in their planning and administration of health care delivery procedures. In the context of

Chulalongkorn Hospital, the cost information for heart transplantation could be used in the following aspects.

1. Hospital administrators could use the cost information for planning the numbers of operation. Within a limited health care budget, it is impossible to provide heart transplants for all the patients who need such intervention. In this situation, the doctors must be more cost conscious and set a more rational criteria for patient selection.

2. Cost information could also be used as a basis for cost recovery. It is reasonable to make a full cost recovery for both efficiency and equity concerns. Recovered costs could be reallocated to other health areas from which the poor could benefit.

3. As we have determined from the analysis that the total cost is related to the length of stay in the ICU and the ward, it is obvious that the costs could be reduced if the length of stay decreases. However, the length of stay is not solely dependent on economic concerns. The medical justifications have more to say in this aspect.

4. The cost information regarding the controllable and uncontrollable costs should be of interest to administrators. In our study, recurrent costs are the major share of the total cost in which some of the cost items are controllable, such as the supplies drugs costs. From this point of view, those costs could be controlled by the hospital personnel involved.

5. In sense of equity concerns, even if the heart transplant service is free of charge to some patients we could not say that all of those

in need have equal access to the operation, as the external costs to the patient may be high enough to prevent him from getting the operation. This requires further study of the full economic cost of heart transplantation, including internal and external costs.

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