CHAPTER 3

Conceptual Framework and Modeling Costs

Conceptual Framework

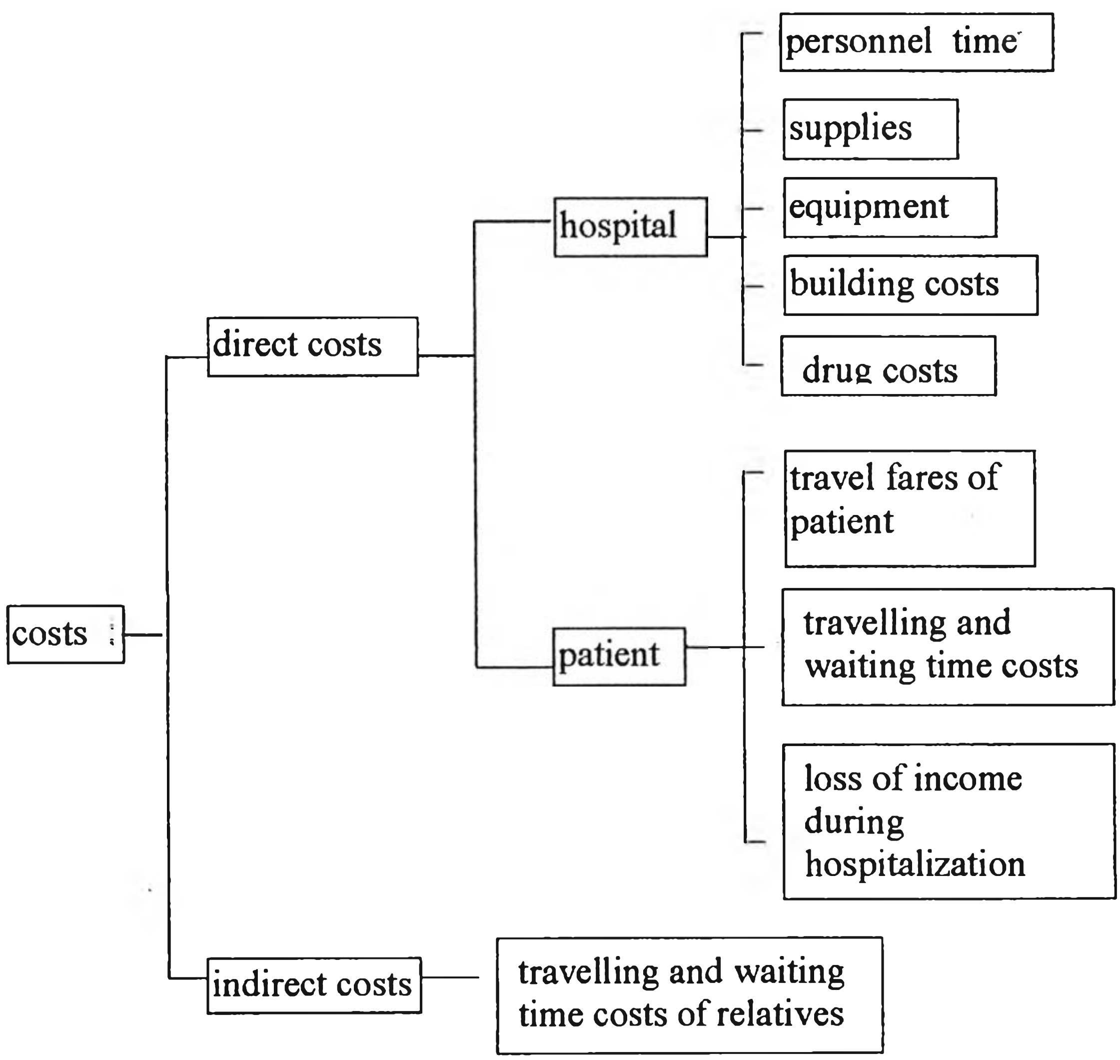
Costs that are relevant to health services can be divided into hospital costs, patient costs and patient relatives costs. Hospital costs are the cost of health care resources used, which can be classified by many ways depending on the purpose of each study, such as capital costs and recurrent costs, fixed costs and variable costs, medical and non medical costs. Capital costs are the costs of resources that have a life expectancy of 1 year or more which are used by the health service such as buildings, cars, and medical equipment. Recurrent costs are resources that are purchased and used within 1 year such as wages and salaries, medicine and supplies, and food. Fixed costs are costs, which do not vary with the level of output in one year e.g. rent and equipment. Variable costs are costs, which vary with the level of output e.g. medical supplies, food. Medical costs are costs that can be directly attributable to the service. Non-medical costs are costs or resources that can be indirectly ascribed to the service.

This study divided the treatment costs of alcoholism into direct and indirect costs

1. **Direct costs**: costs or resources that can be directly attributable to treatment:
   1.1 Hospital costs are costs that consist of the costs of organizing and operating the program. These costs include the cost of the time to health staff, medical supplies, medical equipment, building and drugs.
   1.2 Patient costs are costs that are attributed to the expenses of patients. In this study, patient costs are travelling expenses, including the value of their time. Relevant time costs include travel and waiting time as well as the time spent receiving treatment.

2. **Indirect costs**: those costs are income or benefits of relatives foregone due to participation in the treatment process. They include travelling and waiting time costs of relatives.
   The conceptual framework is shown in figure 3.1

Figure 3.1 Conceptual framework



RESEARCH METHODOLOGY

Because of data availability, samples are selected from Thanyarak Hospital. The hospital is a public hospital under the direct jurisdiction of the Medical Department, Ministry of Public Health.

Population and samples.

Study population: patients who were being treated for alcoholism in the hospital

Study sample unit: eligible patients who had suffered from alcoholism before treatment.

Method of selection: A simple random sampling technique was used to select the patients. Each unit in the study population has an equal chance of selection by using a random table.

Sample size: sample size was calculated using the following statistical methods.

$$n = \frac{Z^2 \times p \times q}{d^2}$$

where : : n = sample size

Z = the degree of confidence (95%), value of $Z = 1.96$ at 95 % confidence interval

p= proportion of alcoholism patients measured from the population (0.5)

$q = 1-p$

d = acceptable error (0.1)

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{0.1^2}$$

$$n = 96$$

Sources of Data

Primary Data

- Time Data: The working time of doctors, nurses and other staff was acquired from the record and by interview.
- Data of Supplies: Based on interviews with x-ray staff and laboratory staff about material and medical equipment that were used for x-ray and in the laboratory.

Secondary Data

- Data of patients: Those were address, economic and social background, history of drinking, details about treatment which consist of number of times of x-rays, number of times of blood and urine tests, medical records during treatment.
- Drug costs, material costs, equipment costs were acquired from the Account Unit of pharmaceutical, materials, radiology and laboratory department, respectively.
- Salaries of doctors, nurses and other staff.
- Number of times of x-rays in 1998.
- Number of times of laboratory tests in 1998.

From the study, it was found that the processes used for treatment of alcoholism in Thanyarak Hospital are similar to the processes used to treat drug addicts in this hospital.

Processes of Treatment:

1. Pre-admission:

This stage consists of appointments between nurses and patients. The patients receive information about treatment processes and prepare to be treated.

2. Detoxification

2.1 For out-patients:

They must spend at least 21 days for the treatment of alcoholism. The bezodiazepine drug group is used for 21 days. Dosage for treatment depends on the body weight of patients and the symptoms exhibited. Generally, chlordiazepoxide is used for treatment and the dosage is 25-50 mg, 4 times a day. The dosage is gradually decreased until the patients begin recover.

2.2 For in-patients:

The typical treatment period for in-patients is 21 days. However, patients who have received detoxification from other hospitals may spend 14 days in recovery, depending on the doctors' evaluation of the situation.

3. Rehabilitation: after detoxification, the patients will spend approximately eighteen months in rehabilitation. No drug dosage reduction is made at this stage, but patients will be given psychotherapy.

4. Convalescence and follow up: The period of follow up is between 1 and 5 years by communication, appointment, and ambulatory.

Inclusion Criteria for this thesis

- Alcoholism patients were both in-patients and out-patients at Thanyarak Hospital.
- Alcoholism patients who did not have associated diseases or had mild complication diseases such as common colds and peptic ulcers.
- Only patients who were treated for a full course of 21 days.
- Stages of Rehabilitation, convalescence and follow up of the treatment process are excluded because of uncompleted data.

MODELING COSTS

Direct Costs

1. Hospital Costs

1.1 Personnel Costs:

Personnel costs refer to the expenditure associated with staff concerned in the alcoholic treatment process. The calculation of personnel costs for alcoholism treatment includes the earnings rate of the personnel concerned and the time spent on alcoholic patients. The earnings rate can be calculated from the total expenditure of each member of staff in 1 year, that is a summation of salaries, bonuses and child's tuition reimbursements of each member of staff, divided by the total working time of personnel in each type in 1 year. The working time of government officials in 1 year is 52 weeks, 5 days per week, 7 hours per day (excluding rest time). Holidays per annum are 16 days. Therefore, the total working time of a government official in 1 year is 1708 hours per person as shown below:

total working time of government official per annum

$$= [(52 \times 5)-16] \times 7$$

$$= 1708 \text{ hours per person}$$

An example of the calculations of earnings:

$$\text{Earnings rate of doctor} = \frac{\text{Total earnings all of doctors (baht)}}{\text{Total working time all of doctors (hours)}}$$

Then, personnel costs for out-patient visits are calculated by the earnings rate of personnel multiplied by the time spent on each visit. Personnel costs for in-patients are calculated by the earnings rate of personnel multiplied by time spent in 1 day as follows:

Personnel costs for out-patient per 1 visit (each category of personnel)

= Earnings rate of personnel x Time spent per 1 visit

Personnel costs for in-patient for 1 day (each category of personnel)

= Earnings rate x Time spent in 1 day

As alcoholism treatment at Thanyarak Hospital takes 21 days for each course. Therefore,

Personnel costs for out-patient per course

= Personnel costs per 1 visit x Times of follow up

Personnel costs for in-patient per course

= Personnel costs per day x 21 days

Finally, total personnel costs for 1 course are a summation of doctor costs, nurse costs and other staff costs for 1 course.

The calculation of personnel costs includes salary, child's tuition reimbursements and the work duration of the staff concerned. While personnel expenditure was obtained through the Head of the Finance and Accounting section, the amount of working time for staff could only be determined by, first examining the procedures involved, for both inpatients and out patients. This information was thus obtained through interviews with the Head Nurses of Out-Patients, and the Head Nurses of In-Patients for Alcoholic Patients, then, the work duration of staff was obtained by recording time.

1.2 Supplies Costs

Supply costs are the expense for materials used for treatment as a direct input to the principal activity performance of the program, and other small items purchased during the year. The materials consist of drugs, syringes, needles, x-ray films, gauzes, gloves, and cottons. The supply costs were estimated by interviews with special doctors, head ward nurses, heads of radiology and head technicians concerning and medical records. Then the amount of materials used for one treatment multiplied by the price of materials. The price of materials is the original price, as purchased by the hospital. The patients are divided into 2 groups; out-patients and in-patients. So, supplies costs for out-patients are estimated for 1 visit. For in-patients, they are calculated from supply costs per day. The number of days for the treatment of 1 course is 21 days. Therefore, total costs of in-patients can be calculated from supply costs per 1 day multiplied by 21 days; whereas the total costs of out-patients can be calculated from supply costs for 1 visit multiplied by the number of visits.

1.3 Equipment Costs

Drummond et al. (1997) state that capital costs are the costs used to purchase the major capital assets required by the program; generally equipment, buildings and land. They represent an investment in assets, which are used over a period of time. Capital costs consist of two components; one is the opportunity cost of the funds tied up in the capital asset. This cost is the lost opportunity to invest the sum in other ventures yielding positive benefits. It is usually valued by applying an interest rate to the amount of capital invested.

The another component of a capital cost represents the depreciation over time of the assets. Various accounting procedures are available for use in the accounts of the organization. As English (1915) described various depreciation methods as follows:

- Straight-line Depreciation.

Straight-line depreciation is the simplest and most widely used. The asset value is divided by the number of years over which it is to be depreciated, in order to obtain the depreciation allowance for each year.

- Declining-balance Depreciation.

Declining-balance depreciation is computed as a negative exponential but the calculation is done in discrete increments. The percentage rate of decline is usually based on taking the same lives as for straight-line depreciation.

- Sum of the digit Depreciation.

The sum of digit allowance is found by summing the years of depreciation life.

$$S = 1+2+3+4+\dots\dots+n$$

The ith years allowance is then the ratio $(n-i+1)/S$ and times the original asset cost.

- Sinking-fund Depreciation.

Sinking-fund depreciation is based on hypothetical deposits into a sinking fund, which accumulating at a specified interest rate, will amount to the original asset value at the depreciable asset life. The depreciation is the same as the proportion of an annuity payment that is allocated to the retirement of the principle.

In economic evaluation, the best method is an annualized basis. The method automatically incorporates both the depreciation aspect and the opportunity costs aspect of the capital costs. Therefore medical equipment used in the examination and treatment of patients includes x-ray machines, laboratory devices, etc.. The cost is calculated on an annualized basis, using the following approach.

- Current Value.

Estimating the current value of the equipment is calculated from the amount paid for the equipment.

A prospective future dollar is not equivalent in value to a present dollar. Therefore, the equipment which was bought and buildings which were constructed at different time must be adjusted the differential timing for the expenditure equivalent current value to present value by time preference.

The time preference depends on discount rate

$$PV = C(1+i)^n$$

Where

PV = Present value (in this study the 1998 value)

C = costs of equipment or current value (at the year of purchasing the equipment)

i = discount rate

n = Period of time since purchasing the equipment through the year 1998

Therefore, the value of equipment used to calculate is the present value.

- Lifetime. Lifetime is the age of the facilities of the capital equipment. Lifetime of medical equipment obtained from American hospital association "Estimates of useful lives depreciable hospital assets" (1978 in Pitusorn Hempisut 1992).

- Discount rate. The discount rate acts in much the same way as opportunity costs in private enterprise. The rate is determined by the opportunities that are forgone in the private sector as a result of the social project. The foregone opportunities reflect reduced private investment and consumption. Warner and Luce (1982) stated that the discount rate is independent of the inflation rate because the discount rate reflects the real rate of return. For operational purposes in the World Bank, the opportunity cost of capital is commonly taken to be in the order of 10 percent a year. Therefore, this study used the World Bank discount rate of 10 %.

- Annualization factor. The annualization factor is the weight assigned to annualize costs that incurred in the corresponding year and at the corresponding discount rate. The ways to find the annualization factor can be seen in the following formula or standard table.

Annualization formula

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

a (i,n) = the annualization factor,

i = discount rate, and

n = life time of assets.

- Calculation of annual costs. Annual costs are the amount of the cost that should be allocated each year. By dividing the present value of the item by the annualization factor.

$$\text{Annual costs} = \frac{\text{Present value}}{\text{Annualization factor}}$$

Medical equipment data was obtained through interviews with the Head of the X-ray and Laboratory Section, who provided information on the purchase of medical equipment in regards to purchasing costs, year of purchase, and the number of units.

Costs per time calculated from annual costs divided by the number of times of x-ray or laboratory tests in 1 year.

$$\text{Equipment costs per time} = \frac{\text{Annual costs}}{\text{Number of times of x-rays or laboratory tests in 1998}}$$

Therefore:

Equipment costs per case = Number of times of x-rays or laboratory tests of alcoholism per case (1 course) x Equipment costs each time

1.4 Building Costs

Building costs refer to construction costs including the costs for design and decoration, land costs together with material and equipment used in construction. For this study the building costs that were used in calculation for in-patients includes the cost for couches, too. In the case of calculation depreciation, it can be calculated from the costs of building divided by the number of years of the expected lifetime of the building. In economic costs, the values of alternative opportunities are considered as well. As a result, calculation for annual building costs is similar to calculation of equipment costs. Following the Research Project on the Economic Remuneration Rate of Investment in Education (1996), the expected life time of a building is 50 years.

The calculated building costs of Thanyarak Hospital are divided into 2 groups, (1) a new building, established in 1994 (2) seven old buildings, established in 1967. The total area of the new building is 23,500 square meters of which 22 percent or 5,160 square meters is treatment space. Both out-patients and in-patients utilize the new building. The facilities space of the new building for each type of drug addict patient is similar. Therefore, calculating the cost of the new building can be achieved as follows:

$$\text{Annual costs of the new building} = \frac{\text{Budget for construction}}{\text{Annualization factor}}$$

Annual costs of the treatment area of the new building = 0.22 x Annual cost of the new building

New building costs per case (treatment area costs of new building per case) =

$$\frac{\text{Annual costs of treatment area}}{\text{The number of patients overall in 1998}}$$

Therefore, the new building costs per case for alcoholism patients is equal to the new building costs per case (treatment area costs of new building per case).

The construction costs for all the seven old buildings established in 1967 were 39,500,000 baht. All seven buildings were similar in size and design but just one building was used for alcoholism in-patients. Therefore, old building costs for alcoholism were calculated for only one building as follows:

Old buildings costs for alcoholism in-patients per case:

$$= \frac{\text{Annual costs of 1 old building}}{\text{The numbers of alcoholism in-patients in 1998}}$$

Building costs of alcoholism out-patient = New building costs per case
Building costs of alcoholism in-patient = New building costs per case + Old building costs per case

1.5 Drug Costs

Drug costs refers to the amount of drugs consumed by patients multiplied by the original as purchased by the hospital. The data for drug consumption came from the medical records of patients.

Costs of hospital per case

Costs of hospital per case referred to the costs of personnel per case + costs of supplies per case + costs of equipment per case + costs of building per case + drug costs per case.

2. *Patient Costs*

2.1. Patients and Relatives' Travelling Costs

Travelling costs refers to the amount of money spent on each visit (return trip) to the hospital by patients with or without relatives to receive treatment. Because of time constraints during the collecting of information, direct interviews with patients were not possible. An alternative method was chosen to estimate the traveling costs by comparing the distance traveled with the taxi rates for patients living in Bangkok and surrounding provinces.
Travelling costs of patients resident in Bangkok = Taxi fare

For patients living in other provinces, the costs were estimated from the cost of hiring a pick-up truck and the cost of diesel fuel. The price for diesel fuel uses the 1998 annual price of the Petroleum Authority of Thailand. The amount of fuel needed for the journey in 1998 was taken into consideration as well. By assuming that pick-up trucks consume 10 kilometers/liter of diesel fuel, so the quantity of fuel required can be calculated as follows:

$$\text{Quantity of fuel needed} = \frac{\text{Distance}}{\text{10 kms./liter}}$$

Therefore, Cost of fuel = Quantity of fuel needed x Price of diesel fuel

Travelling costs of patients from other provinces
= Rate of car rent + Cost of fuel

The distance from the patient's home, in Bangkok, to the hospital was calculated with the assistance of a computerized street map, by courtesy of the Land Traffic Department. For patients from other provinces, the distances and rates for car rental were obtained by interviewing car rental companies (see appendix c).

Travelling costs for out-patients were determined from the number of visits made for treatment or for the purchasing of medicine. On the other hand, in-patients' travel expenses occured only one time (return trip) – on the date of admittance, and on the final day of hospitalization.

Therefore;

Travelling costs of out-patients = Travelling costs each time (return trip) x Number of follow up

Travelling costs of in-patients = Travelling costs each time (return trip)

Table 3.1: Taxi rate.

Distance (Km.)	Fare rate (baht or baht per Km.)
Between 0 and 2^{nd}	35.00 baht
Between 2^{nd} and 12^{th}	4.50 baht per kilometer
Between 12^{th} and 20^{th}	5.00 baht per kilometer
More than 20 kilometer	5.50 baht per kilometer

source : Land Transportation Department (See details in appendix B)

Table 3.2: The pick up truck rent rate from Bangkok to provinces in this study.

Province	Distance(km.)	Rent rate (baht)
Prachuap Khiri Khan	281	1500
Pattani	1055	2000
Sara Buri	107	1300
Nakhon Ratchasima	259	1500
Phetchabun	346	1500
Udon Thani	504	1700
Roi Et	512	1500
Yasothon	531	1500
Buri Ram	410	1500
Si Sa Ket	531	1500
Ayuthaya	77	1300
Sing Buri	144	1500
Uthai Thani	219	1500
Nakhon Sawan	241	1500
Phitsanuloak	377	1500
Phrae	551	1500
Suphan Buri	100	1300
Ratcha Buri	100	1300
Samut Sakhon	36	800
Chachengsao	71	1300
Chonburi	81	1200
Prachin Buri	136	1300
Rayong	179	1300

Source: Car Rental Company Limited (See details in appendix C)

2.2 Travelling and waiting time costs of patients

Travelling and waiting time costs of patients refers to income foregone by patients. Waiting time is the time spent for waiting and receiving the treatment. Waiting time costs represent the loss of income of out-patients. They can be calculated by income per hour multiplied by waiting time per visit and multiplied by the number of visits. Waiting time per visit was obtained from time records, beginning when patients came to register until they left the hospital. The income of patients was also obtained from medical records. If the patients were unemployed or had no data on medical record, their income were estimated by the average income of the sample group (with similar education background and resident) of which income data was available. Waiting time costs can be calculated as follows:

$$\text{Waiting time costs} = \text{Income per hour x Waiting time per visit x Number of follow up}$$

The income-per-hour rate can be calculated for patients with a monthly salary as monthly salary divided by 154 hours (7 hrs per day excluding rest time, 22 days per month). For patients with daily wages; the wages are divided by 7 hours, excluding lunchtime.

Travelling time costs can be computed by income per hour multiplied by travelling time per one return trip. Travelling time was calculated by distance divided by average speed as in the equation below:

$$\text{Time spent} = \frac{\text{Distance}}{\text{Average speed}}$$

[1]Average speed of vehicles in Bangkok = 20 kilometers/hr.
[2]Average speed of vehicles in other provinces = 110 kilometers/hr.

Therefore;
Cost of travelling time each time = Income per hour x Travelling time for one return trip.

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[1] Source: Land Traffic Department

[2] Source: Car Rental Company Limite

Total costs of travelling time = Costs of travelling time each time x Number of times of travel.

2.3 Loss of income during hospitalization (in-patients)

Loss of income represented income foregone of the patients during hospitalization.

In-patients spend 21 days in hospital for each course of treatment. Therefore, in-patients lose a total of 21 days work time.

Loss of income per case = 21 days (the number of days without work) x Income per day

The income of patients was obtained from medical records. If the patients were unemployed or had no data on record, their income were estimated by a comparison of income, education, age and residents among the sample group for which income data was available.

Indirect costs

-Travelling and waiting time costs of relatives

Travelling time and waiting time costs of relatives represented income foregone by relatives. Both the calculations for out-patients and in-patients' relatives, is similar to the calculations for patients' travelling time costs. The calculations of waiting time costs of relatives are also similar to those for out-patients.

Therefore,

Cost of travelling time each time (both out-patients and in-patients' relatives)

= Income per hour x Travelling time for one return trip.

Total cost of travelling time = Costs of travelling time each time x Number of visits.

Waiting time costs (out-patients' relatives)

= Income per hour x Waiting time per visit x Number of visits.

The lost time for in-patients' relatives is always on the first and the final day. Equal time is spent on each visit. So, the numbers of follow up for relatives of in-patients are 2.

Waiting time costs (in-patients' relatives)

= Income per hour x Waiting time per visit x 2