

## **Chapter 3**

### **Research Methodology**

This study is a retrospective study relating to the incremental cost-effectiveness analysis, in order to compare the outcomes between, burnt and scalded patients treated with autologous skin graft and those treated with cultured skin graft, at the Burn Unit of Chulalongkorn University. This chapter will cover the research methodology, which involves conceptual framework, research design, population and sampling, including information characteristics and analysis.

#### **3.1 Conceptual Framework**

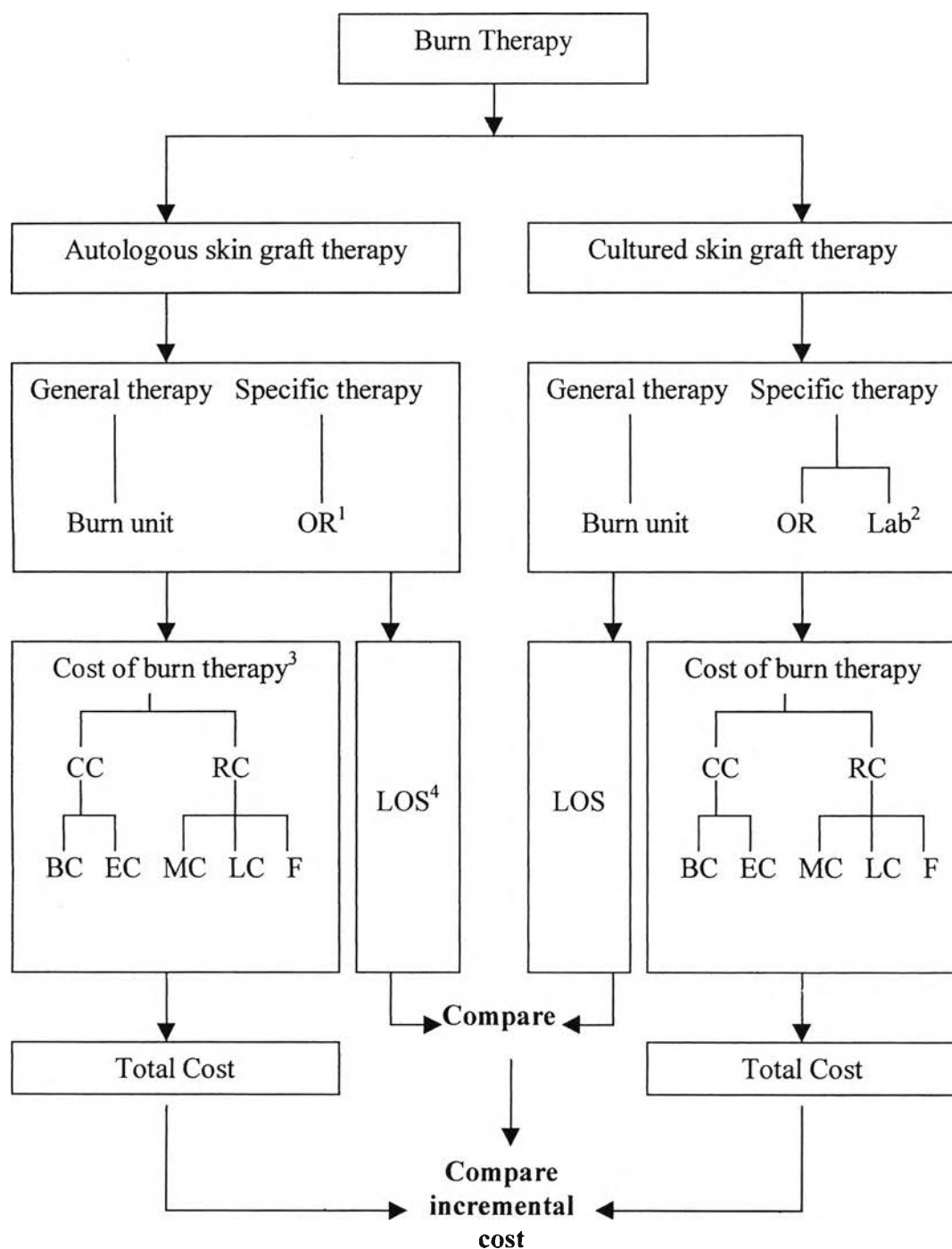
This study will categorize treatment method for burnt and scalded patients into two types: autologous skin graft and cultured skin graft. Both method of treatment can be separated into two stages of activity: general activity and specific activity. General activity is the routine treatment being done on all patients at the Burn Unit. Specific activity is treatment being done on patients in the operating room. Activities at the Biomaterial Laboratory is also counted as a part of the specific activity in order to treat burnt and scalded patients with cultured skin graft method.

Cost estimation for each stage of treatment, from the viewpoint of the services provider, is separated into two types: capital cost and recurrent cost. Capital cost is the cost of buildings and other equipments in the hospital. Recurrent cost is the cost of material, labor and facilities that associate with the treatment of burnt and scalded patients.

Total cost calculation for burnt and scalded patients can be done in two ways, 1.) by summation of the capital cost and recurrent cost that is related to the treatment for patients, or 2.) by adding the cost of general activity and specific activity together.

Finally, a comparison of the incremental difference in total cost, and outcome between each treatment method for burnt and scalded patients is illustrated in Figure 3.1.

### 3.1 Conceptual Framework



<sup>1</sup>OR=Activities in operating room, <sup>2</sup>lab=Activities in laboratory room, <sup>3</sup>CC=Capital cost, RC=Recurrent cost, BC=Building cost, MC=Material cost, LC=Labor cost, F=Facility cost  
<sup>4</sup>LOS=Length of stay

## **3.2 Treatment Method for Burnt and Scalded Patients**

### **3.2.1 Autologous Skin Graft Treatment for Burnt and Scalded Patients**

Autologous skin graft treatment for burnt and scalded patients can be divided into 2 stages:

1. General activity which is a routine treatment done on all patients by physician at the Burn Unit. The routine treatment consists of:

- 1.) Medical care, which involves treatment order and routine treatment by the physicians after a preliminary examination has been done on the patients. Medical care consists of, investigative examination, such as, CBC, UA, blood chemistry (BUN, Cr, electrolyte, etc.), LFT, HIV, and CXR. EKG is also performed on patients with electrical burn or over 35 years of age. Other medical care includes, IV fluid, such as, RLS, 5%DN/2, D5W, and colloid, medical such as, antipyretic and anti-analgesic drug, and antibiotic drug, type of food such as, NPO (no food and liquid), liquid diet or soft diet, and rehabilitation if necessary.
- 2.) Nursing care, which involves attending the patients to ensure complete and continuous treatment according to routine treatment ordered by the physicians. Nursing cares consists of medication, wound cleaning, vital sign measurement, IV fluid, complication prevention and others.

2. Specific activity is any kind of treatment done on the patients according to physicians' routine treatment in the operating room. The specific activity consists of:

- 1.) Anesthetic activities are done in order to make the patients unconscious by general induction method. After which, any handwork can be done on the patients. Anesthetic activities include overseeing and preparation of the patient before, during and after the anesthetic activities, after the handwork is finished.
- 2.) Operative debridement is any handwork done according to the physician's routine treatment after the patient loss consciousness. Operative debridement consists of scrub burn, in order to sterile the patients' skin before grafting is done.

### 3.2.2 Cultured skin graft Treatment for Burnt and Scalded Patients

Cultured skin graft treatment for burnt and scalded patients can be divided into 2 stages, similar to the autologous skin graft treatment. However, a skin graft culturing activity in the Biomaterial Laboratory is included as a part of the specific activity stage.

1. General activity is a routine treatment done on all patients by physician at the Burn Unit. The routine treatment, which is similar to those for Autologous skin graft treatment, consists of:

- 1.) Medical care, which involves treatment order and routine treatment by the physicians after a preliminary examination has been done on the patients. Medical care consists of, investigative examination, such as, CBC, UA, blood chemistry (BUN, Cr, electrolyte, etc.), LFT, HIV, and CXR. EKG is also performed on patients with electrical burn or over 35 years of age. Other medical care includes, IV fluid, such as, RLS. 5%DN/2, D5W, and colloid, medical such as, antipyretic and anti-analgesic drug, and antibiotic drug, type of food such as, NPO (no food and liquid), liquid diet or soft diet, and rehabilitation if necessary.
- 2.) Nursing care, which involves attending the patients to ensure complete and continuous treatment according to routine treatment ordered by the physicians. Nursing cares consists of medication, wound cleaning, vital sign measurement, IV fluid, complication prevention and others.

2. Specific activity is any kind of treatment done on the patients according to physicians' routine treatment in the operating room and skin culture activity. The specific activity, which is similar to those for autologous skin graft treatment, has some differences in the detail of its operation.

- 1.) Anesthetic activities are done in order to make the patients unconscious by analgesic IV using titrate with induction method. Anesthetic activities include overseeing and preparation of the patient before, during and after the anesthetic activities, after the handwork is finished.
- 2.) Operative debridement is any handwork done according to the physician's routine treatment after the patient loss

consciousness. Operative debridement consists of 1.) scrub burn, in order to sterile the patients' skin before grafting is done and 2.) grafting by cultured skin graft sheet in order to cure the wound of the patient.

- 3.) Skin graft culturing is an activity performs in the biometerial laboratory in order to manufacture graft sheet for treatment of the patients.

### **3.3 Research Design**

This study is a retrospective study, which covers only cases of burnt and scalded patients treated in the Burn Unit at the Chulalongkorn Hospital. Cost incurred to the services provider will be analyzed with incremental cost-effectiveness analysis, in order to compare the outcomes between burnt and scalded patients treated with autologous skin graft and cultured skin graft method. This research will study burnt and scalded patients treated with autologous skin graft method, and the information obtained is used as the base for estimation and calculation of cost incurred to services providers who use cultured skin graft method to treat their patients. The results are then compared in terms of incremental cost and effectiveness between autologous skin graft and cultured skin graft methods.

### **3.4 Population and Sampling**

#### **3.4.1 Studied Population**

Population under study is a group of burnt and scalded patients in the Burn Unit at the Chulalongkorn Hospital from January 1<sup>st</sup>, 1998 to December 31<sup>th</sup>, 1998. Services provide at the Burn Unit is of in-patient type. During the time of information gathering, from January 1<sup>st</sup>, 1998 to December 31<sup>th</sup>, 1998, there were 55 burnt and scalded patients at the Chulalongkorn Hospital, 27 of which treated with autologous skin graft method. Therefore, the population under study is a group of 27 burnt and scalded patients treated with autologous skin graft method.

#### **3.4.2 Inclusion Criteria**

- 1.) Must be a burnt and scalded patient in the Burn Unit at the Chulalongkorn Hospital.
- 2.) The patients must have second and/or third degree burn and been treated with the autologous skin graft method.

- 3.) The patients must not have any past record of hereditary diseases, such as, diabetes, hypertension, and obesity.
- 4.) The patients must not have any complication condition, such as, infection, or upper intestinal and stomach ulcer.

#### 3.4.3 Exclusion Criteria

- 1.) Patients with complication condition during the burnt and scalded treatment process.
- 2.) Patients who deceased during the treatment process.
- 3.) Patients with past record of serious illnesses.

3.4.4 Patients' information, covering a period of one year back into 1998, have been gathered from the patients' registration records at the Chulalongkorn Hospital.

### 3.5 Information Characteristics and Analysis

#### 3.5.1 Information characteristics

Information relating to cost is gathered from the studied group, or those burnt and scalded patients treated with Autologous skin graft method. Costing information is secondary source data in the reports and documents regarding burnt and scalded patients from several departments at the Chulalongkorn Hospital, for example the hospital administrative department. The secondary data in this study includes health personnel income, the component of autologous skin graft method, number and severity of patients, material, facilities usage and their cost, etc.

Meanwhile, services provider costing information for burnt and scalded patients treated with cultured skin graft is obtained from, and based on the contemplated costing information for burnt and scalded patients treated with autologous skin graft. Cost relating to culturing in the laboratory is an exception, and gathered from reports and documents by the Biomaterial Laboratory at the National Center for Genetic Engineering and Biotechnology.

#### 3.5.2 Cost Classification

According to economic theory, economists use production time as the basis for differentiating cost into: short-term cost and long-term cost. Short-term cost means cost measured during a period that major production factors can not be altered. On the other hand, long-term cost means cost measured during a period that all production factors can not be changed.

Categorization of cost can be done in many ways, by using different kinds of criteria, depending on the objectives of the research. In this study, cost is differentiated by the characteristics of treatment or “by activities,” and by characteristics of production factor or “by input.”

1.) Differentiating cost by the characteristics of treatment or “by activities,” means cost that includes the cost of general activity and cost of specific activity, such as:

- 1.1) Cost of autologous skin graft treatment for burnt and scalded patients is the cost that contains the cost of general activity and cost of specific activity. These comprise of cost of treatment at the Burn Unit and cost of treatment at the operating room, which in turn make up of, for example, cost of medical care, nursing care, anesthetic and operative debridement.
- 1.2) Cost of cultured skin graft treatment for burnt and scalded patients is the cost that contains the cost of general activity and cost of specific activity. The cost of general activity is similar to those of autologous skin graft treatment, such as, the cost of treatment at the Burn Unit, which involves the cost of medical care and nursing care. The cost of specific activity comprises of cost of treatment at the operating room, which involves the cost of, for example, anesthetic, operative debridement and cultured skin graft sheet.

2.) Differentiating cost by the characteristics of production factor or “by input,” means cost that includes the capital cost and the recurrent cost relating to the treatment of burnt and scalded patients. Capital cost includes costs of building, and equipment. Recurrent cost is defined as the cost of personnel or labor cost, material supply, facilities or maintenances such as electricity and water usage.

This study classifies provider cost by input to capital cost and recurrent cost. More cost details are mentioned below.

- 2.1) Capital cost is the cost of inputs with value equals to or more than Baht 1,000, purchased or procured for more than one year or in the year before this study, and associated with the establishment or productive capacity and physical infrastructure. Capital cost includes the cost of building, and equipment.

- Buildings and concrete structures, according to National Educated Department (1996), must have at least 50 years of useful life. Cost calculation for building is done by calculating the depreciation cost of the working space of Burn Unit, operating room and that of the Biomaterial Laboratory, according to the number of usage year. There are many approaches to calculate building cost, for example record assesses, which uses the resting cost for the similar space or look for the cost of similar building. In this study, cost of building is a construction cost obtained from the Planning Department's records at the Chulalongkorn Hospital. The obtained construction cost is then projected to current or present cost.
- Permanent equipment and apparatus in this study is, according to hospital staff, assumed to have a useful life of 10 years. Any equipment or apparatus has been used for more than 10 years, will not be included as cost, financially. Permanent equipment includes categories that had been used in hospital for at least one year, with unit price more than Baht 1,000. Some cost of equipment is the original cost as drawn from the Planning Department's record, burn unit, operating room, of Chulalongkorn hospital and Biomaterial Laboratory room. However, for some equipments, the current cost is approximated from a similar piece of equipment from the standard of equipment account, or calculated from a current market price.

2.2) Recurrent cost is the burn therapeutic costs associated with the operation or maintenance of facilities or assets. The context mentions below will be considered as the recurrent cost.

- (1) Labor cost is the expenses paid to physicians, nurse and other hospital staffs involving in the treatment of patients. This expense is paid for services rendered. Other include, monetary fringe benefit, for example, salary, wages, overtime, and allowance, calculates in term of time spent for treatment of burnt and scalded patients who are the studied group.
- (2) Material cost is the cost of all kinds of material used during the course of year as direct input to the principle activities performed by the program, including other



small items purchased during the year. The unit cost for these items is less than Baht 1,000. In this study, material cost is divided into 3 types of:

- Medical cost, which is the cost of medicine and medical supplies directly use for burnt and scalded patients treatment, such as, medicine, intravenous fluid, intravenous set, syringe needle, glove, thermometer, gauze, blade, cotton, etc. This cost is calculated from the market prices paid by the procurement division.
- Non-medical cost, which is the overhead cost not associating with treatment, such as, office tables, chairs, or supplies.
- Chemical cost is the cost paid for various types of chemical use for culturing in the Biomaterial Laboratory, in case of cultured skin graft treatment, such as antiseptic solution, liquid nitrogen, trypsin inhibitor, fetal calf serum, DMEM, epidermal growth factor, etc.
- Facilities cost or office utility is the cost of water and electricity. This cost is calculated from actual usage. Electrical cost is calculated base on working space of each department, which in this study are assumed to be equaled, since Chulalongkorn Hospital has a large number of departments operating within the same building, to compute the real area for each department would be impracticable. Water cost is calculated in the same manner.

### 3.5.3 Establishing the list of costs

- (1) The cost of medical, apparatus and equipment use in the treatment is based on their market price.
- (2) Useful life of 10 years for tool and equipment and 50 years for building and structure, are uses for the calculation of their depreciation cost, independent of the imposition of tax. The inclusion of tax will increase the price and cost to the consumer.
- (3) The cost of utilities, such as electricity and water is based on the actual usage rate according to activity.

- (4) The obtained cost is used for calculating present value. Since they are retrospective information, they must be discounted, using discounting rate according to their respective yearly index, to find their present value. The equation is as follow:

$$PVC = C_n (1 + i)^n$$

Whereas PVC = The present value of cost  
 C<sub>n</sub> = The original cost in year n  
 i = Discount rate  
 n = Difference between present and the year of procurement (year n) or usage year

### 3.5.4 Cost Calculation

1.) Calculation of burnt and scalded patient treatment cost according to process of therapy “by activities.”

- (1) The cost of autologous skin graft treatment for burnt and scalded patients is the cost that contains the cost of general activity at the Burn Unit and cost of specific activity in the operating room.

$$TCASG = TCGA + TCSA.....(3.1)$$

Where TCASG = Total cost of autologous skin graft therapy  
 TCGA = Total cost of general activity  
 TCSA = Total cost of specific activity

$$TCGA = TCMC + TCNC.....(3.2)$$

Where TCGA = Total cost of general activity  
 TCMC = Total cost of medical care  
 TCNC = Total cost of nursing care

$$TCSA = TCAA + TCOD.....(3.3)$$

Where TCSA = Total cost of specific activity  
 TCAA = Total cost of anesthetic activity  
 TCOD = Total cost of operative debridement

- (2) The cost of cultured skin graft treatment for burnt and scalded patients is the cost that contains the cost of general activity at the Burn Unit and cost of specific activity in the operating room and Biomaterial Laboratory room. Calculation for the cost of general activity is similar to those of autologous skin graft treatment. The cost of specific activity involves the cost of anesthetic, operative debridement and cultured skin graft sheet.

$$TCCSG = TCGA + TCSA \dots\dots\dots(3.4)$$

Where  
 TCCSG = Total cost of cultured skin graft therapy  
 TCGA = Total cost of general activity  
 TCSA = Total cost of specific activity

$$TCGA = TCMC + TCNC \dots\dots\dots(3.5)$$

Where  
 TCGA = Total cost of general activity  
 TCMC = Total cost of medical care  
 TCNC = Total cost of nursing care

$$TCSA = TCAA + TCOD + TCCGS \dots\dots\dots(3.6)$$

Where  
 TCSA = Total cost of specific activity  
 TCAA = Total cost of anesthetic activity  
 TCOD = Total cost of operative debridement  
 TCCGS = Total cost of cultured skin graft sheet

2.) Calculation of burnt and scalded patient treatment cost, both for autologous and cultured skin methods, according to process of therapy “by input.”

In every steps of the treatment process, the cost is calculated based on the characteristics of production factor, namely, the capital cost and the recurrent cost. The total provider cost is the cost that includes all cost from the total capital cost and total recurrent cost associating with the treatment for burnt and scalded patients.

$$TCB = CCB + RCB \dots\dots\dots(3.7)$$

Where TCB = Total cost of burn therapy  
 CCB = Total capital cost of burn therapy  
 RCB = Total recurrent cost of burn therapy

$$CCB = BCB + ECB \dots \dots \dots (3.8)$$

Where CCB = Total capital cost of burn therapy  
 BCB = Building cost of burn therapy  
 ECB = Equipment cost of burn therapy

$$RCB = LCB + MCB + FCB \dots \dots \dots (3.9)$$

Where RCB = Total recurrent cost of burn therapy  
 LCB = Labor cost of burn therapy  
 MCB = Material cost of burn therapy  
 FCB = Facilities cost of burn therapy

3.) Calculation of capital cost for burn therapy

Calculation of the capital cost for burn therapy in this study requires the following details:

- Present value

In calculating for various costs, different time periods must be taken into consideration, since costs in different period of time do not have the same value. Value of money can change due to inflation. Therefore, before the process of costing is done, market price must be adjusted under the same base. Adjustment to present value can ensure valid cost comparison between different time periods. Adjustment rate or discount rate, base generally on interest rate, is use for discounting the value of money in the past to the present value of money, by using equation 3.10.

$$PV = C_n (1+i)^n \dots \dots \dots (3.10)$$

Where PV = Present value of cost  
 C<sub>n</sub> = Original cost in the year of procurement (year n)  
 i = Discount rate  
 n = Difference between present and the year of procurement (year n), or usage year

- Discount rate is the rate use to adjust the cost in the past or future to the present value, in order to acquire a valid value of good, independent of year of procurement. Generally, interest rate is used as a discount rate, other include, interest from saving account, bond, and inflation rate. In this study, a discount rate of 10%, based on World Bank is used for calculating the cost of building, structure, equipment and tools.

- Depreciation cost is due to the fact that equipment, building and assets gradually lower their value comparing to their original cost, due to their wear and tear (See Appendix for list of depreciable asset). Depreciation cost is calculated based on their useful life. Any equipment, building and assets that have a usage life longer than their useful life, is assumed to have a zero value for their cost. For example, if a piece of equipment had a useful life of 5 years and has been used for more than 5 years, then, its value equals to zero and does not taken into consideration in cost calculation. Calculation for annual depreciation cost is done by dividing the present value with the annualizing factor, in equation 3.11.

$$\text{Depreciation cost} = \frac{PV}{[(1+i)^n-1]/[i(1+i)^n]} \dots\dots\dots(3.11)$$

Where PV = Present value  
 Annualizing factor =  $[(1+i)^n-1]/[i(1+i)^n]$   
 i = Discount rate  
 n = Useful life or life time of asset

- Useful life is the number of year an equipment, building, or other kinds of assets are expected to last. Useful life can be determined by specialists, or from the opinion of the personnel using the equipment. The Code of Revenue has determined the useful life of tool and equipment to be 5 years, and building and structure to be 20 years. The cost of tool and equipment with more than 5 years of usage life is equal to zero, financially. In this study, the useful life of building and structure is based on The National Educated Department (1996) which determined the useful life of a concrete building to be 50 years. Meanwhile, the cost of tool and equipment is based on the opinion of the personnel using those pieces of equipment, or approximately 10 to 15 years depending on types, usage characteristics and maintenance, independent of the imposition of tax. The inclusion of tax will increase the price and cost to the consumer.



- Annualizing factor or present worth of an annuity factor means the summation of present value (in monetary unit) that a person received or paid annually for a number of years. Discounting factor and the useful life (number of year) of an asset, can be used to calculate the annualizing factor, by the following equation:

$$a(i, n) = \frac{[(1 + i)^n - 1]}{[i(1 + i)^n]} \dots \dots \dots (3.12)$$

Where i = Discount rate = 10%  
 n = Useful life  
 a = Annualization

### 3.5.5 Cost Allocation Criteria

1.) From the above stated information, capital cost for burn therapy can be calculated by following these steps below:

- First step, is to adjust the value of the whole capital item used for burn therapy to its present value.
- Second step, is to find the depreciation cost (annual cost) of the item by dividing the present value of the item with annualization factor.

(1) Building cost for burn therapy

- The depreciation cost of building (A) = The present value of building / Annualization factor
- Building cost for working space of each unit of burn therapy (B) = (A) \* proportion of allocation of building for working space of each unit of burn therapy<sup>1</sup>
- Building cost for autologous skin graft = (B) \* proportion of building for autologous skin graft<sup>2</sup>

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<sup>1</sup> Proportion of allocation of building for working space of burn therapy = working space of each unit for burn therapy / total area of building

Total area of building used for burn therapy is 2,178 sq.m., and area of burn unit is 273.6 sq.m. (12.56% of total area of building is used for burn therapy). Area of operating room is 52.5 sq.m. (2.41% of total area of building used for burn therapy). Burn unit and operating room is in the same building. Construction cost of building at 1979 price = 39,000,000 Baht.

Total area of NSTDA building is 4,261.15 sq.m., area of laboratory room is 50.62 sq.m. (0.35% of total area of NSTDA building) Cost of building at 1993 = 219,700,000 Baht.

<sup>2</sup> The proportion of building for autologous skin graft = Total LOS of patients treated by autologous skin graft method in 1998 / the annual capacity for burn therapy.

The capacity for burn therapy is 2,190 patient day / year. (Estimated from 6 patient beds multiplies with 365 days.) In 1998, there were 27 patients treated with autologous skin graft method. (Total LOS = 1,230 days) Proportion for autologous skin graft = 56.16% of the annual capacity for burn therapy.

## (2) Equipment cost for burn therapy

Equipment cost for burn therapy uses the same method of calculation similar to building cost for burn therapy. Each burn therapy unit procured its own equipment, thus each unit utilized 100% of its equipment.

- The depreciation cost of equipment (C) = The present value of equipment / Annualization factor
- Equipment cost of each unit for burn therapy (D) = (C) \* the proportion of allocation of equipment of each unit for burn therapy (100%)
- Equipment cost for autologous skin graft = (D) \* proportion of equipment for autologous skin graft<sup>3</sup>

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<sup>3</sup> The proportion of equipment cost for each patient is equalized, base on annual availability of equipment use for treatment of patients. Calculation is done by dividing total LOS of patients treated with autologous skin graft method during the year 1998, by the annual capacity for burn therapy.

In this study, the capacity for burn therapy is 2,190 patient day / year. (Estimated from 6 patient beds multiplies with 365 days.) Proportion for autologous skin graft = 56.16% of the annual capacity for burn therapy which is the same proportion of building for autologous skin graft.

## 2.) Calculation of recurrent cost for burn therapy.

Recurrent cost for burn therapy, in this study, means labor cost, material cost and facilities cost use for the process of rendering services of burn therapy in the hospital.

### (1) Labor cost for burn therapy

In this study, labor cost means expenses paid to physicians, nurses, and hospital personnel in return for their services regarding burn therapy. It includes salary and over time based on time proportion being used in burn therapy of the group under study. In this study, educational and medical benefit are not included under labor cost. The salaries of the personnel from the hospital are lower than those of the personnel from the Biomaterial Laboratory<sup>4</sup>. Calculation involves the following steps:

- First step is to sum the payment received by each personnel in return for their burn therapy services in 1998.
- Second step is to calculate for the unit cost of labor for burn therapy by dividing the sum of payment in the year, by the total working hours per year<sup>5</sup>
- Third step is to calculate the cost per personnel by multiplying time spent for patient with the unit cost of labor.
- The last step is the calculation of the total labor cost for autologous skin graft by multiplying the total cost per personnel, with the proportion of time spent performing autologous skin graft<sup>6</sup>

### (2) Material cost for burn therapy

Information relating to the material cost for burn therapy is

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<sup>4</sup> The salaries of the personnel from the hospital including fringe benefit but the personnel from the Biomaterial Laboratory not including fringe benefit due to the higher basic salary.

<sup>5</sup> In the year 1998, total working days = 246 days, excluding weekend and holiday, for each personnel. Time spent for patient = 7 hours / day or 1,722 hours / year (246 days \* 7 hours), excluding resting hour, of burn therapy services for each personnel

<sup>6</sup> The proportion of time in this case is 49.09% (27 patients treated with autologous skin graft, from a total of 55 patients at the Burn Unit). This study assumed that all patients treated with an approximately equal amount of time, due to the assumption that all patients have the same type and severity of burn.



obtained from the requisition forms or requisition book of the costing unit at the inventory/supplies department. The value of material is based on information at the requisition point, immediately after the costing unit request for the material. This is done to ensure that no mistakes from repeated count can occurred. In this study, the material cost is divided into 3 types: medical cost, non-medical cost and chemical cost including facilities cost.

- (2.1) Medical cost directly associates with burn therapy such as, medicine, intravenous fluid, intravenous set, syringe, needle, glove, thermometer, gauze, blade, cotton, etc. These are obtained from the reports and requisition documents of Burn Unit, operating room and Biomaterial Laboratory. These costs are counted as actual usage and based on market price paid by the supporting procurement division. Some costs on medical and equipment are unavailable, thus is estimated to be similar to those actual cost of medical and equipment with similar composition, type, and suppliers.
- (2.2) Non-medical cost is overhead supplies not associating with, but supporting the burn therapy. They include for examples, stationery, and other office supplies. Their costs are obtained from the reports and requisition documents of the Burn Unit, operating room and Biomaterial Laboratory. These costs are counted as actual usage and based on market price paid by the supporting procurement division. Some costs on non-medical and equipment are unavailable, thus is estimated to be similar to those actual cost of non-medical and equipment with similar composition, type, and suppliers.
- (2.3) Chemical cost includes DMEM, Clorox, Trypsin 2.5%, liquid nitrogen, fetal calf serum, Epidermal growth factor, etc., used for the skin graft culturing in the Biomaterial Laboratory, in the case of cultured skin graft method. The chemical cost is obtained from Biomaterial Laboratory, BIOTEC documents. These costs are counted as actual usage and based on market prices paid by the Biomaterial Laboratory supporting procurement division.

Patients treated with autologous skin graft can immediately use their own skin for the treatment process. However, autologous skin graft patient must sometimes wait for recovery of their healthy skin donor site before using them for treatment. Patients treated with cultured skin graft must wait for culturing of the graft sheet prior to the treatment process. This difference can somehow affect the length of stay, it will take a short time for cultured skin graft.

Calculation of material cost for burn therapy is done by multiplying the cost per volume (cost of each type of material), with the volume for use (quantity used), for a duration of one year (annual cost). The calculation of the total material cost for burn therapy is done by summing up every type of material cost used in burn therapy.

Calculation of material cost for burn therapy at the Burn Unit and the Biomaterial Laboratory, which involves medical cost, non-medical cost and chemical cost, also depends on the individual consumption list. But for those costs for burn therapy at the operating room, such as, material cost for handwork and anesthetic supplies, this study will consider them in terms of cost per visit<sup>7</sup>. In other words, only material cost including in the medical cost is counted, excluding the non-medical cost.

- (2.4) Facilities cost is the annual cost relating to electricity and water usage of the Burn Unit, operating room and Biomaterial Laboratory. This cost is calculated from actual usage. Electrical cost is calculated base on actual working space of each department, which in this study assumed to be equal, since Chulalongkorn Hospital has a large number of departments operating within the same building, to compute the actual area for each department would be impracticable. Method for calculating facilities cost for each area is as follow:

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<sup>7</sup> General anesthetic is more expensive comparing to analgesic injection, since it involve more equipments and procedured. Operative debridement = 400 baht per visit. Anesthetic activities (general anesthesia) = 3,000 Baht per visit. Anesthetic activities (analgesic injection) = 1,000 Baht per visit

- The first step is to calculate the facilities cost per sq.m., by dividing total expenditure of the facilities in the year 1998<sup>8</sup>, with the total working space<sup>9</sup>.
- The second step is to find the facilities cost for each burn therapy unit, such as, Burn Unit, operating room and Biomaterial Laboratory, by multiplying working area of each unit with the facilities cost per sq.m.<sup>10</sup>
- The last step is to find the proportion of facilities cost for patients treated with autologous skin graft method, by assuming that all patients has the same rate. Calculation is done by dividing the total number of patients treated with autologous skin graft in 1998, with the annual capacity for burn therapy in 1998<sup>11</sup>.

### 3.5.6 Calculation of total cost of burn therapy for burnt and scalded patients

There are 2 methods for calculation of total cost of burn therapy. The first method is done by summing the cost of general and specific activity of patients undergoing autologous skin graft according to equation 3.1, which is similar to the total cost of general and specific activity of patients treated with cultured skin graft according to equation 3.4. And, the second method is done by summing up the capital and recurrent cost associating to burn therapy, according to equation 3.7. In equation 3.13, all data are entered as follow:

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<sup>8</sup> Total working area of the hospital = 411,412.50 sq.m. Total working area of NSTDA = 14,261.15 sq.m.

<sup>9</sup> For Chulalongkorn hospital in 1998, total expenditure of electricity charge = 50,519,921 Baht. Total expenditure of water usage = 3,640,708 Baht. Total expenditure of the facilities in NSTDA, total expenditure of charge for electricity = 7,435,446 Baht. Total expenditure of water usage = 270,175 Baht.

<sup>10</sup> Area of burn unit = 273.6 sq.m., area of operating room = 52.5 sq.m., area of Biomaterial Laboratory room = 50.62 sq.m.

<sup>11</sup> Proportion of facilities cost for patients treated with Autologous skin graft = 49.09% (27 / 55)

$$TCB = (\sum_{i=1}^3 B_i S_{1i}) + (\sum_{j=1}^J E_j S_{2j}) + (\sum_{k=1}^K L_k S_{3k}) + (\sum_{l=1}^L M_l S_{4l}) + (\sum_{m=1}^M F_m S_{5m}) \dots \dots \dots (3.13)$$

|       |          |   |
|-------|----------|---|
| Where | TCB      | = Total cost of burn therapy  |
|       | $B_i$    | = Annual cost of working space of each unit*<br>(*burn unit, operating room, laboratory room) |
|       | $S_{1i}$ | = Proportion of working space of each unit in total building space used for burn therapy      |
|       | $i$      | = Working space of each unit; $i = 1, 2, 3$   |
|       | $E_j$    | = Annual cost of equipment of each unit   |
|       | $S_{2j}$ | = Proportion of equipment of each unit used for burn therapy                                  |
|       | $j$      | = Item of equipments; $j = 1, \dots, J$   |
|       | $L_k$    | = Annual cost of health personnel of each unit  |
|       | $S_{3k}$ | = Proportion of labor time of each unit used for burn therapy                                 |
|       | $k$      | = Personnel; $k = 1, \dots, K$  |
|       | $M_l$    | = Annual cost of material of each unit  |
|       | $S_{4l}$ | = Proportion of material of each unit used for burn therapy                                   |
|       | $l$      | = items of materials; $l = 1, \dots, L$   |
|       | $F_m$    | = Annual cost of facilities of each unit  |
|       | $S_{5m}$ | = Proportion of facilities of each unit used for burn therapy                                 |
|       | $m$      | = items of facilities; $m = 1, \dots, M$  |

### 3.5.7 Effectiveness Analysis

In effectiveness analysis, effectiveness means the success of an activities or a project when compares with the predetermined target or objective. In this study, since the target of activity to be analyzed is the comparison of outcome between autologous skin graft and cultured skin graft method, and, subsequently the said outcome was not predetermined, thus the objectives are assumed to be equaled. Effectiveness analysis in this study uses the outcomes from autologous skin graft and cultured skin graft method as the measurement of effectiveness for a therapy. Effectiveness for this study is:

- The length of stay or the difference of duration a patient, treated with autologous skin graft when compares with cultured skin graft, stays in

the hospital. Effectiveness of the therapy is its ability to decrease the length of stay for a patient.

### 3.5.8 Incremental Cost-Effectiveness Analysis

Incremental is the difference in cost and output between two or more programs being compared in an evaluation. Such analysis is performed to obtain the information on the additional cost imposed by use of one service over another, compared with the additional effects it deliver. The result is the increase in cost in order to decrease the length of stay by one day.

In this study, incremental cost is calculated by dividing the difference in total cost (TC) between autologous skin graft and cultured skin graft, by the difference in their length of stay.

This is shown by the following formula:

$$\begin{aligned} \text{Incremental Cost-Effectiveness} &= \frac{\Delta C}{\Delta E} \\ &= \frac{C_A - C_C}{E_A - E_C} \end{aligned}$$

Where:

$C_A$  and  $E_A$  are the cost and length of stay for autologous skin graft and  $C_C$  and  $E_C$  are the cost and length of stay for cultured skin graft.

Which means, if we want to switch from autologous skin graft to cultured skin graft for burn therapy, how much (in Baht) must be added in order to reduce the length of stay by one day.